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Biotope analysis of Marine Scotland Science underwater video footage from the Hebridean Slope

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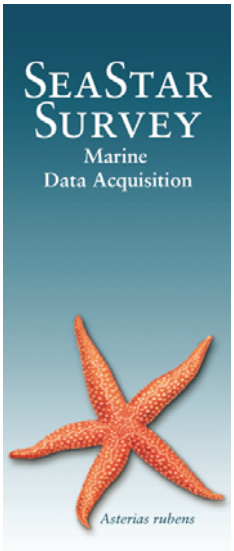

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Summary

Background

The Scottish Marine Protected Areas (MPA) Project is a joint project between Marine Scotland (Scottish Government), Scottish Natural Heritage (SNH), Joint Nature Conservation Committee (JNCC)[1] and Historic Scotland with the aim of providing 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.

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 February 2013 to undertake the seabed habitat and taxonomic analysis of underwater video footage acquired from a selection of Marine Scotland Science (MSS) deep-water survey stations, with the aim of assigning biotopes and assessing the presence of any MPA search features.

Main findings

- Four hours and six minutes of underwater video camera footage from 19 stations on the Hebridean Slope were analysed.

- According to the EUNIS[2] classification, four habitats were identified:
  - A6.14 : Boulders on the deep-sea bed
  - A6.2 : Deep-sea mixed substrata
  - A6.3 : Deep-sea sand
  - A6.5 : Deep-sea mud

- Under the proposed deep-sea biotope classification of Howell *et al* (2010), three habitat complexes and two biotopes were observed, including a newly proposed biotope '*Nephrops norvegicus* burrows with Geryonidae and anemones'.

- The other habitats and biotopes identified were:
  - Atlantic Upper Slope Coarse Sediment
  - Atlantic Upper Slope Mixed Sediment
  - Atlantic Upper Slope Sand
  - Halcampoid anemones in rippled sand

- One station (DW02011) was a potential Annex I stony reef habitat, with 'low reefiness'.

- Three MPA search features were observed:
  - Offshore subtidal sands and gravels
  - Offshore deep sea muds
  - Burrowed mud

[1] For more information visit http://jncc.defra.gov.uk/default.aspx?page=5269
[2] For more information visit http://jncc.defra.gov.uk/page-3365

- ‘Offshore subtidal sands and gravels’ was the most frequently observed MPA search feature, observed at six of the 19 stations, followed by ‘Offshore deep sea muds’, observed at five stations. The ‘Burrowed mud’ search feature was observed at three of the survey stations.

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1 Introduction

1.1 Background

The Marine (Scotland) Act and the UK Marine and Coastal Access Act include new powers for Scottish Ministers to designate Marine Protected Areas (MPAs) in the seas 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), 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, such as fisheries restriction areas. 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 on advice concerning designation of MPAs within Scottish territorial waters and JNCC is leading on advice concerning designation of MPAs in offshore waters 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.

As part of the process of identifying areas with MPA Search Features, JNCC commissioned Seastar Survey Ltd. in February 2013 to undertake the seabed habitat and taxonomic analysis of underwater video footage from 19 deep-water survey stations from five surveys undertaken by Marine Scotland Science (MSS) between 2000 and 2009. MSS conducts underwater television surveys of areas of burrowed mud around Scotland, on an annual basis, to assess stocks of the Norway lobster, *Nephrops norvegicus*. Footage of offshore deep mud has also been collected opportunistically on MSS deep-water surveys that are primarily trawl surveys for deep-water finfish species. A selection of these survey stations coincide with two nature conservation MPA proposals[3].

[3] For more information on these sites visit http://jncc.defra.gov.uk/page-5269

Analysis of the MSS deep-water video footage will further the evidence base of the presence and potential extent of Scottish MPA search features and Priority Marine Features. Where applicable, these features will be included within the Scottish MPA project's geodatabase of marine features in Scotland (GeMS).

2 Methods

2.1 Data collection

The underwater video footage was collected by MSS staff on the FRV *Scotia* during five cruises undertaken between September 2000 and September 2009. The footage was acquired using a range of drop-down camera frames and sledge systems, with either an oblique or downward facing view. The drop frame was suspended approximately one metre above the sea bed and allowed to drift with the ship. Although sea bed underwater footage was obtained, it was not possible to accurately calculate the viewed area because the height of the bottom and the distance travelled was unknown. All video footage was stored directly onto DVD. A total of four hours and six minutes of video footage was analysed from 19 stations sampled from the Hebridean slope. Table 2.1 provides a summary of the stations analysed, and Figure 2.1 shows the locations of the survey stations.

Table 2.1 Summary of MSS survey stations analysed.

Year	Date	Cruise	Station	Positional file	Start	Stop	Duration (min)
2000	10/09/2000	1400s	DEEP12	.dat	22:42	22:52	10
2000	11/09/2000	1400s	DEEP13	.dat	00:28	00:38	10
2000	11/09/2000	1400s	DEEP14	.dat	01:52	02:02	10
2000	11/09/2000	1400s	DEEP15	.dat	03:40	03:50	10
2000	13/09/2000	1400s	DEEP26	.dat	21:53	22:03	10
2002	11/09/2002	1302s	DW02006	.dat	21:43	21:52	10
2002	11/09/2002	1302s	DW02007	Paper	23:38	23:43	5
2002	12/09/2002	1302s	DW02008	Paper	22:07	22:10	3.5
2002	12/09/2002	1302s	DW02009	Paper	23:03	23:18	15
2002	13/09/2002	1302s	DW02010	Paper	00:05	00:21	16
2002	13/09/2002	1302s	DW02011	Paper	01:11	01:21	10
2004	04/09/2004	1204s	DW04012	SOL & EOL only	01:51	02:21	30
2006	23/09/2006	1406s	DW06910	.dat	20:15	20:30	15
2009	13/09/2009	1209s	DW0901	Paper	21:57	22:12	15
2009	14/09/2009	1209s	DW0903	.csv	00:12	00:27	15
2009	14/09/2009	1209s	DW0904	.csv	01:34	01:49	15
2009	14/09/2009	1209s	DW0905	.csv	02:54	03:09	16
2009	14/09/2009	1209s	DW0906	.csv	20:00	20:15	15
2009	14/09/2009	1209s	DW0908	.csv	22:36	22:51	15

The survey stations analysed were located from two loose geographical groupings. Eight stations were grouped to the north above 58°N (DEEP26, DW04012, DW0901, DW0903, DW0904, DW0905, DW0906, and DW0908). The other eleven stations were located south of 57°N (DEEP12 – DEEP15, DW02006 – DW02011 and DW06910).

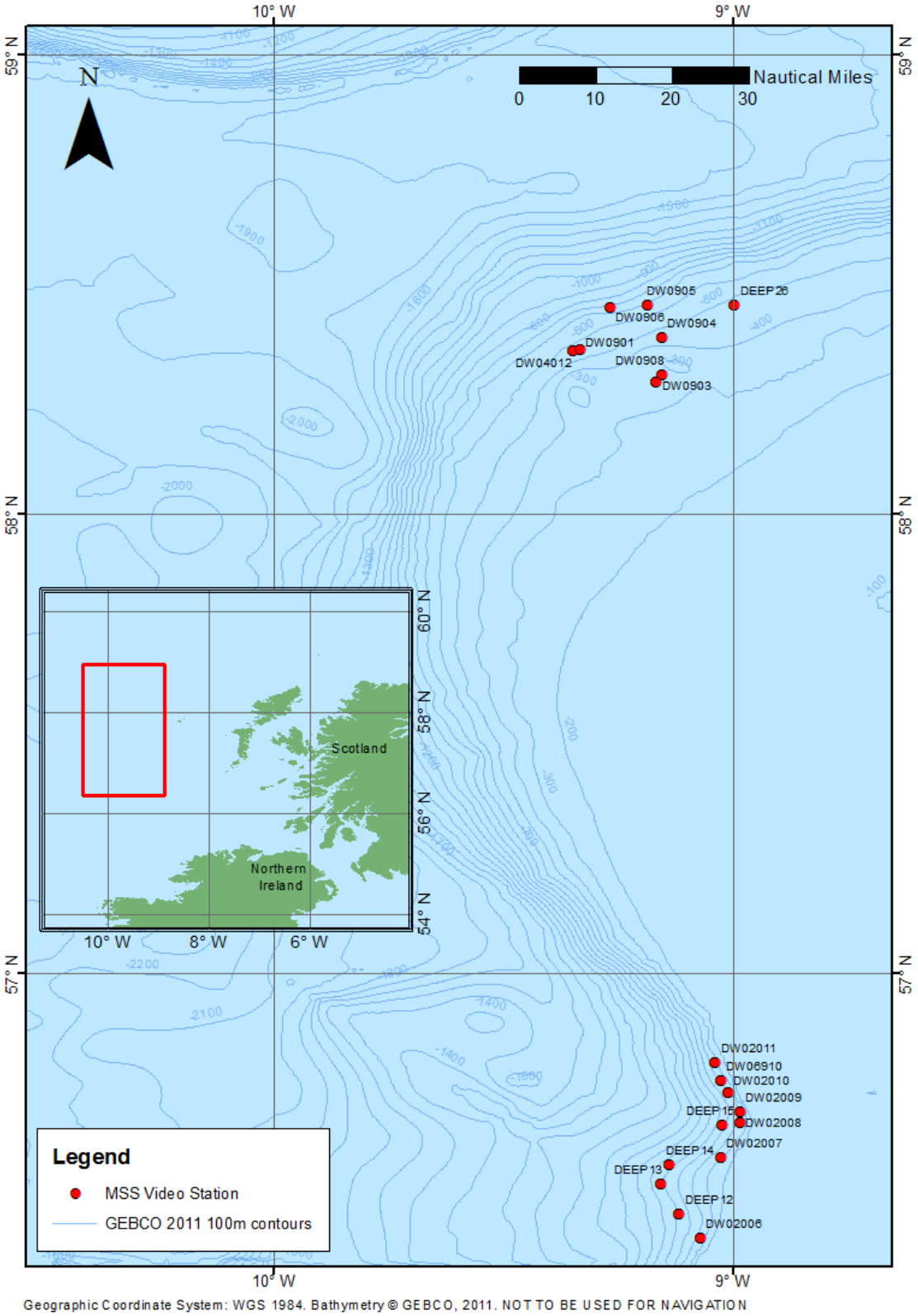

Figure 2.1 Location of MSS deep water survey stations.

2.2 Data analysis

The underwater video footage collected by MSS was principally obtained for fishery stock assessment studies. The data analyses undertaken during this contract are part of a data mining exercise to utilise any existing potential data sources to inform the evidence base for MPA selection. As such, it should be acknowledged that the video footage was not acquired with the ultimate aim of habitat assessment in mind.

2.2.1 Analysis of video footage

The analysis of the video footage began with an initial assessment of each survey station to provide the reviewer with a broad understanding of the substratum, geological features and fauna present, and to allow the identification of different biotopes/habitats on the seabed. The analysis was carried out 'blind' without any prior knowledge of the sites, using a personal computer and the VLC media player software, which allowed standard, fast play, slow-motion and freeze frame analysis. Footage was viewed at 2x normal speed for the initial assessment in order to divide the footage into segments representing different substrata, if necessary. The start and end time and position of each segment were recorded, with the positions calculated using the time codes on the video overlay related back to the navigation data. Brief changes in substratum type were considered to be incidental patches and were not recorded as part of the habitat description. Further, more detailed analysis of the video footage was then undertaken as detailed below.

Detailed analysis of the video footage consisted of an experienced ecologist describing the seabed according to a standardised habitat recording form, and identifying observed fauna to the lowest practical taxonomic level together with their abundance. Sediment categories within the Folk (1954) classification were too detailed for the resolution of the video footage available, so seabed substrata were classified according to the modified Folk triangle of Connor *et al* (2006). General descriptions of the fauna were made, including the presence of any Scottish MPA search features and Annex 1 habitats. Other features of interest, such as trawl marks, were also recorded. Snapshots were taken from the video footage of any characteristic fauna and habitat features. A list of the encountered fauna was produced for each site using species reference numbers as cited in the Marine Conservation Society Species Directory (Howson & Picton 1997), with additional reference to the World Register of Marine Species (WoRMS; Appeltans *et al* 2012) to avoid problems in species nomenclature.

Faunal abundance data were recorded using the SACFOR scale, which is a unified system for recording the abundance of marine benthic flora and fauna in biological surveys[4]. No scaling devices were present on the camera equipment, and the two different camera orientations resulted in varying fields of view for each video line. For the purpose of this study, inherent assumptions on the field of view and the area covered on each video transect have been made. These assumptions were based on the analyst's previous experience gathered from the analysis of other drop-down camera surveys and the size of common fauna in the video footage. The broad classes used in the SACFOR scale[4] allow for some discrepancies in the field of view between stations, resulting in the collection of comparable data. The semi-quantitative nature of SACFOR data limited the level of statistical analysis that could be undertaken on the collected data set. However considering the level of video footage resolution, the variety of field of views, and the generally scarcity of deep-sea fauna, using the SACFOR abundance scale was deemed to be the most appropriate method for the analysis of the video footage.

[4] SACFOR abundance scale - http://jncc.defra.gov.uk/page-2684

2.2.2 Biotope classification

Habitats beyond the continental shelf and the deep sea (i.e. depths below 200 m) are not covered by Marine Habitat Classification for Britain and Ireland (v04.05) (Connor *et al* 2004)[5], although a classification system for deep sea biotopes is currently being developed (Howell *et al* 2010; Howell 2010; JNCC 2012a). Therefore, the habitats and biotopes present in each segment of video footage have been identified using the EUNIS habitat classification system, aiming to match Level 4 biotopes of 'A6 : Deep Sea'. The classification scheme below this level of hierarchy is also under review and development, and there are very few geographically relevant Level 5 deep sea biotopes for the area surveyed.

In addition to the EUNIS classification, the proposed scheme of Howell *et al* (2010) was used to define biotopes where possible. Where data did not fit the existing biotopes, new biotopes have been proposed according to the substrate present and the characteristic fauna observed.

Multivariate statistics were undertaken using PRIMER v.6 (Clarke and Warwick 2001) to examine any similarities between the faunal assemblages at each station to help identify any groupings. Faunal data were rationalised to remove any taxa found in the water column, and therefore not diagnostic of the seabed habitat. Lebensspuren were included in the analysis as they were deemed to be indicative of the presence of fauna taxa. SACFOR faunal abundances were converted into their numerical equivalent (i.e. Rare = 1, Occasional = 2 etc.), and resemblance matrices were constructed using non-transformed data using the Bray-Curtis similarity index. Group-average clustering analysis was used to produce dendrogram plots of similarities between survey stations, along with MDS plots. SIMPER analysis was then undertaken to highlight which taxa characterised the station groups identified from the cluster analysis.

Some caution may be needed in the interpretation of the deep sea habitats observed. For each habitat, descriptions have been made in addition to the classification and these should be accounted for when analysing the results.

After a habitat/biotope were designated to each station, comparisons were made with the MPA search feature checklist (Appendix 1). Any matches between MPA search features and the habitats observed at each station were recorded. Assessment was also made whether any stations represented potential Annex I habitats.

2.2.3 Quality control

The Quality Control (QC) process involved an on-going element and a post-analysis element. A principal analyst examined all the data to ensure a level consistency, with on-going collaboration with other Seastar Survey staff to check species identification, sediment classification and biotope classifications during the process of analysis. A senior member of staff also checked any uncertain identification to ensure the highest possible level of quality in the data. The post-analysis QC process involved a re-assessment of 10% of the data, checking the faunal/floral identification, habitat/biotope classification and data entry. Any discrepancies were discussed between analysts and agreed on prior to finalisation of the results.

[5] See http://jncc.defra.gov.uk/default.aspx?page=5931 for more details

2.2.4 Reference collection

A reference collection was created of short extracts from the video footage to represent the biotope from each section. Footage for each station was reviewed, and a short clip (10 –15 sec) identified to represent each of the biotopes present along the tow. Metadata for the extracted footage was collated, including the station number, date of tow, duration of extract, start and end time, start and end position, and the biotope represented (see Appendix 2).

3 Results

A summary description of the habitats present at each station is detailed below. Duration of video camera tows are given as hh:mm:ss. Snapshots taken from the video footage showing examples of the principal epifauna and features of interest observed at each station are also included. The full lists of taxa identified at every survey station can be found in Appendix 3.

3.1 Habitat descriptions

3.1.1 Station DEEP12

Camera sledge 00:10:10 duration 578 m depth 119 m tow
Oblique view

The video footage was of adequate quality, although low resolution and speed of the camera system over the seabed limited accurate identification of fauna to species level. The substrate observed was fine sand. Occasional ripples were evident, suggesting a degree of hydrodynamic activity at the seafloor. Lebensspuren (biologically formed sedimentary structures found in sediments) in the form of feeding mounds (Figure 3.1a) and tracks were observed, along with small infaunal burrows.

Fauna was relatively sparse but included caridean shrimps (Figure 3.1b), observed close to the largest faunal burrows. Hermit crabs (Paguridae), an asteroid (Figure 3.1c) and an ophiuroid, and several species of fish were also seen.

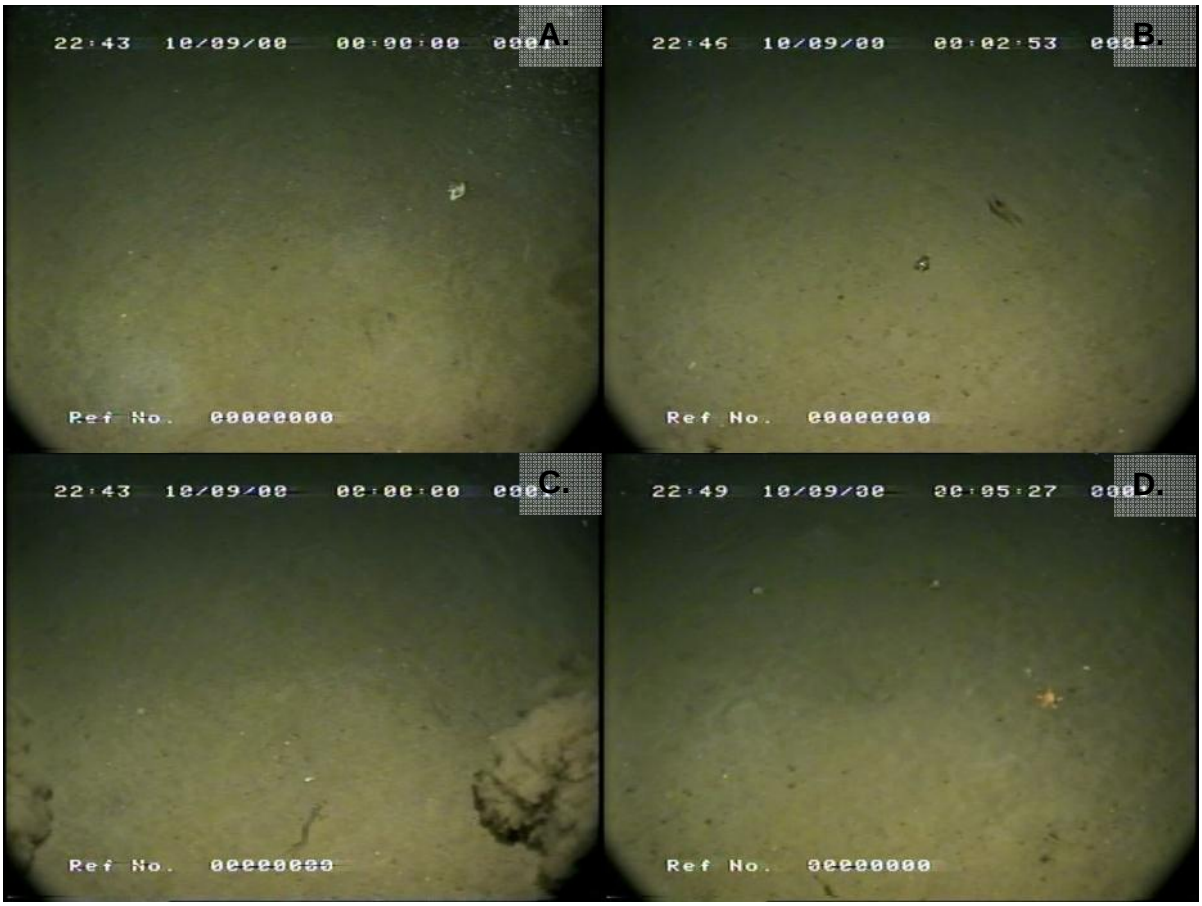

Figure 3.1 Video footage snapshots from station DEEP12 **A)** Feeding mound; **B)** Caridean shrimp; **C)** Unidentified eel-shaped fish; **D)** Asteroidea sp.

3.1.2 Station DEEP13

Camera sledge 00:10:24 duration 631 m depth 123 m tow
Oblique view

The video footage was adequate, although resolution was low and camera speed relatively high. The substrate at DEEP13 was observed as fine sand, with a small amount of gravel present on the surface. Sediment ripples indicated a degree of seafloor hydrodynamic activity. Evidence of lebensspuren such as feeding mounds and tracks were also present, with the occasional small faunal burrow.

The heart urchin *Spatangus raschi* was observed throughout the video transect (Figure 3.2a & b). Other fauna present included the echinoid *Echinus acutus* (Figure 3.2c), unidentified species of fish (Figure 3.2d), asteroids and ophiuroids.

Figure 3.2 Video footage snapshots from station DEEP13. **A)** & **B)** *Spatangus raschi*; **C)** *Echinus acutus*; **D)** Unidentified fish species.

3.1.3 Station DEEP14

Camera sledge 00:10:08 duration 618 m depth 126 m tow
Oblique view

The video footage quality along this line was adequate, although resolution was low whilst camera speed over the ground was high. The substratum was observed as fine sand, with occasional ripples and an element of surface gravel. Feeding mounds and tracks were observed. Occasional small infaunal burrows were also present.

The fauna was dominated by *Spatangus raschi,* which was observed all along the video transect (Figure 3.3a). A cluster of *Echinus acutus* were observed towards the end of the video line. Other fauna observed included ophiuroids, asteroids (Figure 3.3b) and various unidentified fish species.

Figure 3.3 Video footage snapshots from station DEEP14. A) *Spatangus raschi*; B) Unidentified Asteroidea sp.

3.1.4 Station DEEP15

Camera sledge 00:10:07 duration 545 m depth 101 m tow
Oblique view

The video footage was adequate, although camera speed was high and resolution low. The substratum was coarse sand, with a degree of gravel on the surface. The gravel infrequently formed bands ~30 cm wide.

The fauna observed included a large number of scallops (Pectinidae) (Figure 3.4a), and hermit crabs (Paguridae) (Figure 3.4b). Asteroidea and fish (Figure 3.4c) were occasionally observed, and a small clump of white Porifera was seen at the start of the line (Figure 3.4d).

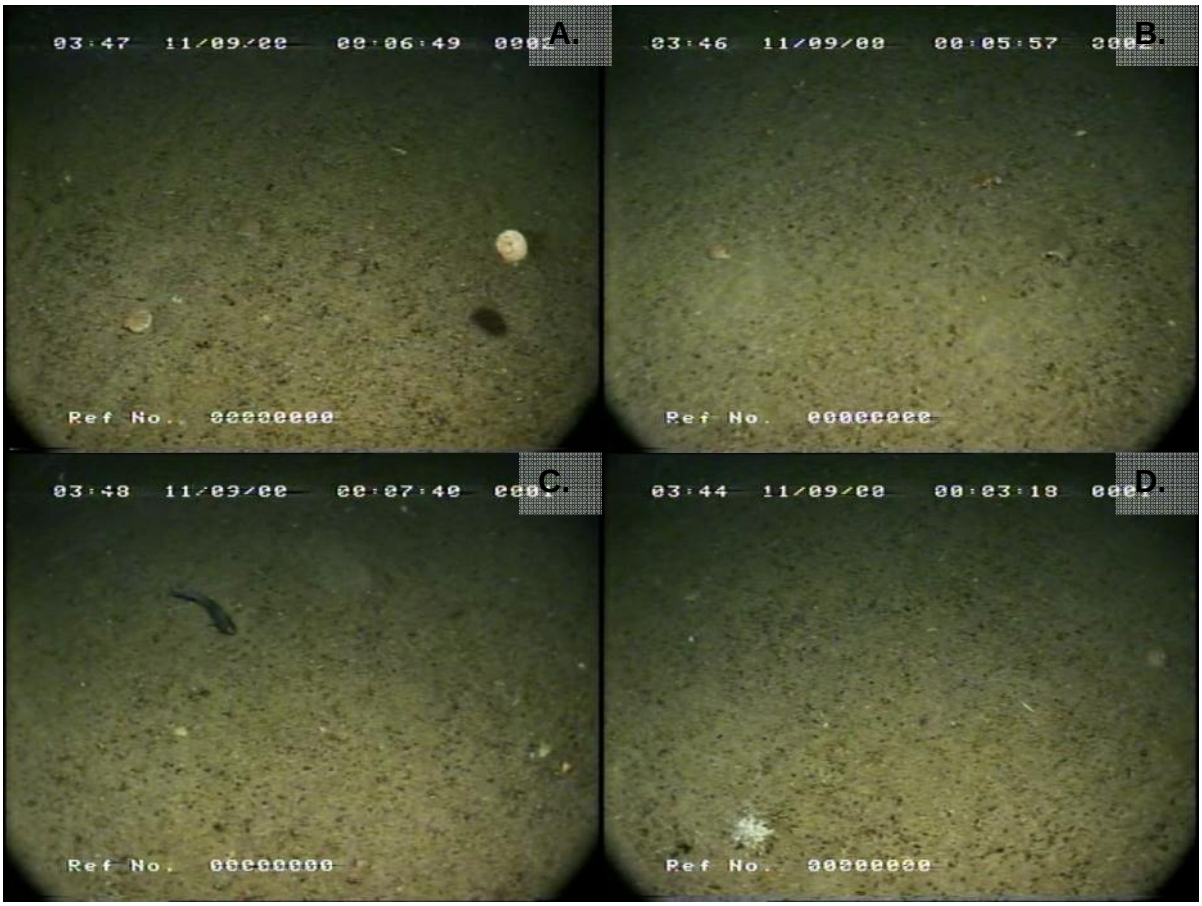

Figure 3.4 Video footage snapshots from station DEEP15. **A)** Unidentified scallop species; **B)** Paguridae species; **C)** Unidentified fish species; **D)** White Porifera species.

3.1.5 Station DEEP26

Camera sledge 00:10:05 duration 496 m depth 119 m tow
Oblique view

The video footage quality along this line was adequate, although resolution was low and camera speed over the ground was relatively high. The substratum was fine sand, with some gravel on the surface. Occasional gravel bands ~30 cm wide were present. An occasional large cobble was observed on the sediment. Infrequently observed areas of the sediment had been heavily burrowed and bioturbated (Figure 3.5a). There was no evidence of the species resident in the burrows, although the burrow size and shape suggested some species of large Crustacea. The size, crescentiform shape and sediment ejecta around the burrows suggested that they could be *Nephrops norvegicus* burrows.

A variety of fauna were observed, including the echinoids *Cidaris cidaris* (Figure 3.5b) and *Echinus acutus*, holothurians, and the seapen *Pennatula phosphorea*. Various fish species such as *Helicolenus dactylopterus* (Figure 3.5c) and *Chimaera monstrosa* (Figure 3.5d) were also present.

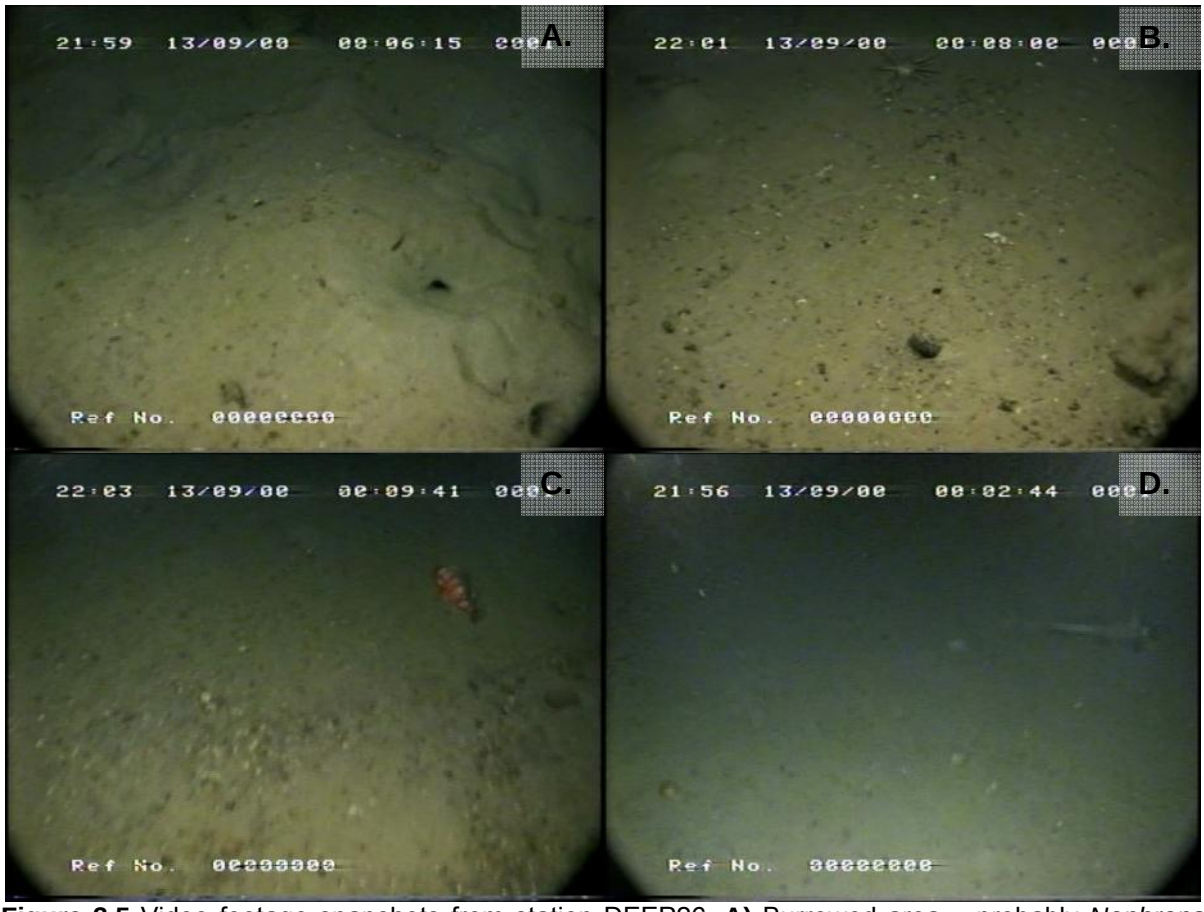

Figure 3.5 Video footage snapshots from station DEEP26. **A)** Burrowed area – probably *Nephrops norvegicus*; **B)** Gravel and *Cidaris cidaris*; **C)** *Chimaera monstrosa*; **D)** *Helicolenus dactylopterus*.

3.1.6 Station DW02006

Drop camera frame 00:10:13 duration 240-263 m depth 241 m tow
Downward view

The quality of the video footage was adequate, although the camera was generally flown too high above the seabed for accurate assessment of the epifauna present, with identification typically limited to higher taxonomic levels. The substratum mixed sediment, composed of a coarse sandy matrix with gravel and pebbles embedded throughout (Figure 3.6a). Occasional large cobbles and boulders observed on the sediment surface (Figure 3.6b).

Fauna present included occasional hermit crabs (Paguridae), the asteroid *Porania* sp. and Ophiuroidea. Epifauna was rarely seen, but some Serpulidae tubes and hydroids were observed on the larger pebbles and cobbles.

Figure 3.6 Video footage snapshots from station DW02006. **A)** Mixed sand and gravel sediment; **B)** Cobbles and boulders present on the sediment surface.

3.1.7 Station DW02007

Drop camera frame 00:05:18 duration 291-317 m depth 247 m tow
Downward view

The video camera footage quality was adequate, although the camera height and speed over ground prevented accurate assessment of the epifauna. The substrate was mixed sediment of coarse sand with embedded gravel and pebbles. Occasional cobbles and boulders were observed on the sediment surface (Figure 3.7a).

Fauna were sparse, but included mobile species such as hermit crabs (Paguridae), *Cancer pagurus* (Figure 3.7b), and the fish *Helicolenus dactylopterus.*

Figure 3.7 Video footage snapshots from station DW02007. **A)** Cobbles and boulders on the sediment surface; **B)** *Cancer Pagurus.*

3.1.8 Station DW02008

Drop camera frame 00:04:02 duration 322-366 m depth 127 m tow
Downward view

The video footage was an adequate quality, although camera was flown too high over the seabed for accurate assessment of the epifauna present. The substratum was mixed sediment composed of coarse sand, gravel and pebbles, with occasional cobbles and boulders (Figure 3.8a). The substratum during the last few seconds of the video footage appeared to be fine sand (Figure 3.8b). However, there is insufficient footage of this sand section to confidently assign a break in habitat types – it may represent a small patch of finer sediment within the dominant sandy gravel habitat observed along the rest of the video transect.

Epifauna was rarely observed, but included Serpulidae tubes and faunal turf on the some of the rocks. Other fauna observed included hermit crabs (Paguridae), squat lobsters (*Munida* sp.), and the fish *Helicolenus dactylopterus*.

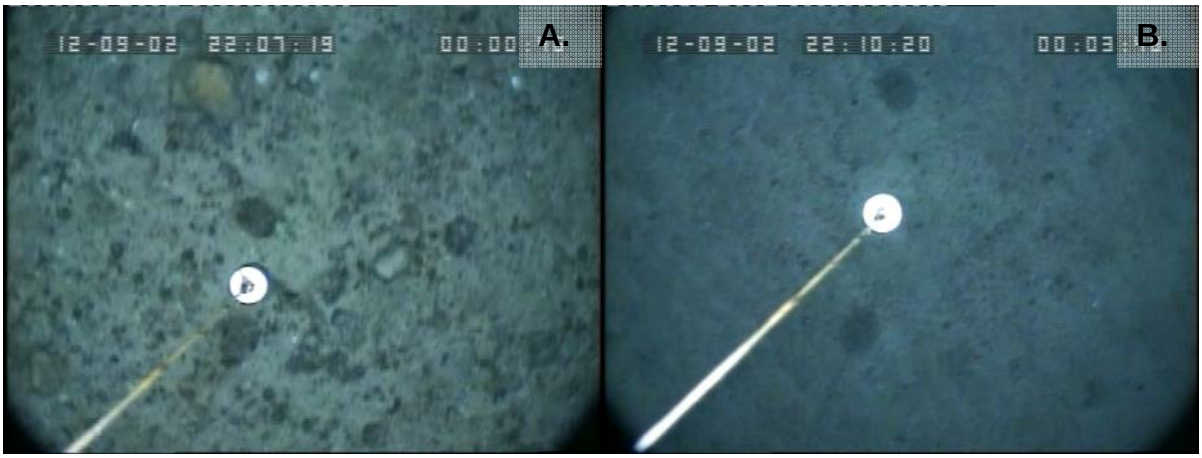

Figure 3.8 Video footage snapshots from station DW02008. **A)** Cobbles and boulders present on mixed sediment; **B)** Sand sediment.

3.1.9 Station DW02009

Drop camera frame 00:15:09 duration 271-327 m depth 492 m tow
Downward view

The video camera footage was of adequate quality, but identification of epifauna was hampered by the camera speed over the ground, and the height of the camera above the seafloor (please note snapshot images are not representative of camera height above seabed for the majority of the video line). The substratum was composed of mixed coarse sand with gravel and pebbles (Figure 3.9a). Isolated cobbles and boulders were present on the surface of the sediment.

Observed epifauna included Serpulidae tubes, encrusting yellow Porifera, a crinoid, an anemone and faunal turf on the larger stones. Mobile fauna present included *Cancer pagurus* (Figure 3.9b), hermit crabs (Paguridae) (Figure 3.9c), *Helicolenus* and an unidentified Carcharhiniformes (Figure 3.9d).

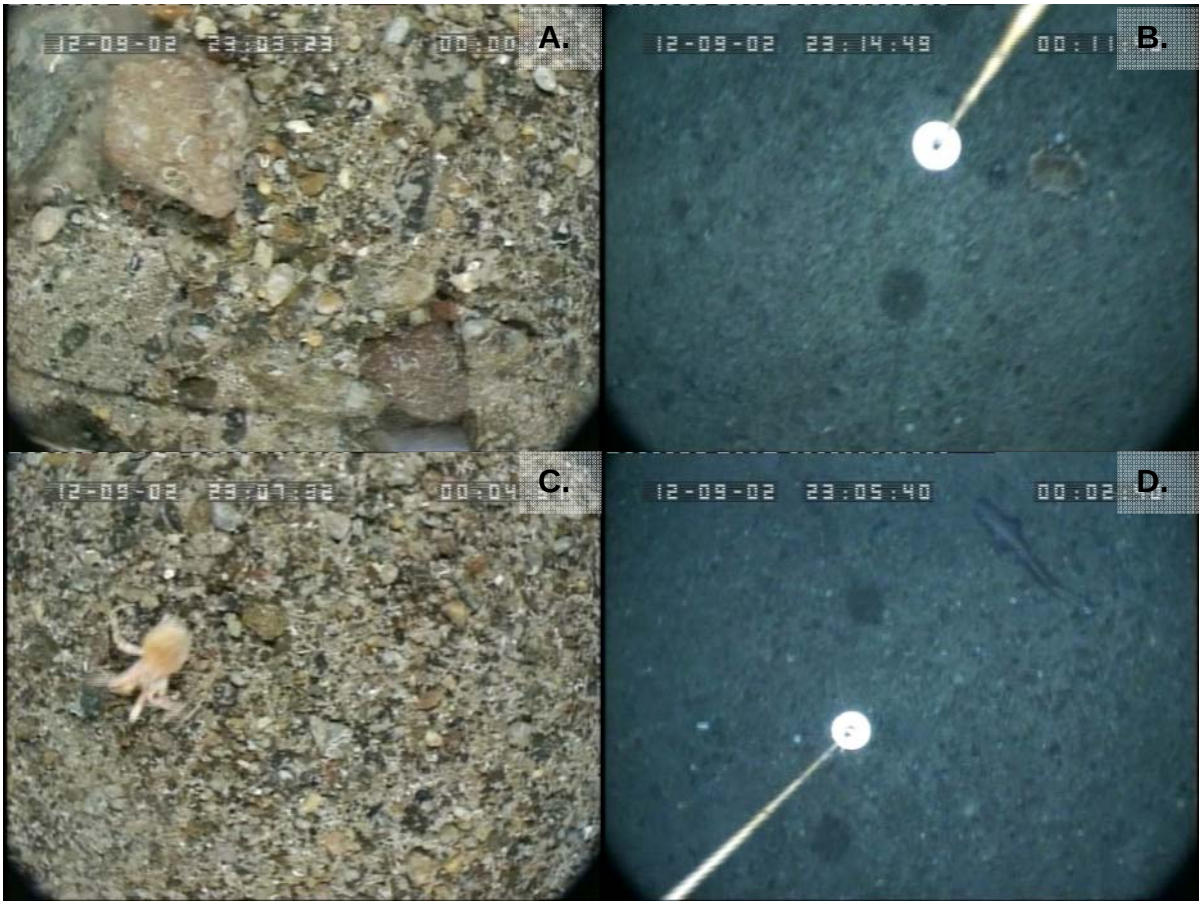

Figure 3.9 Video footage snapshots from station DW02009. **A)** Mixed sand and gravel sediment; **B)** *Cancer Pagurus*; **C)** Paguridae sp.; **D)** Carcharhiniformes sp.

3.1.10 Station DW02010

Drop camera frame 00:15:15 duration 288-323 m depth 706 m tow
Downward view

Adequate quality video camera footage, but the camera system was flown too high from the seafloor for accurate assessment of epifauna (please note snapshot images are not representative of camera height above seabed for the majority of the video line). The substratum was mixed sediment of coarse sand embedded with gravel and pebbles (Figure 3.10a). The occasional cobble and boulder was observed on the surface.

Several species of fish were observed, including a ray (*Raja* sp.; Figure 3.10b), *Helicolenus dactylopterus* (Figure 3.10c) and an unidentified flatfish. Invertebrate fauna included the asteroid *Porania* sp., hermit crabs (Paguridae) (Figure 3.10d) and *Cancer pagurus.*

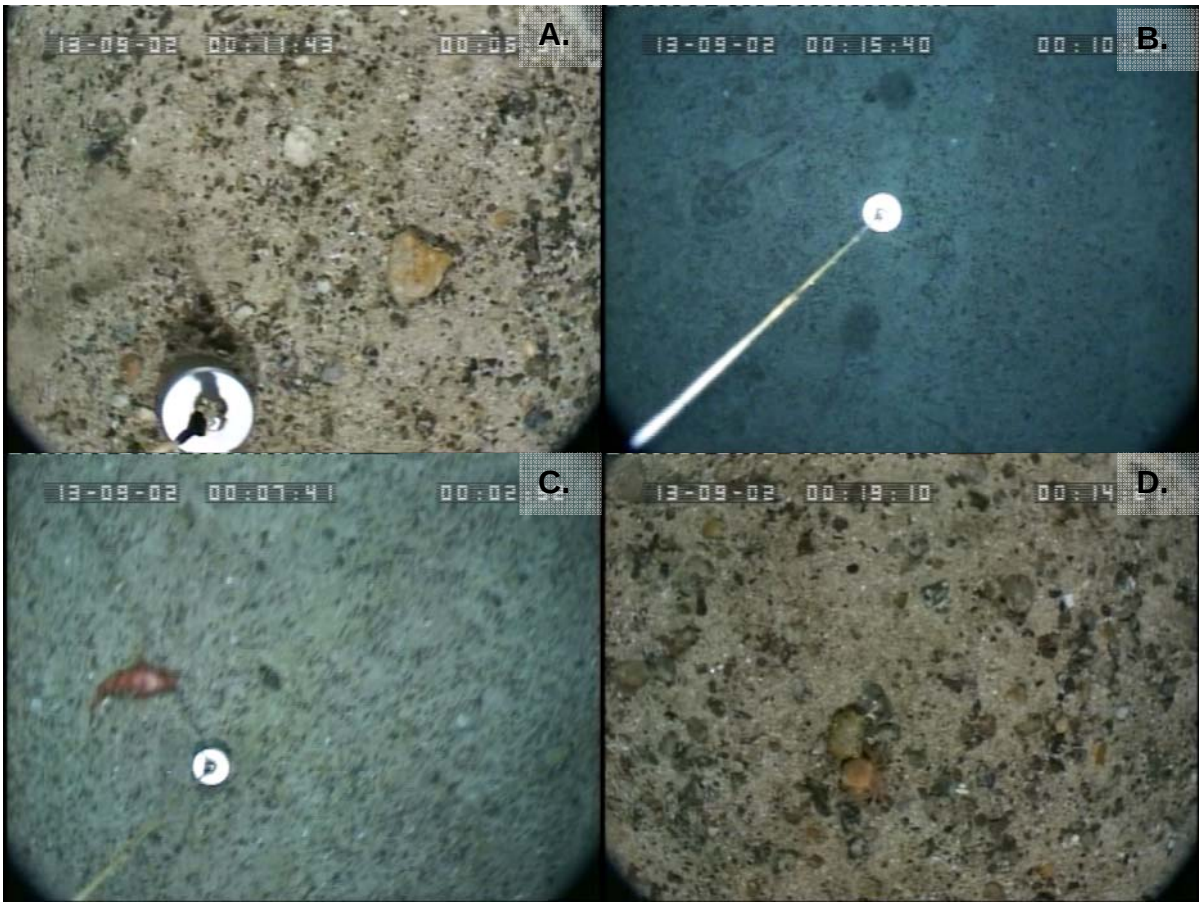

Figure 3.10 Video footage snapshots from station DW02010. **A)** Sand and gravel sediment; **B)** *Raja* sp.; **C)** *Helicolenus dactylopterus*; **D)** Paguridae sp.

3.1.11 Station DW02011

Drop camera frame 00:10:27 duration 272-308 m depth 212 m tow
Downward view

The video camera footage was adequate quality, although the height of the camera above the seabed prevented accurate assessment of the epifauna present. The substratum was a mixed coarse sand and gravel (Figure 3.11a). Frequent large cobbles and boulders were observed on the sediment surface. They appeared to be relatively clean, lacking many obvious epifauna.

The epifauna that was observed included encrusting Porifera, faunal turf and Serpulidae tubes. DW02011 was also characterised by high numbers of *Helicolenus dactylopterus*, which were observed throughout the video camera transect (Figure 3.11b-d). Other species present included *Porania* sp. and hermit crabs (Paguridae).

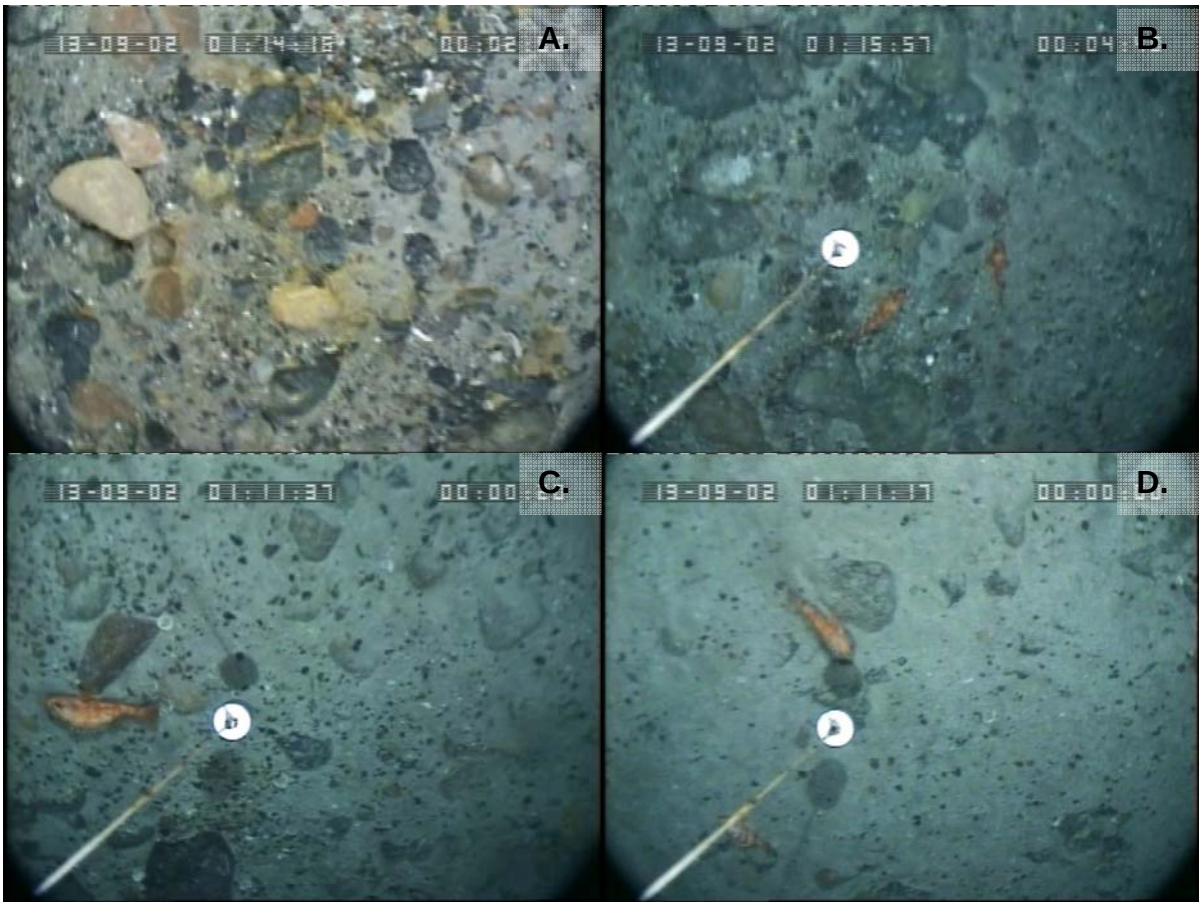

Figure 3.11 Video footage snapshots from station DW02011. **A)** Mixed sediment; **B)** – **D)** *Helicolenus dactylopterus*.

3.1.12 Station DW04012

Camera sledge 00:30:05 duration ~600 m depth 880 m tow
Oblique view

The video camera footage was of an adequate quality. Substratum was muddy, with some gravel and occasional large drop stone (Figure 3.12a). There were areas of intensive burrowing and bioturbation (Figure 3.12b). Although the brachyuran crustacean Geryonidae sp. were frequently seen on the sediment surface close to burrow entrances (Figure 3.12c), the size and structure of the burrows suggested that *Nephrops norvegicus* was probably responsible for their construction. However, no *Nephrops* were observed within the video footage. Lebensspuren such as feeding mounds and tracks were also present.

A variety of fauna were observed. The holothurian *Parastichopus tremulus* (Figure 3.12d) and several different species of anemone (Figure 3.12e), including cerianthids, were frequently seen throughout the video camera transect. A burrowing holothurian with yellow tentacles was seen. A variety of fish species were present, including *Helicolenus dactylopterus* (Figure 3.12f), and a monkfish *Lophius piscatorius*.

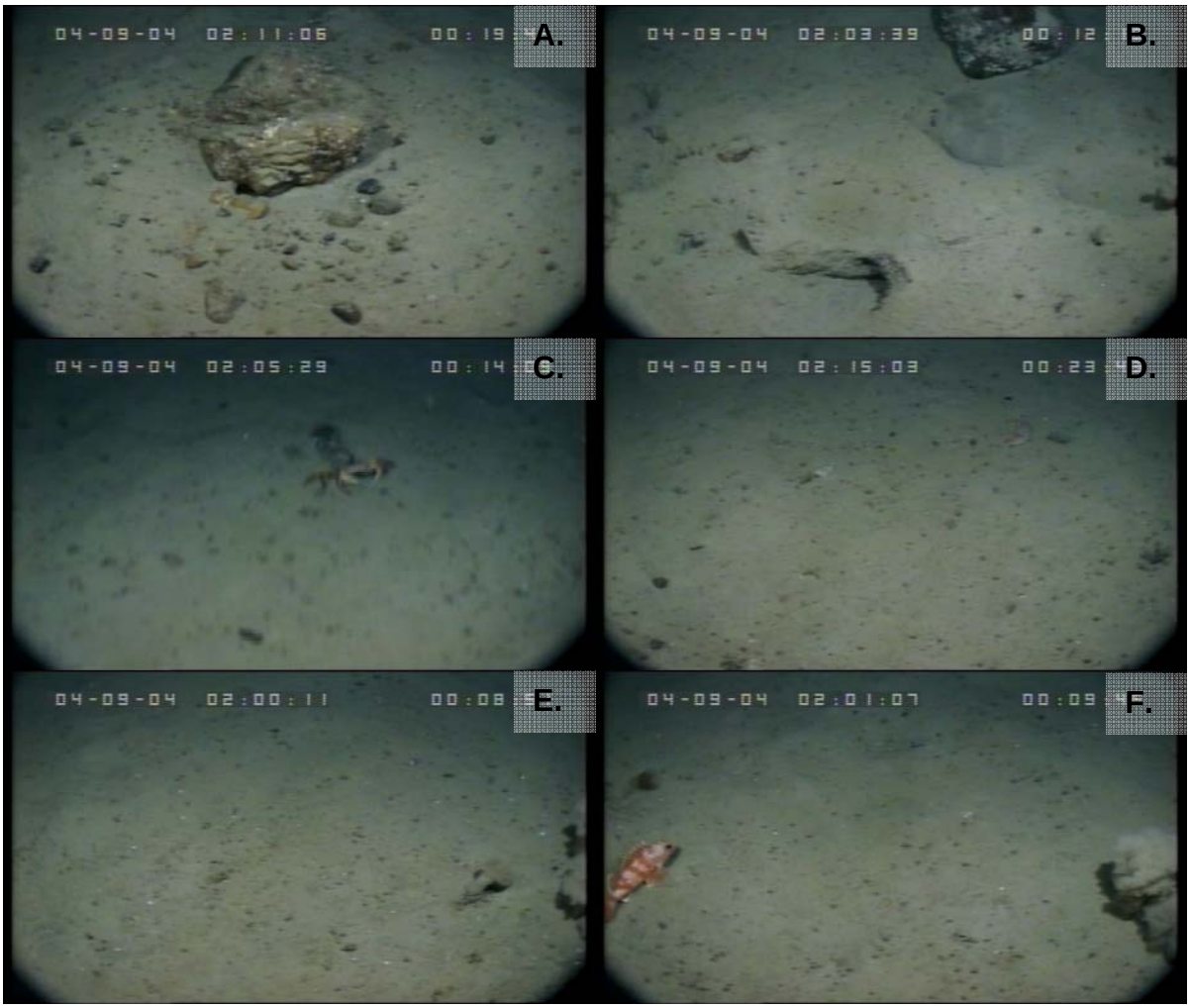

Figure 3.12 Video footage snapshots from station DW04012. **A)** Large drop stone; **B)** Macrofaunal burrow **C)** Geryon sp.; **D)** *Parastichopus tremulus*; **E)** Unidentified anemone; **F)** *Helicolenus dactylopterus.*

3.1.13 Station DW06910

Drop camera frame	00:15:27 duration	355-360 m depth	Length of tow
Downward view			unknown

The video camera footage was adequate quality. The substratum was composed of coarse sand, with some gravel present (Figure 3.13a). Some ripples were evident, suggesting some hydrodynamic activity.

Fauna observed included galatheid squat lobsters (Figure 3.13b), including *Munida* sp., hermit crabs (Paguridae), *Porania* sp., burrowing holothurians (Figure 3.13c) and some scallops. Fish species observed included *Chimaera monstrosa* (Figure 3.13d).

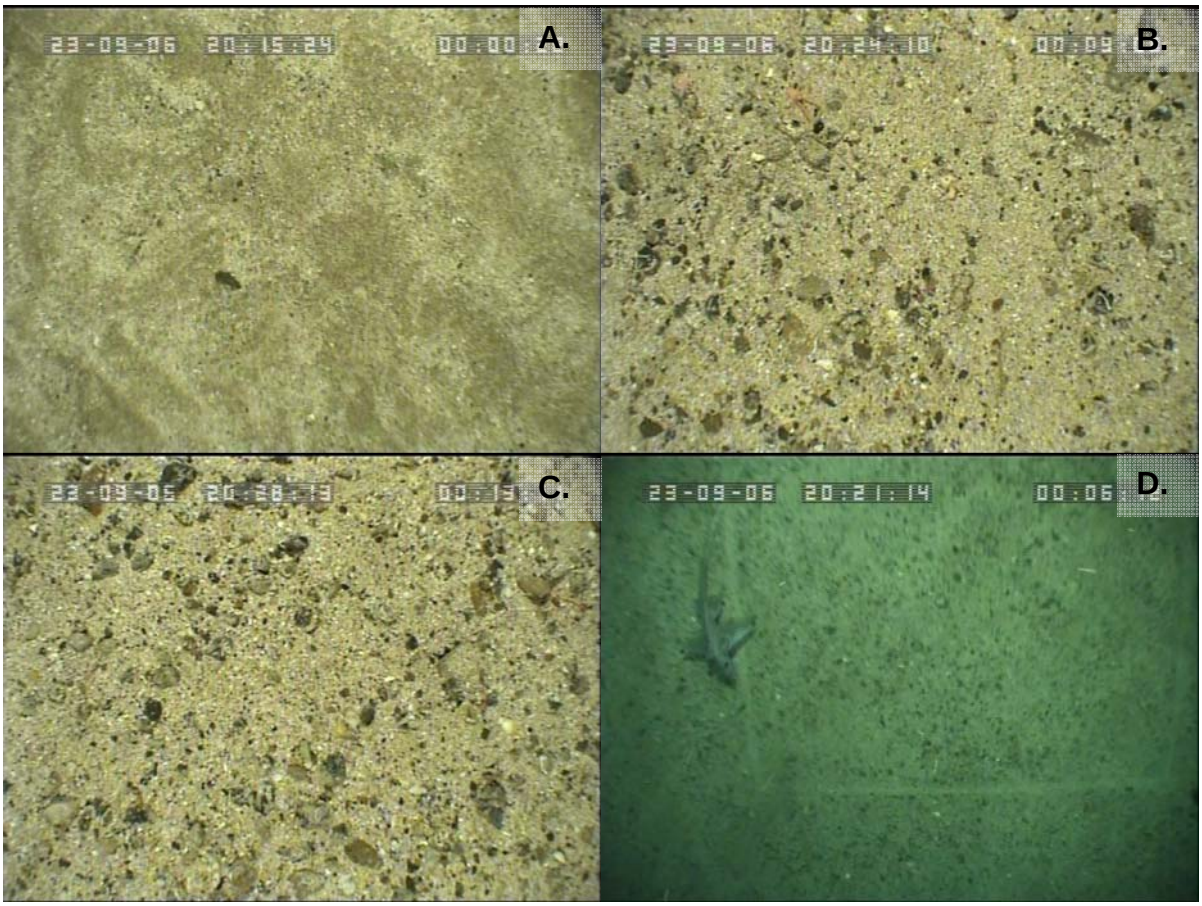

Figure 3.13 Video footage snapshots from station DW06910. **A)** Coarse sand sediment; **B)** *Munida* sp.; **C)** Unidentified burrowing holothurian (top left, under overlay); **D)** *Chimaera monstrosa*.

3.1.14 Station DW0901

Drop camera frame 00:16:07 duration 553-545 m depth 345 m tow
Downward view

The video camera footage quality was adequate, although low resolution prevented accurate identification of the species present. The substratum at the station appeared to be mud (Figure 3.14a), with some gravel and occasional cobbles seen on the surface of the sediment. Infaunal burrows and lebensspuren such as faecal casts, feeding mounds, and tracks (Figure 3.14b) were present.

Fauna present included several species of anemones (Figure 3.14b & c) and fish species, including flatfish (Figure 3.14d) and Macrouridae. The crustacean Geryonidae sp. was occasionally observed on the sediment surface (Figure 3.14e), although the size and structure of the large burrows observed suggested residency by *Nephrops norvegicus*. Also present was the holothurian *Parastichopus tremulus* (Figure 3.14f). There was some evidence of trawl or dredge marks across the sediment surface.

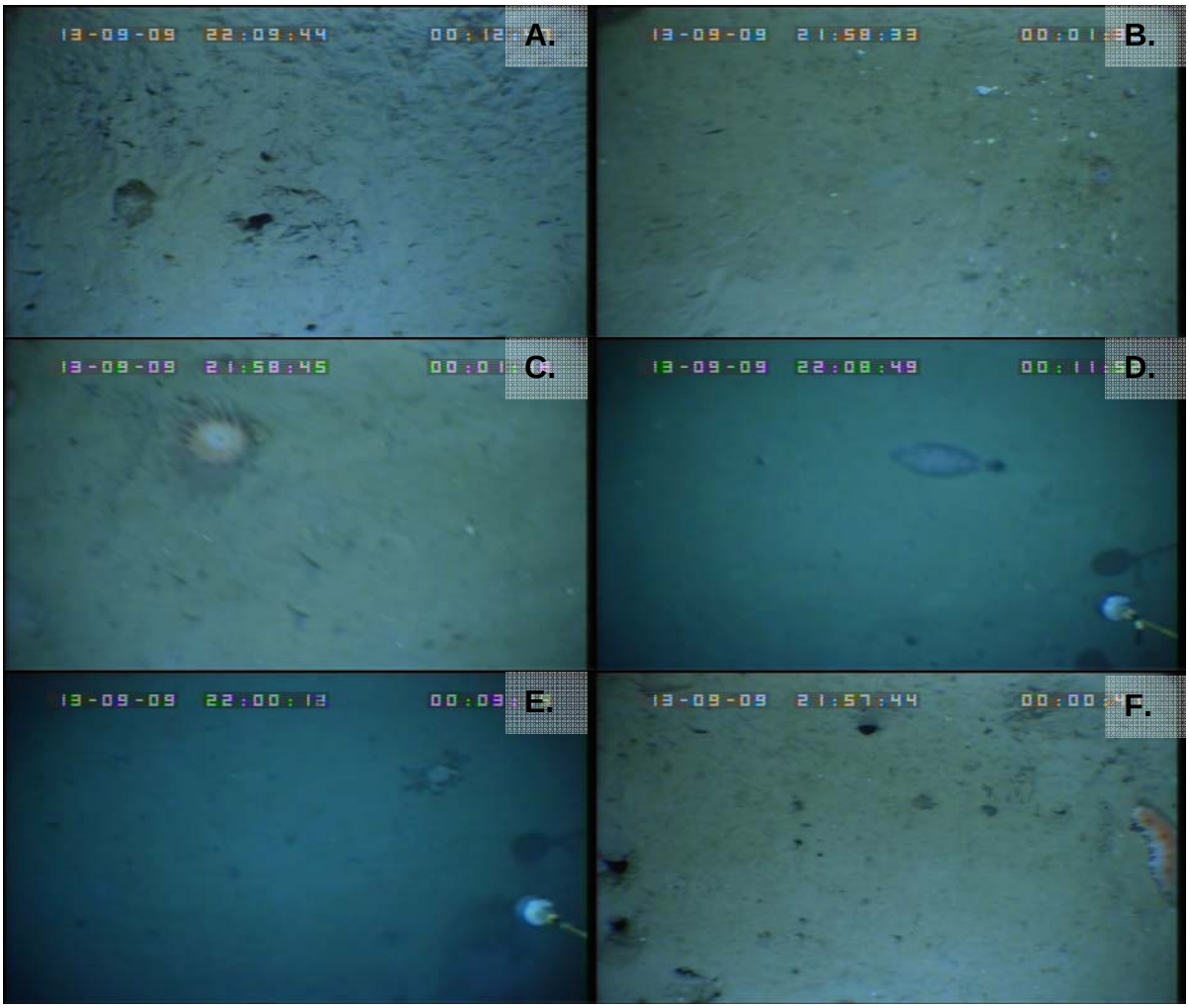

Figure 3.14 Video footage snapshots from station DW0901. **A)** Mud sediment; **B)** Lebensspuren; **C)** Unidentified anemone species; **D)** Flatfish species; **E)** Geryon sp.; **F)** *Parastichopus tremulus.*

3.1.15 Station DW0903

Drop camera frame 00:15:27 duration 368 m depth 365 m tow
Downward view

The video camera footage was adequate, but low lighting and camera speed over ground made identification of fauna problematic. The substratum appeared to be fine sand with some gravel present on the surface, along with occasional drop stones. Faunal burrows, feeding mounds and tracks were observed.

Large numbers of small burrowing *Halcampoides* anemones were visible when the camera was landed (Figure 3.15a – c). The size of the anemones meant they were not visible when the camera system was flown above the seabed. However, they were present in similar densities whenever the camera landed, so were assumed to occur in similar concentrations throughout the video camera line. Other fauna present included larger unidentified burrowing anemones (Figure 3.15d), Asteroidea, *Parastichopus*, hermit crabs (Paguridae) and fish including *Helicolenus dactylopterus*.

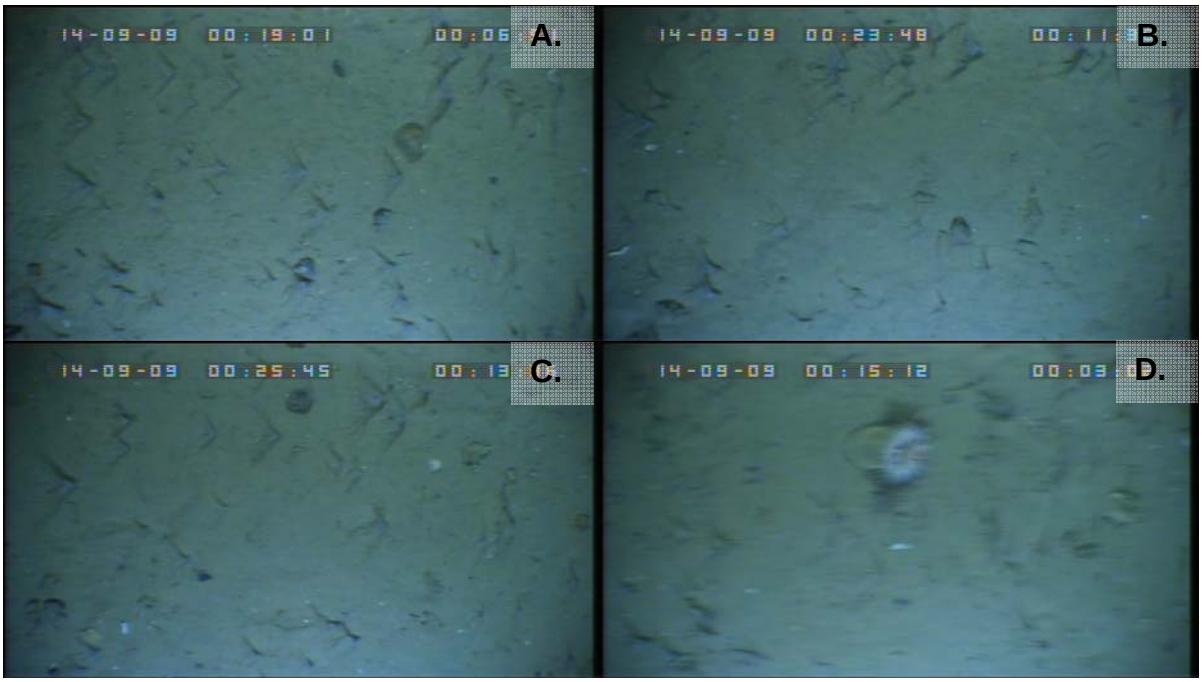

Figure 3.15 Video footage snapshots from station DW0903. **A)** – **C)** *Halcampoides* sp.; **D)** Unidentified burrowing anemone species.

3.1.16 Station DW0904

Drop camera frame 00:15:22 duration 466-472 m depth 411 m tow
Downward view

The video camera footage was adequate, but with some low lighting and high camera speed over ground. The substratum was fine sand, with some gravel and occasional drop stones. Lebensspuren including feeding mounds, tracks and faunal burrows were present.

Halcampoides sp. was seen in high numbers whenever the camera was landed (Figure 3.16a), so was assumed to be ubiquitous along the video camera line. *Spatangus raschi* was commonly observed (Figure 3.16b). Other fauna present included *Parastichopus tremulus, Echinus acutus*, anemones and hermit crabs (Paguridae).

Figure 3.16 Video footage snapshots from station DW0904. **A)** *Halcampoides* sp.; **B)** *Spatangus raschi* and *Parastichopus tremulus.*

3.1.17 Station DW0905

Drop camera frame 00:16:31 duration 612-616 m depth 420 m tow
Downward view

The video camera footage was adequate, but with relatively low lighting and high camera speed over ground. The substratum was fine sand, with some gravel and occasional drop stone. Feeding mounds (Figure 3.17a) and faunal burrows were present.

Halcampoides was again always seen when the camera was landed, and thus assumed to be present throughout the video camera line. *Parastichopus tremulus* was frequently seen on the sediment surface, as were large unidentified burrowing anemones (Figure 3.17b). Other fauna included and *Porania* sp. and *Helicolenus dactylopterus.*

Figure 3.17 Video footage snapshots from station DW0905. **A)** Feeding mound; **B)** Unidentified burrowing anemone species.

3.1.18 Station DW0906

Drop camera frame 00:15:31 duration 656-650 m depth 346 m tow
Downward view

The video camera footage was adequate, although the light levels and camera resolution were low. The substratum was mud, with some gravel and occasional drop stone. Lebensspuren such as feeding mounds and tracks were present. Large faunal burrows were seen, along with Geryonidae sp. (Figure 3.18a). As per stations DW04012 and DW0901 the structure and shape of the burrows were indicative of *Nephrops norvegicus,* which was assumed to be the resident species. Some evidence of trawl/dredge marks were seen (Figure 3.18b).

Fauna observed included large unidentified anemones and cerianthids (Figure 3.18c). *Parastichopus* and hermit crabs (Paguridae) were all frequently observed, along with occasional flatfish (Figure 3.18d).

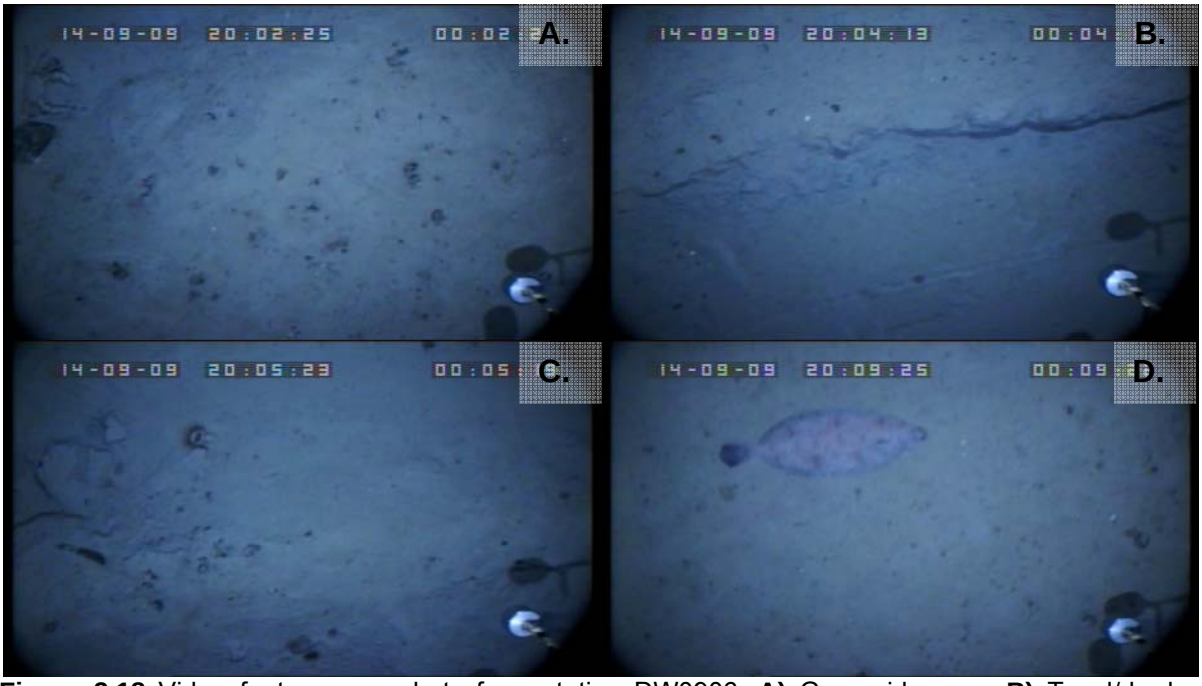

Figure 3.18 Video footage snapshots from station DW0906. **A)** Geryonidae sp.; **B)** Trawl/dredge marks; **C)** Cerianthid anemone species; **D)** Flatfish.

3.1.19 Station DW0908

Drop camera frame 00:15:44 duration 376 m depth 368 m tow
Downward view

The video camera footage was adequate, but low lighting and camera speed over ground made identification of fauna problematic. The substratum was characterised by fine sand with some gravel and occasional drop stones. Some faunal burrows were present, along with feeding mounds and tracks.

Halcampoides was common whenever the camera was landed, so was assumed to be ubiquitous throughout the video camera line (Figure 3.19a). *Spatangus raschi* was commonly observed (Figure 3.19b). Other fauna present included the asteroid *Luidia* sp. (Figure 3.19c), *Parastichopus*, *Echinus acutus*, large unidentified anemones, and hermit crabs (Paguridae). A globular yellow Porifera, possibly *Pheronema* sp., was also occasionally observed (Figure 3.19d).

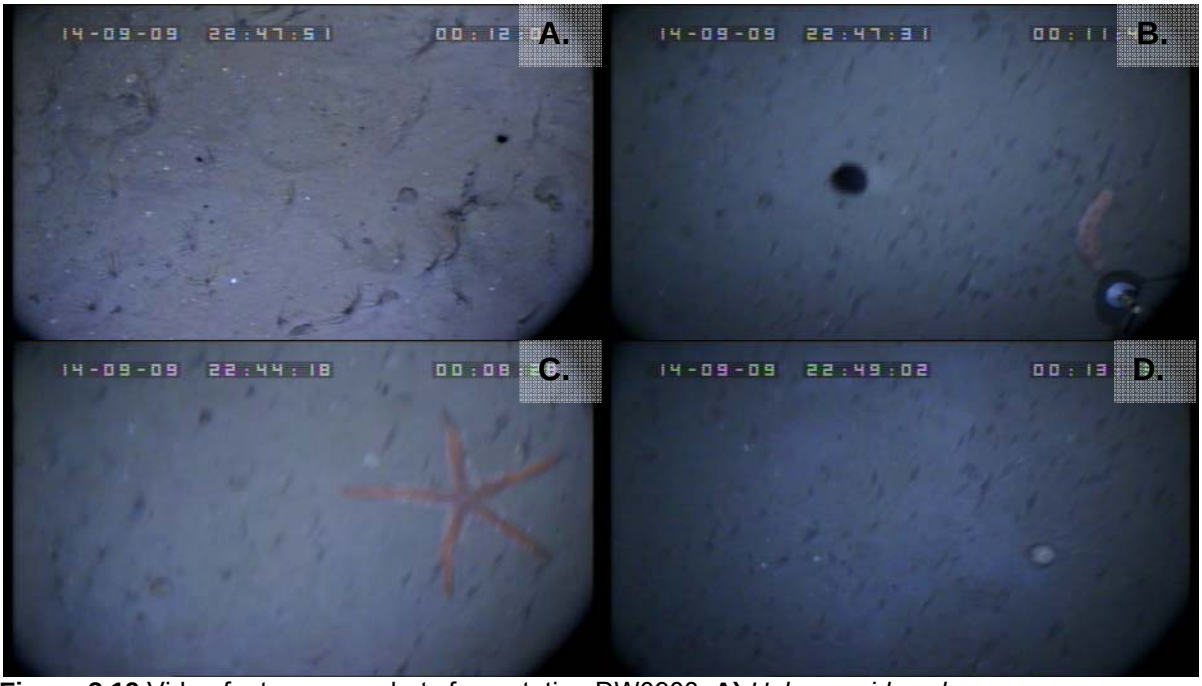

Figure 3.19 Video footage snapshots from station DW0908. **A)** *Halcampoides abyssorum*; **B)** *Spatangus raschi* and *Parastichopus tremulus*; **C)** *Luidia* sp.; **D)** Globular yellow Porifera (possible *Pheronema* sp.)

3.2 Broadscale habitat classification

A broadscale habitat was assigned to each station based on sediment composition and depth (i.e. Level 3 of the EUNIS classification scheme). In addition, all stations were also assigned a Level 3 habitat type according to the scheme proposed by Howell *et al* (2010) based on the biogeography in addition to station depth and substratum present. Table 3.1 summarises the habitats assigned to the survey stations.

Table 3.1 Summary of Level 3 EUNIS habitat classification and Howell *et al* (2010) Level 3 habitats.

Station	Biogeography	Depth (m)	Substratum	EUNIS Habitat	Howell *et al* (2010) Habitat
DEEP12	Atlantic	578	Sand	A6.3 : Deep-sea sand	Atlantic Upper Slope Sand
DEEP13	Atlantic	631	Sand	A6.3 : Deep-sea sand	Atlantic Upper Slope Sand
DEEP14	Atlantic	618	Sand	A6.3 : Deep-sea sand	Atlantic Upper Slope Sand
DEEP15	Atlantic	545	Coarse	A6.3 : Deep-sea sand	Atlantic Upper Slope Coarse
DEEP26	Atlantic	496	Sand	A6.3 : Deep-sea sand	Atlantic Upper Slope Sand
DW02006	Atlantic	240	Mixed	A6.2 : Deep-sea mixed substrata	Atlantic Upper Slope Mixed
DW02007	Atlantic	291	Mixed	A6.2 : Deep-sea mixed substrata	Atlantic Upper Slope Mixed
DW02008	Atlantic	322	Mixed	A6.2 : Deep-sea mixed substrata	Atlantic Upper Slope Mixed
DW02009	Atlantic	271	Mixed	A6.2 : Deep-sea mixed substrata	Atlantic Upper Slope Mixed
DW02010	Atlantic	706	Coarse	A6.3 : Deep-sea sand	Atlantic Upper Slope Coarse
DW02011	Atlantic	272	Mixed	A6.14 : Boulders on the deep-sea bed	Atlantic Upper Slope Mixed
DW04012	Atlantic	~600	Mud	A6.5 : Deep-sea mud	Atlantic Upper Slope Mud
DW06910	Atlantic	355	Coarse	A6.3 : Deep-sea sand	Atlantic Upper Slope Coarse
DW0901	Atlantic	553	Mud	A6.5 : Deep-sea mud	Atlantic Upper Slope Mud
DW0903	Atlantic	368	Sand	A6.3 : Deep-sea sand	Atlantic Upper Slope Sand
DW0904	Atlantic	466	Sand	A6.3 : Deep-sea sand	Atlantic Upper Slope Sand
DW0905	Atlantic	612	Sand	A6.3 : Deep-sea sand	Atlantic Upper Slope Sand
DW0906	Atlantic	656	Mud	A6.5 : Deep-sea mud	Atlantic Upper Slope Mud
DW0908	Atlantic	376	Sand	A6.3 : Deep-sea sand	Atlantic Upper Slope Sand

3.2.1 EUNIS classification scheme

The marine habitats captured in the video footage could only be assigned a Level 3 habitat type under the EUNIS classification scheme as the biogeography of the lower levels currently detailed within the hierarchy were not appropriate for the stations surveyed. Under the EUNIS classification, four different habitats were observed (Table 3.2).

Table 3.2 Summary of habitats observed according to EUNIS classification scheme.

EUNIS habitat code	No. Observations	Stations Observed
A6.14 : Boulders on the deep-sea bed	1	DW02011
A6.2 : Deep-sea mixed substrata	4	DW02006; DW02007; DW02008; DW02009
A6.3 : Deep-sea sand	11	DEEP12; DEEP13; DEEP14; DEEP15; DEEP26; DW02010; DW06910; DW0903; DW0904; DW0905; DW0908
A6.5 : Deep-sea mud	3	DW04012; DW0901; DW0906

The EUNIS classification also has a category ‘A6.4 : Deep-sea muddy sand’. No station was assigned this habitat, since it was not possible to distinguish between sand and muddy sand substratum by visual inspection, and the modified Folk triangle groups muddy sand and sand together. Therefore, some stations classified as A6.3 may fall within the A6.4 biotope if sediment particle size data is acquired for these stations at a future date.

DW02011 was the only station assigned the A6.14 biotope. Although all of the mixed substratum stations had a small degree of boulders and cobbles on the surface, the quantity of the boulders at DW02011 was higher than the other stations.

Figure 3.20 shows the locations of the biotopes defined using the EUNIS classification. The deep-sea mud biotopes were found together in the north-eastern most stations. The deep-sea sand stations found to the west were characterised by fine sand substratum. The deep-sea mixed sediment, boulders on the deep-sea bed and some of the deep-sea sand stations with coarser sand substratum were found in the grouping of stations in the south.

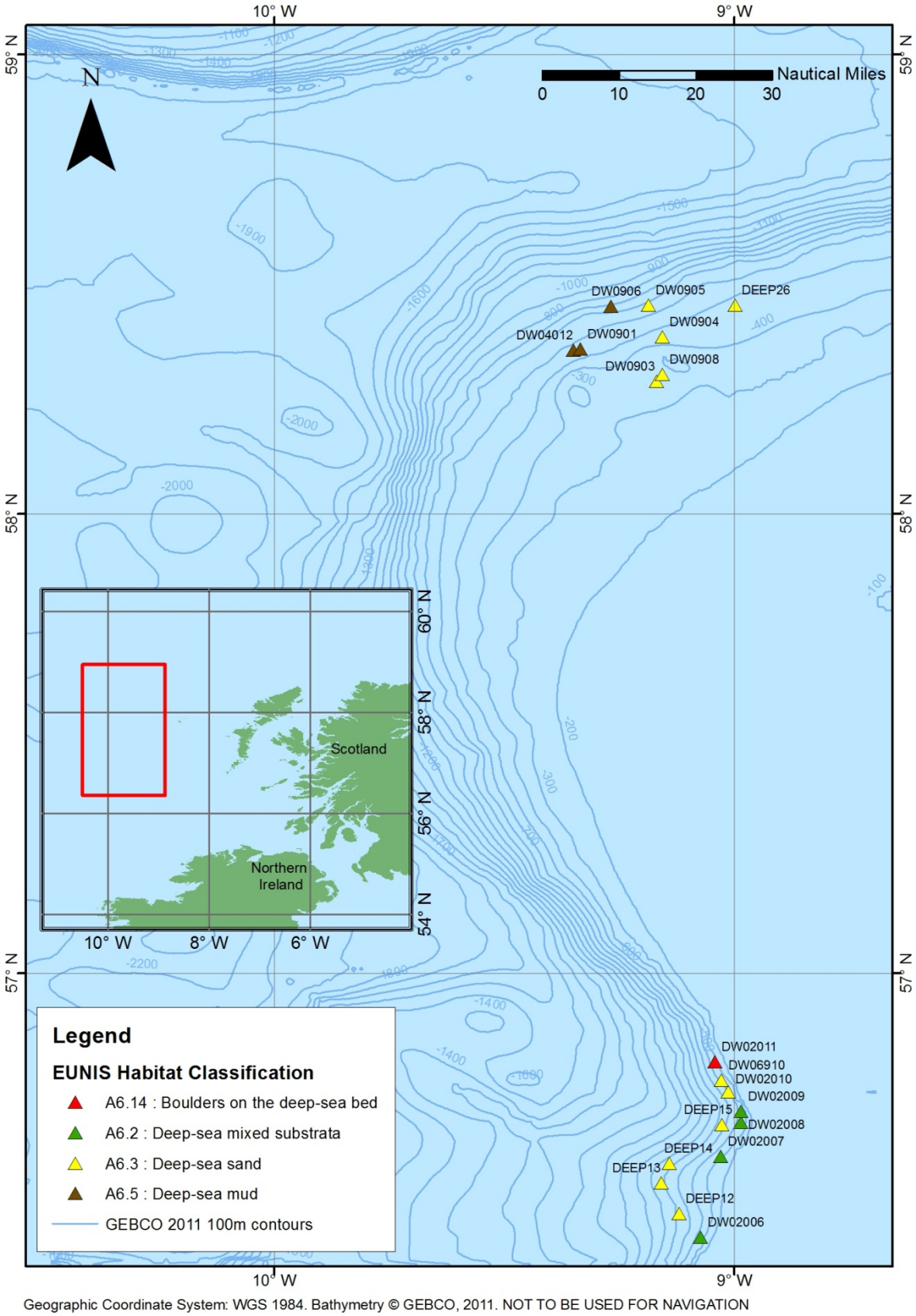

Figure 3.20 EUNIS Level 3 habitat assigned to each station.

3.2.2 Alternative habitat classification (after Howell *et al* 2010)

Using the proposed classification system of Howell *et al* (2010), four Level 3 habitats were observed during the video footage analysis, based purely on the depth and observed sediment characteristics (Table 3.3).

Table 3.3 Summary of habitats observed according to Howell *et al* (2010) classification scheme.

Howell *et al* (2010) habitat code	No. observations	Stations observed
Atlantic Upper Slope Coarse	3	DEEP15; DW02010; DW06910
Atlantic Upper Slope Mixed	5	DW02006; DW02007; DW02008; DW02009; DW02011
Atlantic Upper Slope Sand	8	DEEP12; DEEP13; DEEP14; DEEP26; DW0903; DW0904; DW0905; DW0908
Atlantic Upper Slope Mud	3	DW04012; DW0901; DW0906

3.3 Multivariate analysis

Lower biotope levels can be assigned to stations by consideration of the characteristic faunal communities present in each habitat. Several new deep-sea Level 4 biotopes have been suggested by Howell *et al* (2010). The variable resolution, poor lighting, camera height and speed over ground meant that accurate species identification was extremely difficult, with identification of some taxa restricted to higher taxonomic levels. The lack of taxonomic certainty limited the possibility of classifying samples to Level 4 biotopes for the MSS deep water stations. It should be acknowledged that the analysis of the video camera footage resulted in a relatively taxon poor data set with which to undertake the multivariate analysis (typically <10 taxon per station after rationalisation). Extreme care should be taken when interpreting the results generated from the multivariate analysis.

In order to assess any underlying similarities between the community compositions at each station, cluster analysis was undertaken and the resultant dendrogram plotted (Figure 3.21). The stations clustered into five groups (A – E). Groups A and B separated from groups C – E at ~10% similarity. Group A branched away from group B at ~35% similarity. At ~30% similarity groups C and D spilt away from group E, with group C and D branching from each other at ~ 45% similarity.

Figure 3.22 shows a 2D MDS plot of the survey stations. The MDS plot largely supported the dendrogram, with groups A and B separated from groups C – E. The stations largely clustered together as per the groupings defined from the dendrogram plot, although groups C and D showed some potential overlap. The 2D plot had a relatively low stress value of 0.12, so the groupings displayed can be regarded with some confidence.

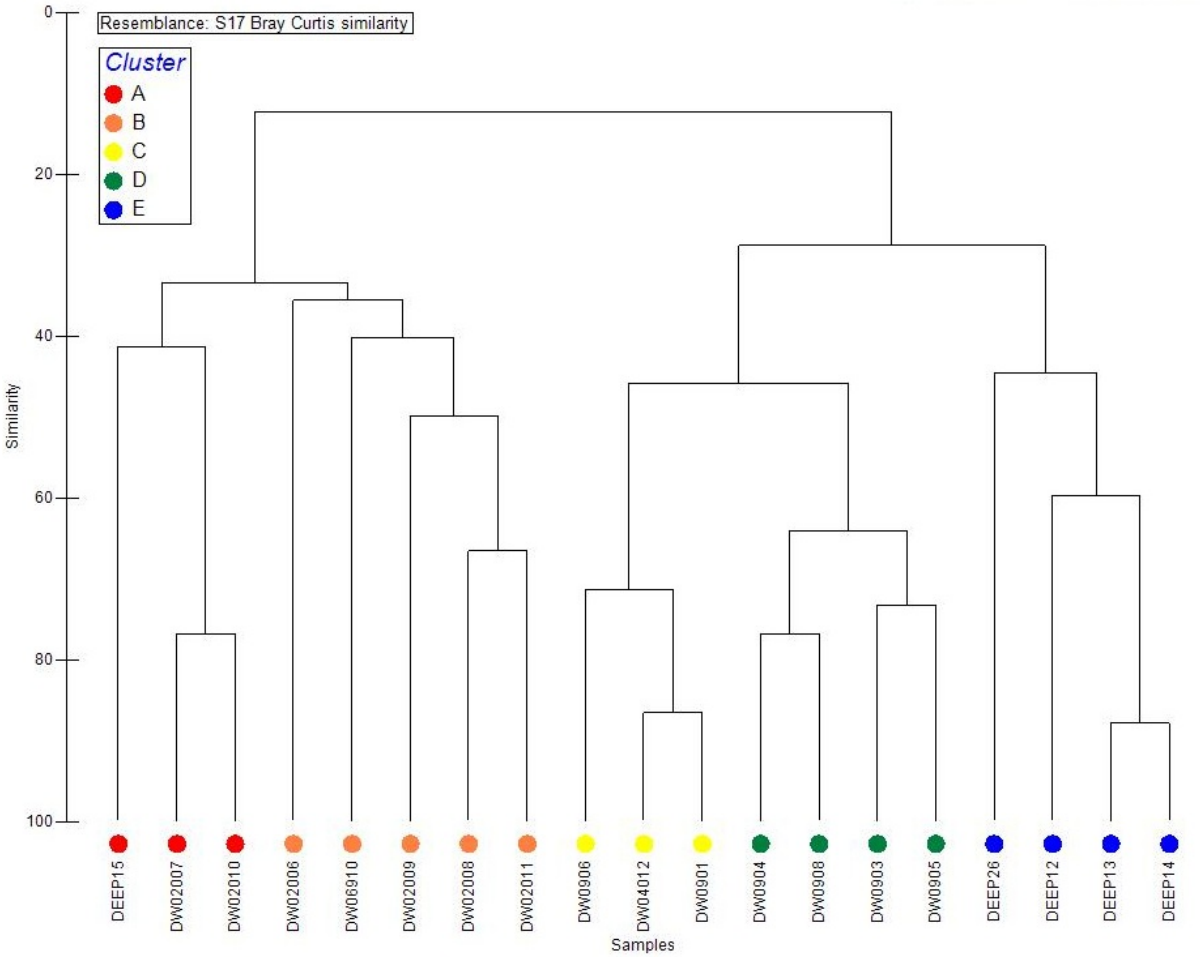

Figure 3.21 Dendrogram resulting from cluster analysis of survey stations.

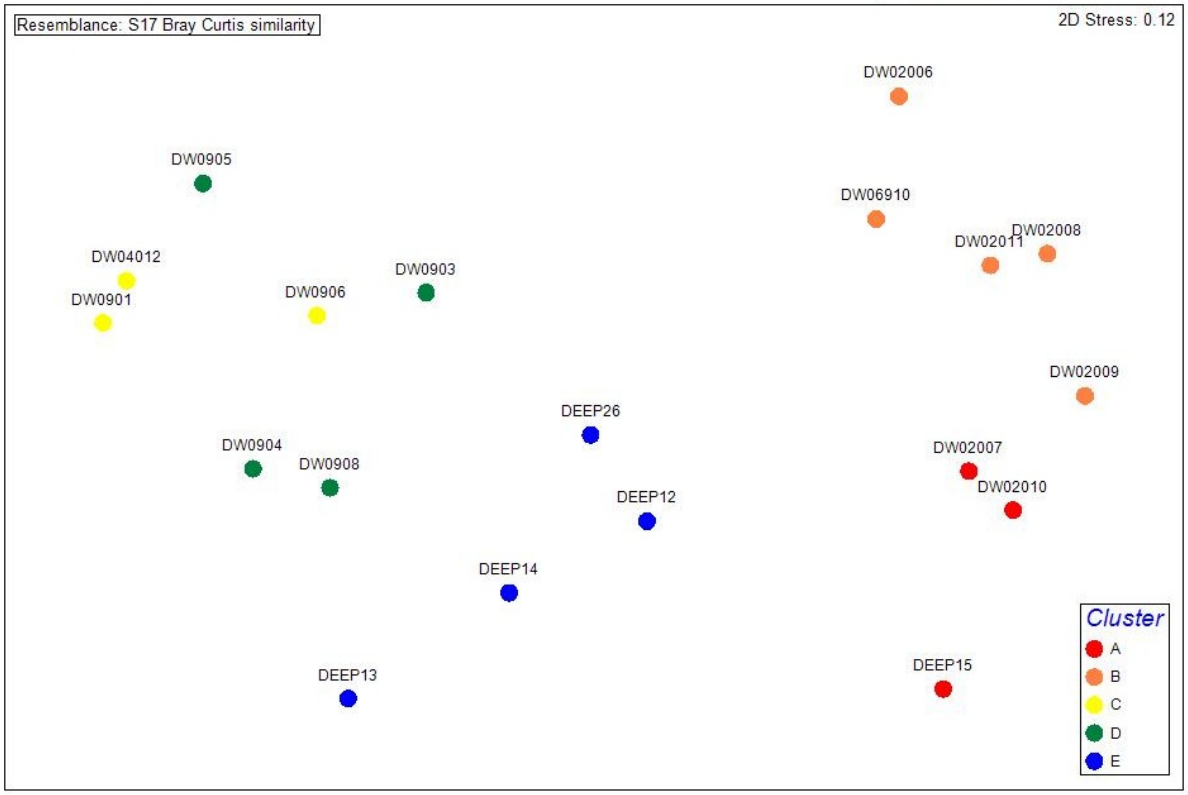

Figure 3.22 2D MDS plot of survey stations.

Figure 3.2.3 shows the dendrogram plotted after the cluster analysis coloured according to the visually estimated substratum at each station. The dendrogram shows a strong relationship between some of the groups and the type of substratum present. Groups A and B both contained mixed or coarse sediments, and were split away from groups C – E containing sand and mud sediments. The three stations containing mud clustered together within group C. Both groups D and E were characterised by sand. The splitting of sand sediment stations between two groups suggested some underlying differences in the faunal communities between the stations present in each group.

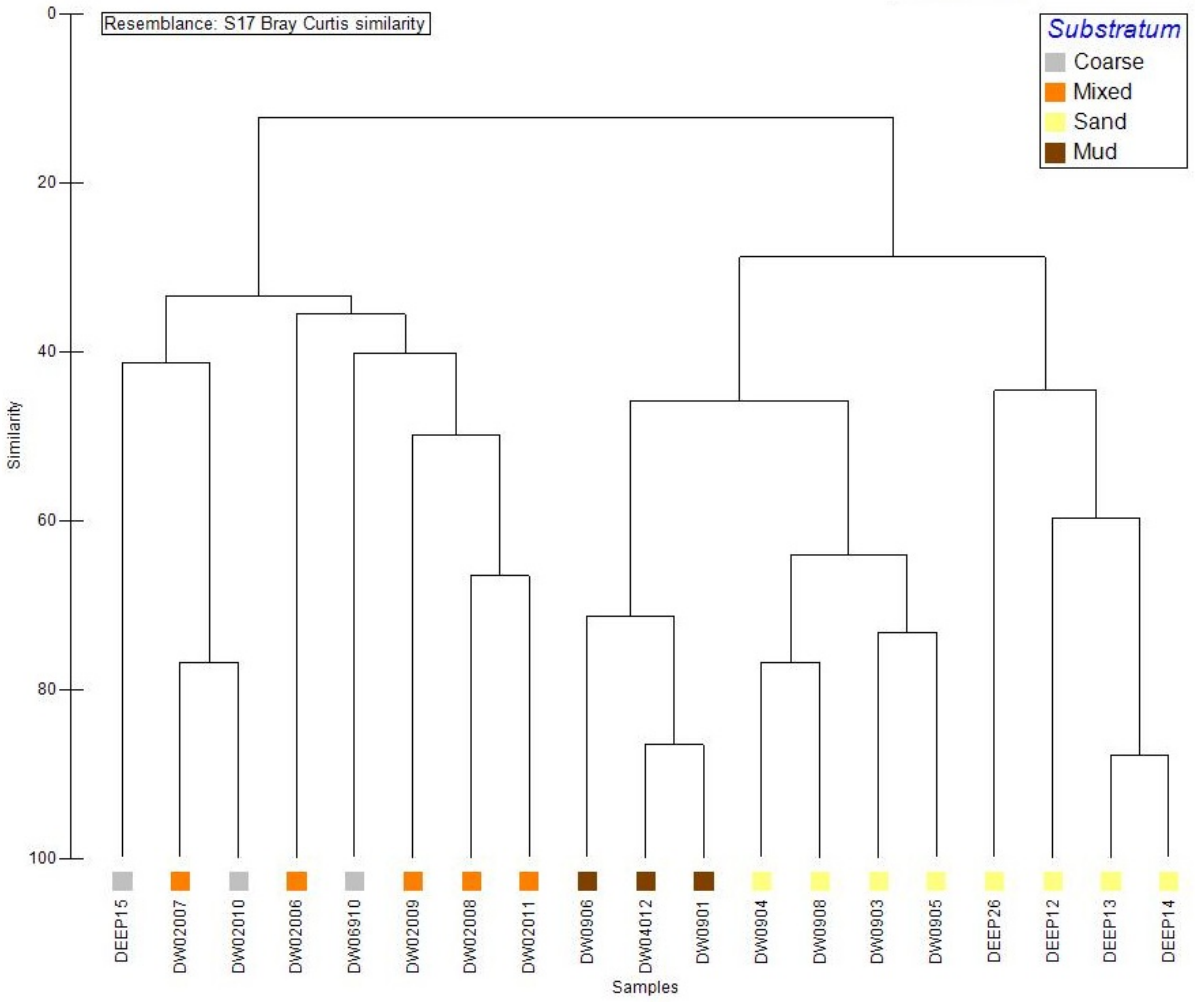

Figure 3.23 Dendrogram plot showing visually estimated substratum at each station.

SIMPER analysis was undertaken to assess which species were characteristic for each of the groups identified from the cluster analysis. Table 3.4 outlines the characteristic taxa for each group, listing those taxa that contributed at least 90% similarity for each group.

Group A was characterised by only two taxa, Paguridae and *Cancer pagurus*. These two taxa alone were not sufficient to indicate a particular biotope, especially since both are relatively mobile species and may not be characteristic of a particular habitat. The sediment at these stations was either coarse or mixed sediment. The stations within Group A were therefore left at their Level 3 habitat classifications.

Four taxa were characteristic of the stations within Group B. Of these, Paguridae, Serpulidae and faunal turf were deemed too widespread among various different biotope types to be

useful for assigning a biotope to these stations. As per Group A, classifications were therefore left at Level 3 habitats.

Group C was characterised by Geryonidae, *Parastichopus tremulus*, *Cerianthus lloydii*, unidentified burrowing Actiniaria and faunal burrows. These fauna and the lebensspuren are suggestive of a fine sediment habitat, which was supported by the visual observation of mud substratum at the stations within Group C. All sites of Group C had large infaunal burrows, probably constructed by *Nephrops norvegicus,* with *Parastichopus* and anemones frequently seen on the surface of the sediment. Evidence of trawl marks was also seen. Although the presence of *Nephrops* burrows suggests that there may be some similarity with circalittoral burrowed mud biotopes (**SS.SMu.CFiMu.SpnMeg** and **SS.SMu.CFiMu.MegMax**), the lack of seapens the presence of *Parastichopus* and Geryonidae, and the depth of the MSS stations indicated that neither of these two biotopes would be appropriate to describe the faunal communities and habitat present. A new biotope "*Nephrops norvegicus* burrows with Geryonidae and anemones" has been used to describe these stations.

Four taxa and two types of lebensspuren characterised Group D: *Halcampoides abyssorum, Parastichopus tremulus,* indeterminate burrowing Actiniaria, Paguridae, burrows and mounds. Although species such as *Parastichopus* and the large anemones seen at these sites are similar to Group C, Group D was defined by the presence of the small burrowing anemone *Halcampoides* sp. in fine sand. A similar biotope has already been proposed by Howell *et al* (2010) 'Halcampoid anemones in rippled sand'. Although there were occasionally observed areas of rippled sand at these sites, it was not a dominating feature. However, the hydrodynamic formation of sand ripples means that they can be fairly ephemeral. Some of the other morphospecies listed by Howell *et al* (2010) for this biotope, such as various morphs of Porifera and Bryozoa, were not evident from the DVD footage, possibly resulting from the limitations of the DVD quality. Despite this, the 'Halcampoid anemones in rippled sand' remained a 'best fit' biotope for these stations.

The stations within Group E were characterised by Paguridae, Asteroidea and the echinoids *Spatangus raschi* and *Echinus acutus*, along with faunal burrows and feeding mounds. However, whilst stations DEEP13 and DEEP14 both had high abundances of *Spatangus raschi*, the heart urchin was lacking from the other two stations in Group E. Without common species the biotope classification for these stations therefore remained at their Level 3 habitat. Despite observing large *Nephrops* burrows infrequently, the rest of the faunal community at station DEEP26 resulted in the station clustering in Group E rather than Group C with the other stations with obvious *Nephrops* burrows. Based on the results of the cluster analysis, station DEEP26 has not been assigned the new *Nephrops* biotope. Further investigation of this site would be required to ascertain a suitable Level 4 biotope for station DEEP26.

Species such as *Spatangus raschi* and *Parastichopus tremulus* were observed at a number of stations, all on sandy substratum but with differing faunal assemblages (DEEP13, DEEP14, DW0904 & DW0908). These sites broadly match an assemblage described by Gage (1986) based on trawl samples, characterised by sparse megafauna, but relatively abundant *Cidaris cidaris, Spatangus raschi* and *Parastichopus tremulus.* Howell *et al* (2010) defined a biotope broadly comparable to Gage's (1986) assemblage, '*Cidaris cidaris – Stichopus tremulus* community' (NB. Please note taxonomic reclassification of *Stichopus tremulus* to *Parastichopus tremulus* after publication of Howell *et al* 2010).

The lack of *Cidaris cidaris* meant that this biotope was not a good fit for these four sites. The presence of Halcampoid anemones at DW0904 and DW0908 appeared to be a more defining characteristic species for the habitat than *Spatangus* and *Parastichopus*. The difficulty of observing the Halcampoid anemones when the camera was flown over the seabed could have resulted in an over estimation of their abundance at DW0904 and

DW0908, with the transects actually being more patchy. However, Axelsson (2003) suggested that *Spatangus* and *Parastichopus* appeared to be defined more by depth range than by the geophysical parameters present at a given location, with the species found on a range of substrata but within a set depth distribution. Caution should therefore be used if trying to define biotopes using these more depth endemic species.

Table 3.4 Results of SIMPER analysis of the groups identified from cluster analysis of MSS survey stations.

Group / Cluster	% Contribution of characterising species	
	Taxa / species	Contribution (%)
A	Paguridae	80.74
	Cancer pagurus	19.26
B	Paguridae	44.62
	Serpulidae	28.03
	Faunal turf	9.68
	Porania sp.	7.98
C	Geryonidae	21.16
	Parastichopus tremulus	21.16
	Vertical burrow	18.26
	Actiniaria (burrowing sp.)	18.26
	Cerianthus lloydii	12.03
D	*Halcampoides abyssorum*	34.81
	Parastichopus tremulus	22.24
	Actiniaria (burrowing sp.)	12.94
	Vertical burrow	8.70
	Feeding mound	8.70
	Paguridae	5.10
E	Vertical burrow	36.75
	Feeding mound	14.79
	Paguridae	14.36
	Spatangus raschi	9.36
	Echinus acutus	9.11
	Asteroidea	7.81

Table 3.5 summarises the final biotopes identified following the proposed classification scheme of Howell *et al* (2010), and Figure 3.24 displays the geographical locations of the different habitats and biotopes.

The northern cluster of stations appeared to be grouped according to biotope, suggesting possible similarities in the biogeography of the stations underlying the presence of characteristic fauna. The southern station cluster also showed some patterns in the spread of biotopes, with sand dominated stations occurring on the deeper parts of the slope further to the west, with the coarse and mixed sediment stations to the east towards the top of the slope.

Table 3.5 Summary of habitats and biotopes identified from video footage analysis.

Station	Biotope Name	Characterising taxa	Substratum	Supporting Reference
DEEP12	Atlantic Upper Slope Sand	Paguridae	Sand	Howell *et al* (2010)
DEEP13	Atlantic Upper Slope Sand	*Spatangus raschi*, *Echinus acutus*, Paguridae	Sand	Howell *et al* (2010)
DEEP14	Atlantic Upper Slope Sand	*Spatangus raschi*, *Echinus acutus*, Paguridae	Sand	Howell *et al* (2010)
DEEP15	Atlantic Upper Slope Coarse	Paguridae, Pectinidae	Coarse	Howell *et al* (2010)
DEEP26	Atlantic Upper Slope Sand	Paguridae, *Nephrops* burrows, echinoids	Sand	Howell *et al* (2010)
DW02006	Atlantic Upper Slope Mixed	None	Mixed	Howell *et al* (2010)
DW02007	Atlantic Upper Slope Mixed	None	Mixed	Howell *et al* (2010)
DW02008	Atlantic Upper Slope Mixed	None	Mixed	Howell *et al* (2010)
DW02009	Atlantic Upper Slope Mixed	None	Mixed	Howell *et al* (2010)
DW02010	Atlantic Upper Slope Coarse	None	Coarse	Howell *et al* (2010)
DW02011	Atlantic Upper Slope Mixed	None	Mixed	Howell *et al* (2010)
DW04012	*Nephrops norvegicus* burrows with Geryonidae, and anemones	*Nephrops* burrows, Geryonidae sp., *Parastichopus*, anemones	Mud	Newly proposed
DW06910	Atlantic Upper Slope Coarse	Paguridae, Galatheidae	Coarse	Howell *et al* (2010)
DW0901	*Nephrops norvegicus* burrows with Geryonidae, and anemones	*Nephrops* burrows, Geryonidae sp., *Parastichopus*, anemones	Mud	Newly proposed
DW0903	Halcampoid anemones in rippled sand	*Halcampoides, Parastichopus,* anemones	Sand	Howell *et al* (2010)
DW0904	Halcampoid anemones in rippled sand	*Halcampoides, Parastichopus,* anemones	Sand	Howell *et al* (2010)
DW0905	Halcampoid anemones in rippled sand	*Halcampoides, Parastichopus,* anemones	Sand	Howell *et al* (2010)
DW0906	*Nephrops norvegicus* burrows with Geryonidae, and anemones	*Nephrops* burrows, Geryonidae sp., *Parastichopus*, anemones	Mud	Newly proposed
DW0908	Halcampoid anemones in rippled sand	*Halcampoides, Parastichopus,* anemones	Sand	Howell *et al* (2010)

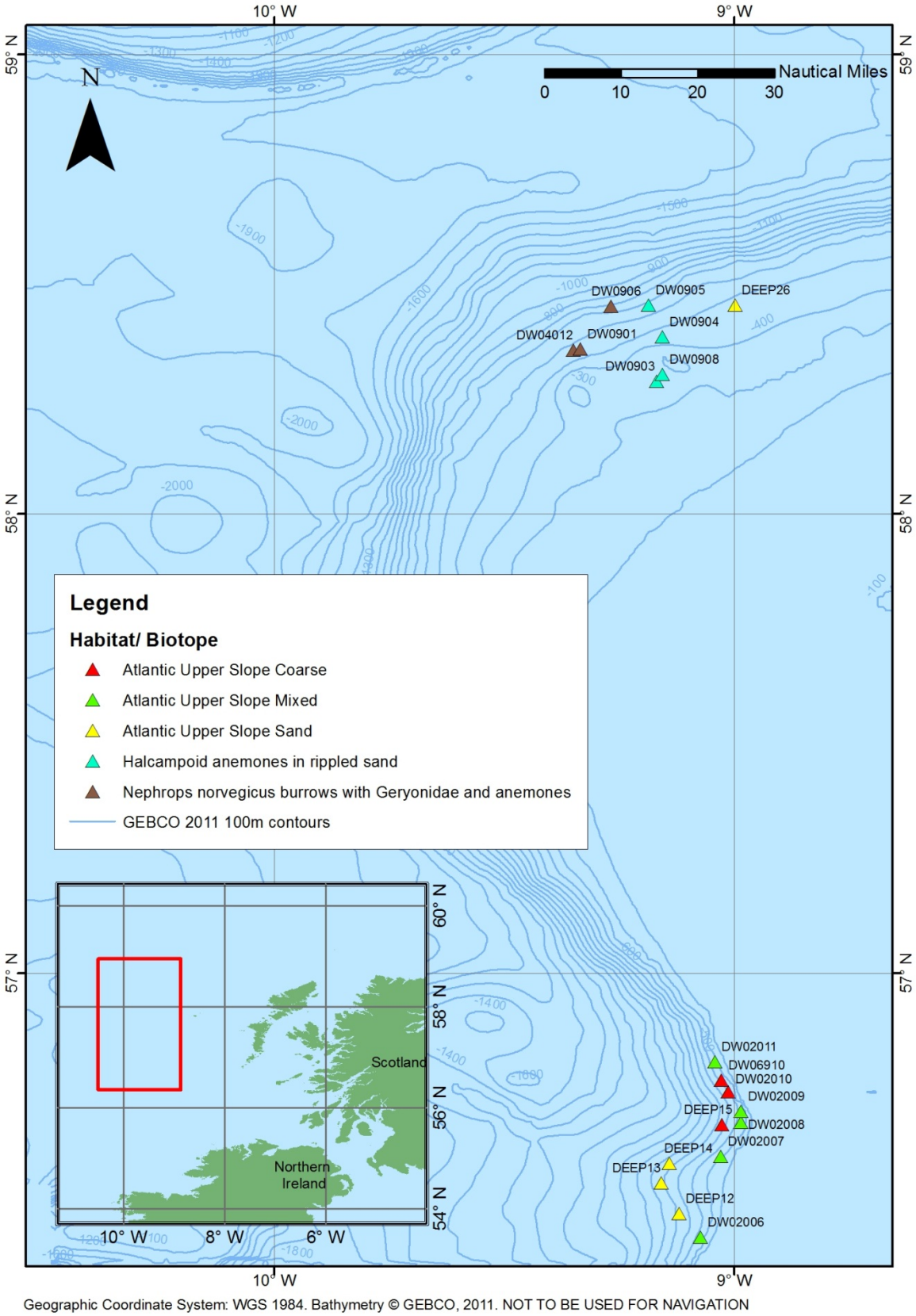

Figure 3.24 Geographical distribution of deep water habitats and biotopes. See text for descriptions of habitats/biotopes.

3.4 Annex I habitats and MPA search features

MPA search features are a subset of the list of Priority Marine Features (PMFs), which consist of species and habitats of conservation importance (Scottish Government 2011; JNCC 2012b). See Appendix 1 for a full list of Scottish PMF habitats and species.

The underwater camera footage revealed that fourteen of the stations were identified as having MPA search features present and a single station as having potential Annex I habitat present. Table 3.6 summarises the presence of MPA search features and Annex I habitats identified at each station. Three MPA search features were identified:

- Offshore subtidal sands and gravels
- Offshore deep sea muds
- Burrowed mud

The MPA search feature 'Offshore subtidal sands and gravels' includes habitats of the EUNIS/ modified Folk (Long 2006) classes of sand, coarse and mixed sediments lying within offshore waters. 'Offshore deep sea muds' are represented by muds and sandy muds. In addition to the continental shelf biotopes of these sediment types, these search features include Atlantic and Arctic influenced habitats (of their sediment type) occurring on and beyond the continental slope (JNCC 2012b).

Table 3.6 Summary of MPA search features and Annex I habitats observed from MSS deep water video footage analysis.

Station	MPA Search Feature	Annex I Habitat
DEEP12	Offshore subtidal sands and gravels	
DEEP13	Offshore subtidal sands and gravels	
DEEP14	Offshore subtidal sands and gravels	
DEEP15	Offshore subtidal sands and gravels	
DEEP26	Offshore deep sea muds	
DW02006		
DW02007		
DW02008		
DW02009		
DW02010	Offshore subtidal sands and gravels	
DW02011		Stony Reef; low reefiness
DW04012	Burrowed mud	
DW06910	Offshore subtidal sands and gravels	
DW0901	Burrowed mud	
DW0903	Offshore deep sea muds	
DW0904	Offshore deep sea muds	
DW0905	Offshore deep sea muds	
DW0906	Burrowed mud	
DW0908	Offshore deep sea muds	

Six stations were characterised by either sand or coarse sand and gravel, and fell within the 'Offshore subtidal sands and gravels' search feature. The mixed sediment stations (DW02006, DW02007, DW02008, DW02009 & DW02011) also had a degree of gravel and sand substratum, but due to the presence of more cobbles, pebbles and generally harder substrata meant that these stations did not fit within the 'Offshore subtidal sands and gravels' search feature.

Five stations were classified as 'Offshore deep sea muds' (DEEP26, DW0903, DW0904, DW0905, & DW0908). Although these five stations were characterised by a sand substratum, uncertainty over the amount of fine material placed these stations near the boundary between muddy sand or sandy mud (Long 2006) which has a bearing on which search feature they represent. After further examination of the fauna and the lebensspuren present, these stations were found to be more similar to the habitats and species described under the 'Offshore deep sea muds' MPA search feature rather than the 'Offshore subtidal sands and gravels' feature.

Three stations (DW04012, DW0901 and DW0906) characterised by deep sea mud also had a large number of faunal burrows created by large macrofauna, probably the crustacean *Nephrops norvegicus*. Although no *Nephrops* were seen and the large decapods of the family Geryonidae were frequently observed close to the burrows, the shape and structure of the burrows observed from these three stations were comparable to *Nephrops* burrows, with characteristic crescentiform entrances, sedimentary ejecta, and broad 'drive-ways'. The presence of the large burrowed areas suggests that these stations also fall within the 'Burrowed mud' MPA search feature. Although burrowed areas were present at DEEP26, they were infrequently spaced, and deemed not to be indicative of the burrowed mud search feature.

The mixed sediment stations (DW02006, DW02007, DW02008, DW02009 & DW02011) were all characterised by a substratum of coarse sand embedded with gravel and pebbles, and the presence of boulders and cobbles on the sediment surface. The frequency of the cobbles and boulders was relatively intermittent throughout these lines, except at Station DW02011. At DW02011 the amount of cobbles and boulders within close proximity to each other suggested that the station could be a potential Annex I habitat 'Stony reef'. Applying stony reef assessment criteria (Irving 2009), the habitat at DW02011 had a 'low reefiness', with a lack of visible epifauna, and some large spacing between the hard substratum areas. DW02011 was characterised by a high abundance of the fish *Helicolenus dactylopterus*.

Figure 3.25 shows the locations of the potential Annex I habitats and MPA search features identified from the data analysed. The northern stations were all characterised by the 'Offshore deep sea muds' and 'Burrowed mud habitats' occurring in the western most, mid slope, stations. The southern group of stations were dominated by 'Offshore subtidal sands and gravels'. The Annex I habitat occurred at the northern most station in the southern group.

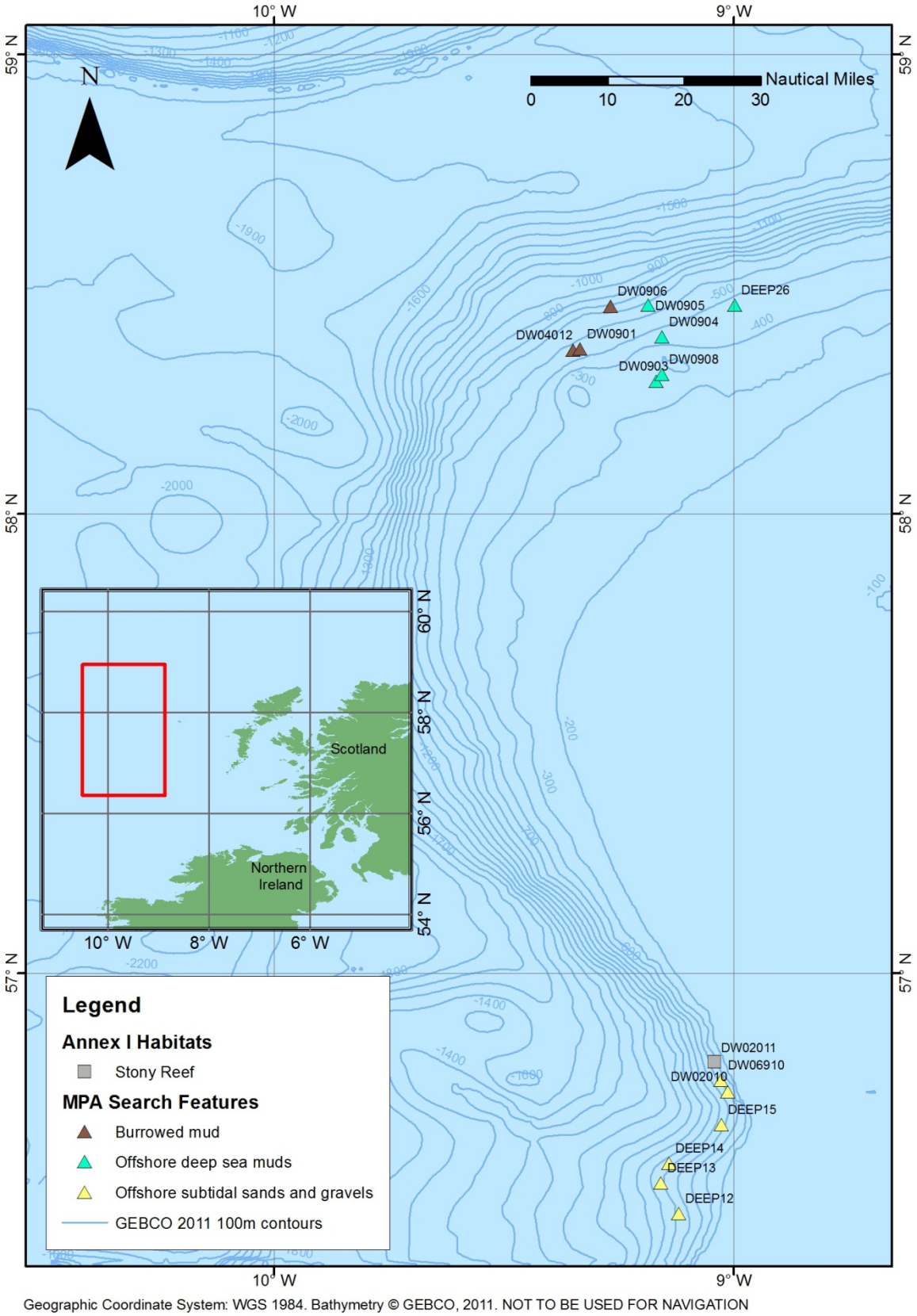

Figure 3.25 Locations of Annex I habitats and MPA search features identified from analysis of MSS underwater camera footage analysis.

4 Discussion

4.1 Data limitations

The analysis of the video footage had several limitations. Surveys were conducted over a number of years, with either oblique or downward facing cameras that resulted in disparity between the field of view and orientation of the camera between stations. Camera tows were a variety of time lengths, and transects were not all consistent lengths. Every effort was made to account for these differences when estimating faunal abundances from each video clip. In order to compare between survey stations, data standardisation would be required to ensure fauna were enumerated over equivalent areas of seabed. The use of the SACFOR abundance scale helped compensate with these disparities.

No still photographs were captured alongside the video footage during these surveys. The lack of still images combined with the low resolution of the video footage meant that faunal identifications could typically only be made at higher taxonomic levels. High resolution digital still images would have allowed for more precise faunal identifications. Sediment particle size and infaunal data were also not collected on these surveys and therefore substratum composition was visually estimated by the reviewer. Differences in fine sediments are hard to distinguish visually, which was partly mitigated by adoption of the modified Folk triangle when assessing seabed substratum. However, assessments of percentage sand and mud present at each station should be treated with caution, as without particle size data these remain rough estimates. The EUNIS habitat ‘A6.4 : Deep-sea muddy sand’ was not used during the analysis, since it was not possible to distinguish between sandy mud and muddy sand habitats by visual assessment alone, and the modified Folk triangle groups muddy sand and sand together at a particular mud/sand ratio (Long 2006). Therefore some stations classified as A6.3 may fall within the A6.4 biotope if sediment particle size data is acquired for these stations at a future date.

Positional data was available in different formats of varying precision and completeness, which hindered consistent and accurate plotting of video tow tracks. Positional data was supplied as either decimal degrees, or degrees and decimal minutes, to three decimal places. This provided a positional accuracy of around 100 m. Several stations only had the start and end of line positions. Due to the degree of positional precision and the lack of navigation data for some stations, all video tows were assumed to have been run in a straight line, and the spatial accuracy qualified in the records. Positions of features could then be estimated by relating the time on the video overlay to the distance travelled, assuming a constant vessel speed.

5 Conclusion

A total of four hours and six minutes of underwater video camera footage from 19 stations on the Hebridean Slope were analysed. The quality of the video camera footage was adequate, although low resolution, poor lighting and height of the camera system above the seabed made certain and accurate identification of fauna to lower taxonomic levels difficult. According to the EUNIS classification, four habitats were identified. Under the proposed new deep-sea biotope classification (Howell *et al* 2010), five biotopes were observed, including a newly proposed biotope ‘*Nephrops norvegicus* burrows with Geryonidae and anemones’. One station (DW02011) was a potential Annex I stony reef habitat. Three MPA search features were observed – ‘Offshore subtidal sands and gravels’, ‘Offshore deep sea muds’ and ‘Burrowed mud’.

The analysis highlighted the difficulty of assigning a substratum class to soft sediment habitats by visual inspection. Although the distinction between mud and sand can be visually recognised, the categories of muddy sand and sandy mud are harder to accurately assign without particle size analysis data. This in turn lead to difficulties in assigning certain biotopes (e.g. EUNIS biotope 'A6.4: Deep-sea muddy sand'). A similar problem was encountered with accurately placing stations within either the MPA search feature 'Offshore subtidal sands and gravels' or 'Offshore deep sea muds'. The biotope classification scheme of Howell *et al* (2010) avoids the use of sandy mud and muddy sand, so offers some advantages over the EUNIS classification. In addition, Howell *et al* (2010) have biotope divisions between sand, coarse and mixed sediments, which are much more suited to analysis of images and underwater video footage without complimentary sediment particle size data.

The quality of the underwater video footage, lack of any sediment particle size and infaunal data limited the ability to assign more definitive biotopes to each station. Most sites had little in the way of visible epifauna, and undoubtedly had far richer infaunal communities. Surface fauna such as *Spatangus* are mobile, and may move between different habitats and may not be good diagnostic fauna to define habitats. Some small fauna appeared to be characteristic for certain habitats (i.e. *Halcampoides* sp.), but were not visible unless the camera system was landed, potentially resulting in under or overestimating their abundance. The level of positional precision for the stations was low, possibly hampering any repeat survey work targeting specific features. This is not surprising considering that the MSS surveys were not designed with habitat assessment in mind. However, the data still provided sufficient detail to inform broadscale habitats at each survey station, with a relatively good assessment of broad substratum possible.

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Appendix 1 MPA search features

Table A1.1 Seabed habitats being used to underpin the selection of Nature Conservation MPAs
(T&D) denotes an OSPAR Threatened and/or Declining habitat or species. Taken from the *Guidelines on the selection of MPAs and development of the MPA network* - http://www.scotland.gov.uk/Topics/marine/marine-environment/mpanetwork/mpaguidelines

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
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
	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

MPA search feature	Component habitats / species	Scottish marine area
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)	Both
	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
	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
	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

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

Table A1.2 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 fragilis*	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 A1.3 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

Appendix 2 Video footage reference collection

Positions are WGS84 Latitude and Longitude - Decimal Degrees (DD.DDD)

Station	Date	SOL Time	EOL Time	SOL Latitude	SOL Longitude	EOL Latitude	EOL Longitude	Duration	Biotope
DEEP12	10/09/2000	22:44:56	22:45:11	56.478	-9.119	56.478	-9.119	00:00:15	Atlantic Upper Slope Sand
DEEP13	11/09/2000	00:30:46	00:31:01	56.544	-9.157	56.544	-9.157	00:00:15	Atlantic Upper Slope Sand
DEEP14	11/09/2000	01:55:21	01:55:36	56.587	-9.141	56.587	-9.141	00:00:15	Atlantic Upper Slope Sand
DEEP15	11/09/2000	03:46:04	03:46:19	56.671	-9.024	56.671	-9.024	00:00:15	Atlantic Upper Slope Coarse Sediment
DEEP26	13/09/2000	21:54:21	21:54:31	58.456	-8.998	58.456	-8.998	00:00:10	Atlantic Upper Slope Sand
DW02006	11/09/2002	21:42:31	21:42:46	56.426	-9.073	56.426	-9.073	00:00:15	Atlantic Upper Slope Mixed Sediment
DW02007	11/09/2002	23:38:30	23:38:45	56.601	-9.029	56.601	-9.029	00:00:15	Atlantic Upper Slope Mixed Sediment
DW02008	12/09/2002	22:06:53	22:07:08	56.676	-8.985	56.676	-8.985	00:00:15	Atlantic Upper Slope Mixed Sediment
DW02009	12/09/2002	23:04:18	23:04:33	56.700	-8.985	56.700	-8.985	00:00:15	Atlantic Upper Slope Mixed Sediment
DW02010	13/09/2002	00:06:34	00:06:49	56.742	-9.013	56.742	-9.013	00:00:15	Atlantic Upper Slope Coarse Sediment
DW02011	13/09/2002	01:11:35	01:11:50	56.807	-9.041	56.807	-9.041	00:00:15	Atlantic Upper Slope Mixed Sediment
DW04012	04/09/2004	01:55:46	01:56:01	58.358	-9.349	58.3584	-9.349	00:00:15	Burrowed mud with *Nephrops norvegicus*, Geryonidae, *Parastichopus* and anemones
DW06910	23/09/2006	20:15:17	20:15:32	56.768	-9.028	56.768	-9.028	00:00:15	Atlantic Upper Slope Coarse Sediment
DW0901	13/09/2009	21:58:44	21:58:59	58.360	-9.334	58.360	-9.334	00:00:15	Burrowed mud with *Nephrops norvegicus*, Geryonidae, *Parastichopus* and anemones
DW0903	14/09/2009	00:25:34	00:25:49	58.289	-9.163	58.289	-9.163	00:00:15	Halcampoid anemones in rippled sand
DW0904	14/09/2009	01:43:47	01:44:02	58.388	-9.156	58.388	-9.156	00:00:15	Halcampoid anemones in rippled sand
DW0905	14/09/2009	03:02:21	03:02:36	58.456	-9.190	58.456	-9.190	00:00:15	Halcampoid anemones in rippled sand
DW0906	14/09/2009	20:05:13	20:05:28	58.452	-9.268	58.452	-9.268	00:00:15	Burrowed mud with *Nephrops norvegicus*, Geryonidae, *Parastichopus* and anemones
DW0908	14/09/2009	22:36:29	22:36:44	58.305	-9.156	58.305	-9.156	00:00:15	Halcampoid anemones in rippled sand

Appendix 3 Taxa/Species identification

Taxa	DEEP12	DEEP13	DEEP14	DEEP15	DEEP26	DW02006	DW02007	DW02008	DW02009	DW02010	DW02011
Vertical burrow	3	2	3	0	3	0	0	0	0	0	0
Feeding mound	1	1	1	0	2	0	0	0	0	0	0
Faunal turf	0	0	0	0	0	0	0	1	1	0	1
PORIFERA white papillate	0	0	0	1	0	0	0	0	0	0	0
PORIFERA yellow encrust	0	0	0	0	0	0	0	0	1	0	0
PORIFERA yellow globular	0	0	0	0	0	0	0	0	0	0	0
HYDROZOA	0	0	0	0	0	1	0	0	0	0	0
Sertularia	0	0	0	0	0	1	0	0	0	0	0
ANTHOZOA	0	0	0	0	0	0	0	0	2	0	0
Pennatula phosphorea	0	0	0	0	1	0	0	0	0	0	0
Cerianthus lloydii	0	0	0	0	0	0	0	0	0	0	0
Actiniaria burrowing sp.	0	0	0	0	0	0	0	0	0	0	0
Halcampoides abyssorum	0	0	0	0	0	0	0	0	0	0	0
Serpulidae	0	0	0	0	0	1	0	1	1	0	1
Decapoda	0	0	0	0	2	2	2	0	0	0	0
Caridea	1	0	0	0	0	0	0	0	0	0	0
Paguridae	2	0	2	3	2	1	3	2	2	3	2
Galatheidae	0	0	0	0	0	0	0	0	0	0	0
Munida	0	0	0	0	0	0	0	2	0	0	0
Cancer pagurus	0	0	0	0	0	0	2	0	2	2	0
Geryonidae	0	0	0	0	0	0	0	0	0	0	0
Pectinidae	0	0	0	3	0	0	0	0	0	0	0
CRINOIDEA	0	0	0	0	0	0	0	0	0	0	1
ASTEROIDEA	1	1	1	1	0	0	0	0	0	0	0
Luidia	0	0	0	0	0	0	0	0	0	0	0
Porania	0	0	0	0	0	1	0	0	0	1	1

Taxa	DEEP12	DEEP13	DEEP14	DEEP15	DEEP26	DW02006	DW02007	DW02008	DW02009	DW02010	DW02011
OPHIUROIDEA	1	1	1	0	0	1	0	0	1	0	0
Cidaris cidaris	0	0	0	0	1	0	0	0	0	0	0
Echinus acutus	0	2	2	0	1	0	0	0	0	0	0
Spatangus raschi	0	4	4	0	0	0	0	0	0	0	0
HOLOTHURIOIDEA	0	0	0	0	2	0	0	0	0	0	0
HOLOTHURIOIDEA burrowing sp	0	0	0	0	0	0	0	0	0	0	0
HOLOTHURIOIDEA yellow burrowing sp	0	0	0	0	0	0	0	0	0	0	0
Parastichopus tremulus	0	0	0	0	0	0	0	0	0	0	0
CARCHARHINIFORMES	0	0	0	0	0	0	0	0	2	0	0
Raja	0	0	0	0	0	0	0	0	0	2	0
Chimaera monstrosa	0	0	0	0	2	0	0	0	0	0	0
TELEOSTEI	2	2	0	2	0	0	0	2	2	2	0
TELEOSTEI eel-like	2	2	2	0	0	0	0	0	0	2	0
Lophius piscatorius	0	0	0	0	0	0	0	0	0	0	0
Macrouridae	0	0	0	0	0	0	0	0	0	0	0
SCORPAENIFORMES	0	0	0	0	0	0	2	2	2	2	0
Helicolenus dactylopterus	0	0	0	0	2	0	0	0	0	2	4
PLEURONECTIFORMES	0	0	0	0	0	0	0	0	0	2	0

Taxa	DW04012	DW06910	DW0901	DW0903	DW0904	DW0905	DW0906	DW0908
Vertical burrow	2	0	2	1	1	1	2	1
Feeding mound	1	0	1	1	1	1	1	1
Faunal turf	0	0	0	0	0	0	0	0
PORIFERA white papillate	0	0	0	0	0	0	0	0
PORIFERA yellow encrust	0	0	0	0	0	0	0	0
PORIFERA yellow globular	0	0	0	0	0	0	0	1
HYDROZOA	0	0	0	0	0	0	0	0
Sertularia	0	0	0	0	0	0	0	0
ANTHOZOA	0	0	0	0	0	0	0	0
Pennatula phosphorea	0	0	0	0	0	0	0	0
Cerianthus lloydii	2	0	3	2	0	0	1	0
Actiniaria burrowing sp.	2	0	2	2	1	2	3	3
Halcampoides abyssorum	0	0	0	4	4	4	0	4
Serpulidae	0	1	0	0	0	0	0	0
Decapoda	0	1	0	1	0	0	1	0
Caridea	0	0	0	0	0	0	0	0
Paguridae	0	2	0	2	1	0	1	2
Galatheidae	0	3	0	0	0	0	0	0
Munida	0	2	0	0	0	0	0	0
Cancer pagurus	0	0	0	0	0	0	0	0
Geryonidae	4	0	3	0	0	0	2	0
Pectinidae	0	1	0	0	0	0	0	0
CRINOIDEA	0	0	0	0	0	0	0	0
ASTEROIDEA	0	1	0	1	0	0	0	1
Luidia	0	0	0	0	0	0	0	3

Taxa	DW04012	DW06910	DW0901	DW0903	DW0904	DW0905	DW0906	DW0908
Porania	0	1	0	0	0	1	0	0
OPHIUROIDEA	0	0	0	0	0	0	0	0
Cidaris cidaris	0	0	0	0	0	0	0	0
Echinus acutus	0	0	0	0	1	0	0	1
Spatangus raschi	0	0	0	0	4	0	0	4
HOLOTHURIOIDEA	0	0	0	0	0	0	0	0
HOLOTHURIOIDEA burrowing sp	0	1	0	0	0	0	0	0
HOLOTHURIOIDEA yellow burrowing sp	1	0	0	0	0	0	0	0
Parastichopus tremulus	3	0	4	4	3	3	2	2
CARCHARHINIFORMES	0	0	0	0	0	0	0	0
Raja	0	0	0	0	0	0	0	0
Chimaera monstrosa	0	2	0	0	0	0	0	0
TELEOSTEI	2	2	2	2	2	0	0	2
TELEOSTEI eel-like	2	0	0	0	0	0	0	0
Lophius piscatorius	2	0	0	0	0	0	0	0
Macrouridae	2	0	2	0	0	0	0	2
SCORPAENIFORMES	0	0	0	0	0	0	0	0
Helicolenus dactylopterus	3	0	0	3	0	2	0	0
PLEURONECTIFORMES	0	0	2	0	0	0	2	0