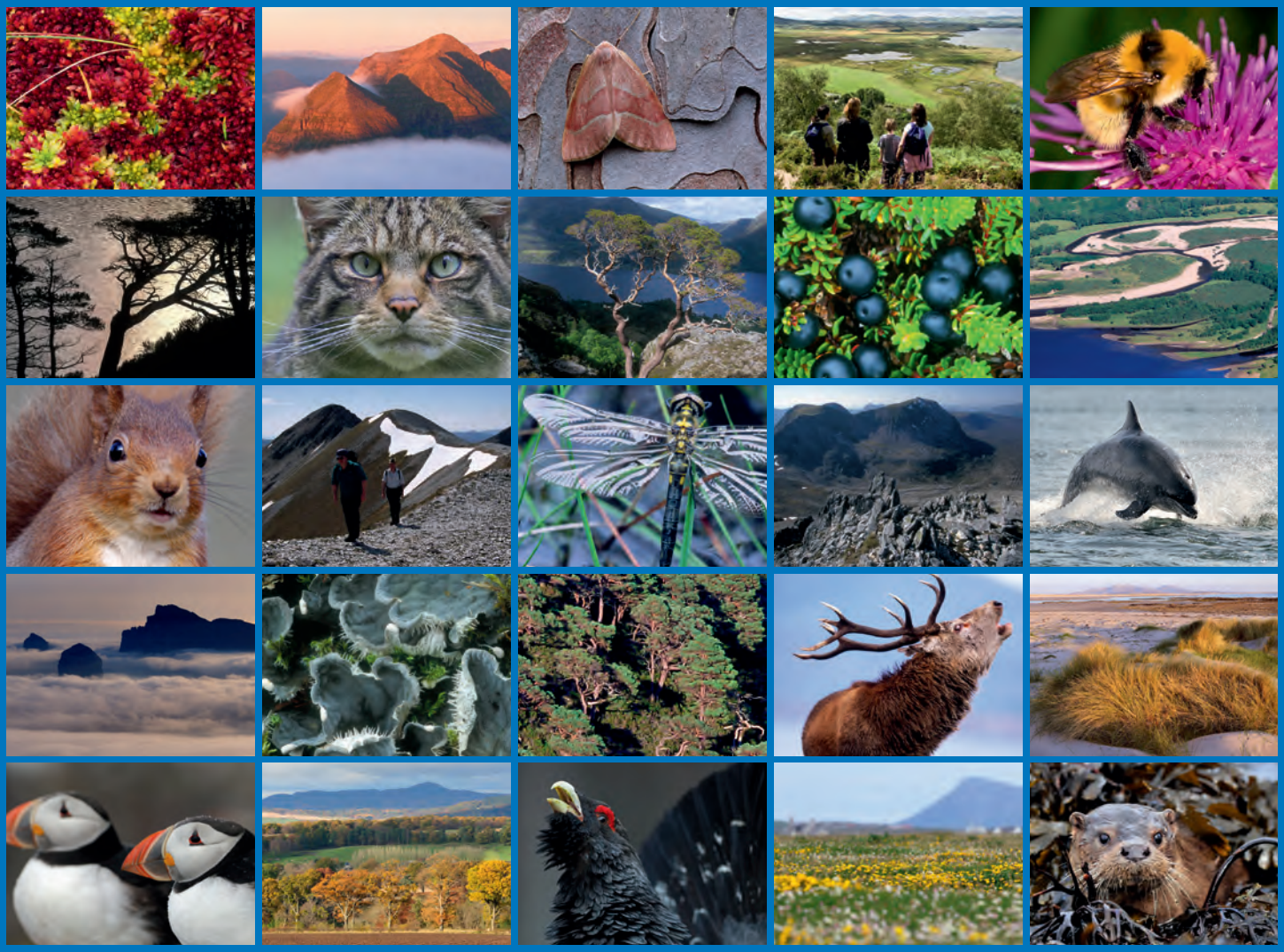
Scottish Natural Heritage
Commissioned Report No. 599

Distribution and status of proposed protected features in the Fetlar to Haroldswick MPA proposal



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COMMISSIONED REPORT

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Distribution and status of proposed protected features in the Fetlar to Haroldswick MPA proposal

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COMMISSIONED REPORT

Summary

Distribution and status of proposed protected features in the Fetlar to Haroldswick MPA proposal

Commissioned Report No. 599
Contractor: Heriot-Watt University
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Background

The Marine (Scotland) Act 2010 and the UK Marine and Coastal Access Act 2009 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. Work to identify these MPAs is coordinated through the Scottish MPA Project, a joint project between Marine Scotland (MS), Scottish Natural Heritage (SNH), the Joint Nature Conservation Committee (JNCC) and Historic Scotland. SNH and JNCC submitted formal advice to Scottish Ministers on the identification of Nature Conservation MPAs in Scotland's seas in December 2012. In total, 33 Nature Conservation MPA proposals have been developed and a further four MPA search locations remain to be fully evaluated.

Data confidence assessments have been completed for each MPA proposal / search location. In some cases these highlighted the need for further work to revalidate older records of proposed protected features, or to improve our understanding of the distribution and extent of these features.

Against this background, SNH undertook benthic survey work within the Fetlar to Haroldswick MPA proposal in September 2012, to determine the wider distribution and validate the continued presence, extent, and status of specified proposed protected features within the MPA proposal.

Main findings

- The proposed protected feature 'maerl beds' was observed at 10 stations (**SS.SMp.Mrl.Pcal** and **SS.SMp.Mrl.Pcal.R**).
- The proposed protected feature 'kelp and seaweed communities on sublittoral sediment' (**SS.SMP.KSwSS**) was recorded at 11 stations.
- The proposed protected feature 'shallow tide-swept coarse sands with burrowing bivalves' (**SS.SCS.ICS.MoeVen**) was observed at 1 station.
- The biotope complexes 'circalittoral coarse sediment' (**SS.SCS.CCS**) and 'infralittoral coarse sediment' (**SS.SCS.ICS**) which are part of the proposed protected feature 'circalittoral sand and coarse sediment communities' were observed at 33 stations (**SS.SCS.CCS**) and at 1 station (**SS.SCS.ICS**) (S75).
- Ten of the **SS.SCS.CCS** stations were identified as the biotope '*Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel' (**SS.SCS.CCS.MedLumVen**) by grab sampling, and appear to be representative of extensive areas around Fetlar.

- Non MPA search feature biotopes / biotope complexes observed included: **CR.MCR.EcCr, CR.MCR.EcCr.FaAlCr, CR.MCR.EcCr.FaAlCr.Bri, SS.SMu.CSaMu, SS.SMu.CSaMu.VirOphPmax, SS.SMu.ISaMu, SS.SMx.CMx, SS.SMx.CMx.OphMx**, **SS.SMx.CMx.FluHyd, SS.SSa.IMuSa.AreISa**, **SS.SSa.IMuSa.EcorEns, SS.SCS.CCS.Pkef, SS.SSa**, and **SS.SSa.CMuSa**.
- Central Bluemull Sound and the entrance to Basta Voe contained horse mussel beds. One of these had previously been recorded in 1987. This was the only historic record we were able to relocate in this survey. Also present in this area were extensive maerl beds interspersed with horse mussel beds and 'kelp and seaweed communities on sublittoral sediment'.
- An area of **SS.SMu.CSaMu.VirOphPmax** in Basta Voe was considered an excellent example of the sea pen habitat, and was adjacent to sparse horse mussels, possibly the remnants of a bed recorded by Howson (1999). This habitat is beside an aquaculture facility.
- Overall, the survey found good quality examples of maerl and horse mussel beds. Regarding their biodiversity value, the maerl and horse mussel communities compared favourably with those elsewhere in Scotland and the UK, but they were of moderate extent.

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Moder Dy, skippered by Leslie Tait and Arthur Johnson owned by the North Atlantic Fisheries College, MV *Halton*, skippered and owned by Bob Anderson. Survey and dive team members - Prof. Hamish Mair, Flora Kent, David Stirling and Sally Rouse as well as Dr Piotr Kuklinsky from the Natural History Museum and Dr Richard Shelmerdine from the North Atlantic Fisheries College. We would also like to thank professional underwater photographers Richard Schucksmith and Paul Kay for use of their images from the survey. All other photographs unless otherwise stated courtesy of Natalie Hirst.

1. INTRODUCTION

The coastal waters between Fetlar and Haroldswick in Shetland have been put forward as a Marine Protected Area (MPA) proposal. Shetland comprises over 100 islands including Foula and the Fair Isle, 16 of which are inhabited. The rocky coastline and clear waters offer a variety of littoral and sublittoral habitats, with sheltered voes and the extremely wave exposed west coast sea cliffs. Shetland is important for seabird populations with numerous internationally important sites for breeding seabirds (Barne *et al*., 1997).

1.1 Previous surveys

Previous surveys of Shetland have focussed primarily on southern areas not within the current MPA proposal. With the exception of stations recorded during a 2011 remote video survey conducted by Marine Scotland Science (MSS), and 24 stations around Fetlar analysed by Moore (2012), data points in Marine Recorder and the SNH GeMS database which did lie within the Fetlar to Haroldswick MPA proposal were over six years old and in need of revalidation (Figure 1, Table 1).

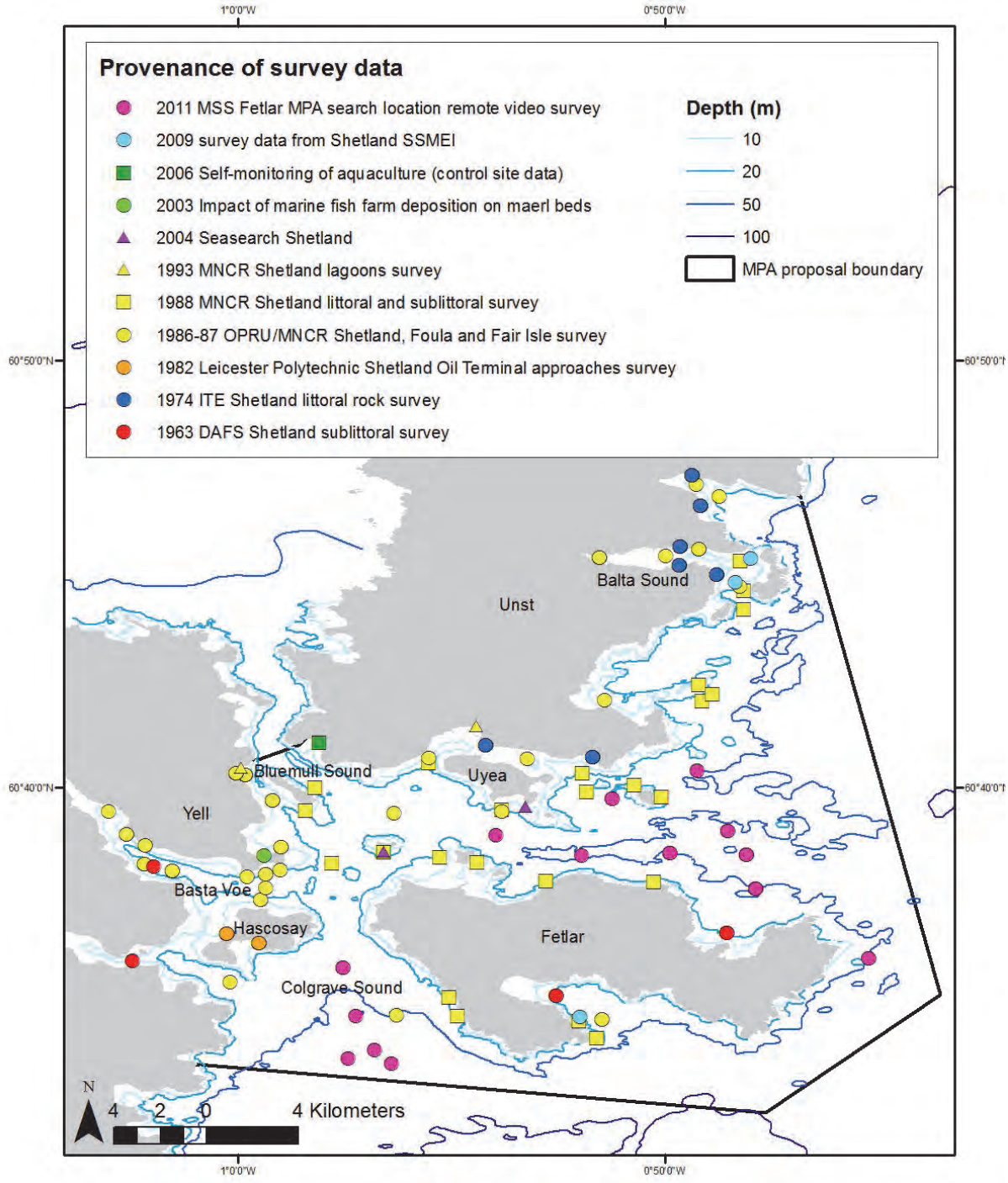

Figure 1. Provenance and geographical coverage of all previous seabed sampling effort within the Fetlar to Haroldswick MPA proposal.

Table 1. Previous surveys in the Fetlar to Haroldswick MPA proposal

Year of survey	Organisation	Details	Source	Proposed protected features recorded
2011	MSS	24 DDV stations around Fetlar	Moore (2012). An assessment of the conservation importance of benthic epifaunal species and habitats identified during a series of research cruises around NW Scotland and Shetland in 2011. Scottish Natural Heritage Commissioned Report No. 507	none
2009	University of the Highlands and Islands (NAFC Marine Centre)	grab survey of Balta Sound and Fetlar	NAFC Marine Centre (2012). A marine spatial plan for the Shetland islands, Part 2: Marine Atlas 3rd Edition.	shallow tide-swept coarse sands with burrowing bivalves
2006	University of the Highlands and Islands (NAFC Marine Centre)	Wick of Belmont (North)	Self-monitoring of aquaculture -control site data (Marine Recorder database)	shallow tide-swept coarse sands with burrowing bivalves
2004	Seasearch	2 sites: 1 on the SS Jane off Fetlar, and one at Hawks Baa, Vyee Isle, Unst	Marine Recorder data base	none
2003	SNH/SEPA	2 sites only	Haskoning UK Ltd. (2006). Investigation into the impact of marine fish farm deposition on maerl beds. Scottish Natural Heritage Commissioned Report No. 213.	maerl beds
1993	JNCC	MNCR Survey of Easter Loch (Unst)	Thorpe (1998). Marine Nature Conservation Review Sectors 1 & 2. Lagoons in Shetland and Orkney: area summaries. Peterborough, Joint Nature Conservation Committee.	none
1988	JNCC	73 habitats surveyed over 49 sites	Hiscock (1988). Marine Nature Conservation Review: Marine biological surveys in Shetland, 28th May – 5th June 1988. Field Report. Unpublished, Nature Conservancy Council, Peterborough.	horse mussel beds, maerl beds**,** kelp and seaweed communities on sublittoral sediment
1986-87	JNCC	618 habitats surveyed over 217 sites	Howson (1988). Marine Nature Conservation Review: survey of Shetland, Foula and Fair Isle, 1987. Nature Conservancy Council, CDS Report No. 816.	horse mussel beds, maerl beds**,** kelp and seaweed communities on sublittoral sediment, and shallow tide-swept coarse sands with burrowing bivalves
1982	Leicester Polytechnic	362 habitats surveyed over 30 sites	Williams, Cohen and Boyce (1983). Ecological studies in the maritime approaches to the Shetland Oile Terminal 1982 part 1. Littoral studies. Unpublished, Leicester Polytechnic, School of Life Sciences.	none
1974	Institute of Terrestrial Ecology	35 habitats surveyed over 36 sites	Institute of Terrestrial Ecology (1975). Report to the Nature Conservancy Council on some aspects of the ecology of Shetland. 6.4: Sublittoral biota. Nature Conservancy Council, CSD Report, No 30.	none
1963	DAFS	33 habitats surveyed over 21 sites	Pearson, Coates and Duncan (1994). Shetland subtidal sediment community analysis. Report on analysis of subtidal sediment data from Shetland to identify community types present. JNCC Report No. 191.	shallow tide-swept coarse sands with burrowing bivalves

1.2 Proposed protected features

The Fetlar to Haroldswick MPA proposal contains six proposed search features: black guillemot, circalittoral sand and coarse sediment communities[1], horse mussel beds, kelp and seaweed communities on sublittoral sediment, maerl beds, and shallow tide swept coarse sands with burrowing bivalves (Figure 2). Horse mussel beds, maerl beds and circalittoral sand and coarse sediment communities have previously been recorded around Shetland. Some records of the latter habitat made from video samples especially around Fetlar may turn out to be shallow tide-swept coarse sands with burrowing bivalves once investigated with grab sampling in the present study (Figure 2).

1.3 Human activities

The Shetland economy previously based around fishing and crofting changed dramatically in the 1970s, with the arrival of the oil industry at Sullom Voe. Aside from oil, Shetland's biggest exports are now from the aquaculture of salmon and mussels throughout the islands.

The Shetland Islands have been identified as having potential for both tidal and wave powered developments (Scottish Government, 2007; Natural Power, 2011). The development of a large scale renewable energy industry in Shetland is currently limited by the absence of an interconnector to the UK national grid. However, it is anticipated that an interconnector will be in place by 2017 hence increasing interest in the development of the renewables industry. For current developments in Shetland developers must gain both a Works Licence issued by the Shetland Islands Council, and a Marine Licence, issued by Marine Scotland. One exploratory Works Licence has been granted by the Shetland Islands Council for a wave energy device, and a Works Licence and Marine Licence have been granted for a small scale, community owned tidal energy device. It is anticipated that the number of licence applications for renewable devices around Shetland will increase in the future (Tweddle *et al.,* 2012).

1.4 Geodiversity interests

The geology of Shetland is varied and includes metamorphosed Precambrian rock more than 554 million years old, which forms the hilly backbone of the islands. On either side of this are exposures of old red sandstone rock of the Devonian age. The coastal region is dominated by rocky shores and large cliff faces (Barne *et al*., 1997). The topography and exposure of the islands creates a gradient of wave exposure with predominantly rocky coastline broken by much more sheltered voes, where environmental conditions and associated habitats can change dramatically (Howson, 1999).

[1] comprising 'Circalittoral coarse sediment' (SS.SCS.CCS) and in particular *'Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel' (SS.SCS.CCS[.MedLumVen]-A5.14[2]), and 'Circalittoral fine sand' (SS.SSa.CFiSa-A5.25)

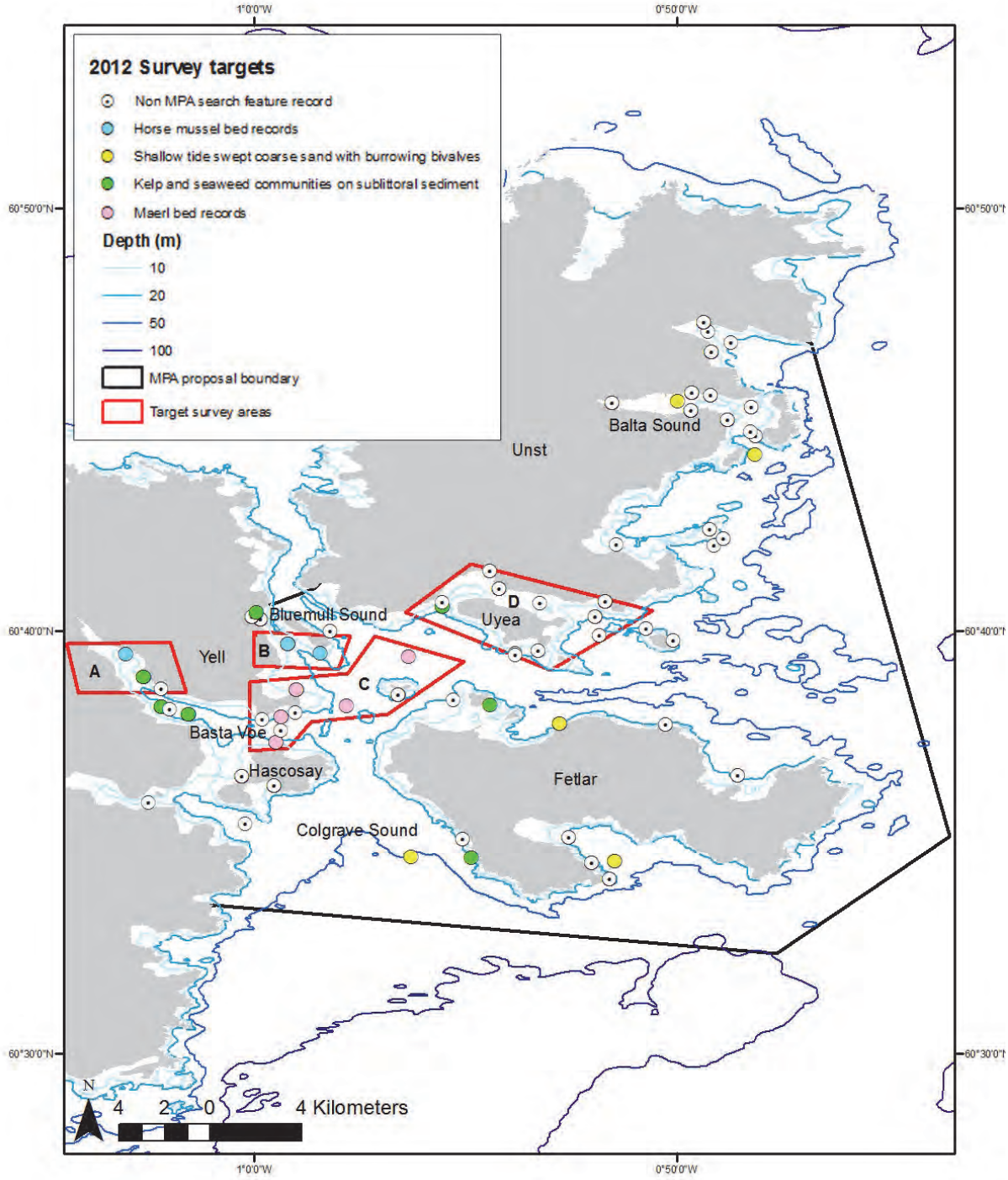

Figure 2. Fetlar to Haroldswick MPA proposal showing the distribution of records of proposed protected features of primary interest to the 2012 survey. Initial SNH suggestions on target survey areas are illustrated as red polygons.

1.5 Survey overview

1.5.1 Objectives

The 2012 survey work within the Fetlar to Haroldswick MPA proposal encompassed two key elements:

A) Enhancing our understanding of the broad distribution of seabed habitats within the MPA proposal to inform future site management.

B) The targeted sampling of proposed protected features previously recorded within the MPA proposal.

The focus of the survey work was to ascertain the continued presence, extent and condition of the proposed protected features maerl beds, horse mussel beds, and shallow tide-swept coarse sands with burrowing bivalves within the Fetlar to Haroldswick MPA proposal. The survey also aimed to improve our existing knowledge-base on the wider distribution of seabed habitats to inform the progression of this proposal and completion of the MPA network in Scottish waters.

The distribution of kelp and seaweed communities on sublittoral sediment was of interest particularly with regard to black guillemot foraging. Investigating its distribution involved visiting suitable areas (based on physical parameters such as water depth, substrates and exposure as derived from Admiralty charts, during the planning process) on an opportunistic basis where practicable on transit to other target features.

1.5.2 Location

Survey stations were chosen to revisit historical records (>6 years old) of proposed protected features, as well as to revisit the MSS 2011 remote video stations to sample these with a Van Veen grab. In total 19 stations from historic records of proposed protected features from Marine Recorder records and the SNH GeMS database were revisited with drop down video (DDV), and 13 records which needed validation with infaunal samples were sampled with the Van Veen grab (9 stations from 2011 MSS video, 2 stations from 1987 MNCR data and 2 stations from 1962 DAFS survey). The exposed location of some stations and bad weather meant that not all planned grab stations could be sampled.

In addition to revisited sites, 51 DDV stations were surveyed to fill in knowledge gaps within the survey area, and 9 grab stations were surveyed to fill in knowledge gaps of soft sediment habitats (Figure 3). A full list of survey stations and coordinates can be found in Appendices 1.1 - 1.3.

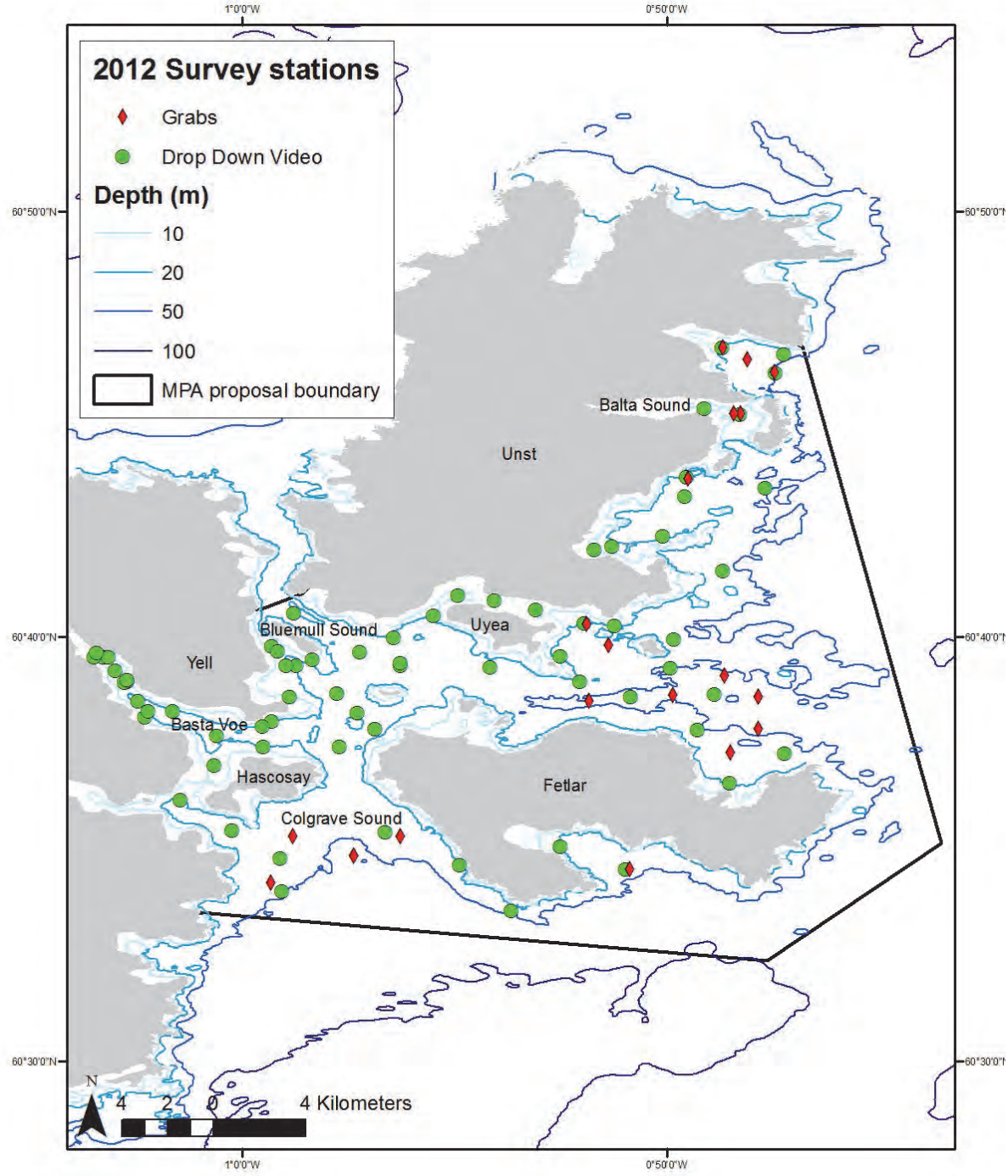

Figure 3. Stations visited in this survey.

2. METHODS

Between 27th August - 5th September 2012 Heriot Watt University, SNH and Marine Scotland (MS) carried out a survey throughout the Fetlar to Haroldswick MPA proposal, conducting drop down video (DDV) tows, Van Veen grab sampling and *in situ* diver surveys (MNCR phase 2 style). In total 70 semi-quantitative epifaunal DDV stations were surveyed and 22 quantitative infaunal grab stations attempted (19 completed). Detailed *in situ* diver surveys were carried out at sites selected from the DDV and grab work to investigate maerl and horse mussel beds. Replicate 'clump', core, and Particle Size Analysis (PSA) samples were taken at the diver survey sites as appropriate. In total three horse mussel beds and two maerl beds were investigated by divers.

Survey stations were chosen using a stratified random coarse grid pattern, radiating from areas where historic records of proposed protected features existed or suitable habitat had been predicted. The survey vessel *Moder Dy*, owned by the North Atlantic Fisheries College, was used from 27th - 31st Aug 2012 operating out of Cullivoe. A second vessel, MV *Halton*, was used during the period 1st - 5th September to undertake diving work.

2.1 Video survey

A Panasonic NV-GS150 3 chip digital video camera was used within a Seapro housing held within a small sled frame, and illumination provided by twin 100 watt lamps. A 150 m umbilical cable carried the video signal to a Sony Video Walkman for real-time observations and recording (Figure 4).

Figure 4. DDV camera setup.

The video sled was suspended from the boat which was allowed to run with the prevailing current or wind until 5 - 10 minutes of steady footage were recorded along a transect. Immediately prior to video deployment a 'clapper board' with the date and station number was recorded on the video tape to determine the start of each new tow. At the beginning of each tow the camera was allowed to settle on the sea bed, and position (WGS 84), start time (GMT), and depth were recorded in the recording form (Appendix 1.2). The video recording started at the same time. The sled was then towed at close to 0.5 knots across the sea bed while substratum type and main taxa were recorded into the field log. At the end of each transect the video recording was stopped, and the end position, depth and time were logged.

GPS tracks of each deployment were recorded to a Magellan GPS unit and simultaneously overlaid onto the video feed and logged onto a laptop. This gave positional information every second for the duration of each tow.

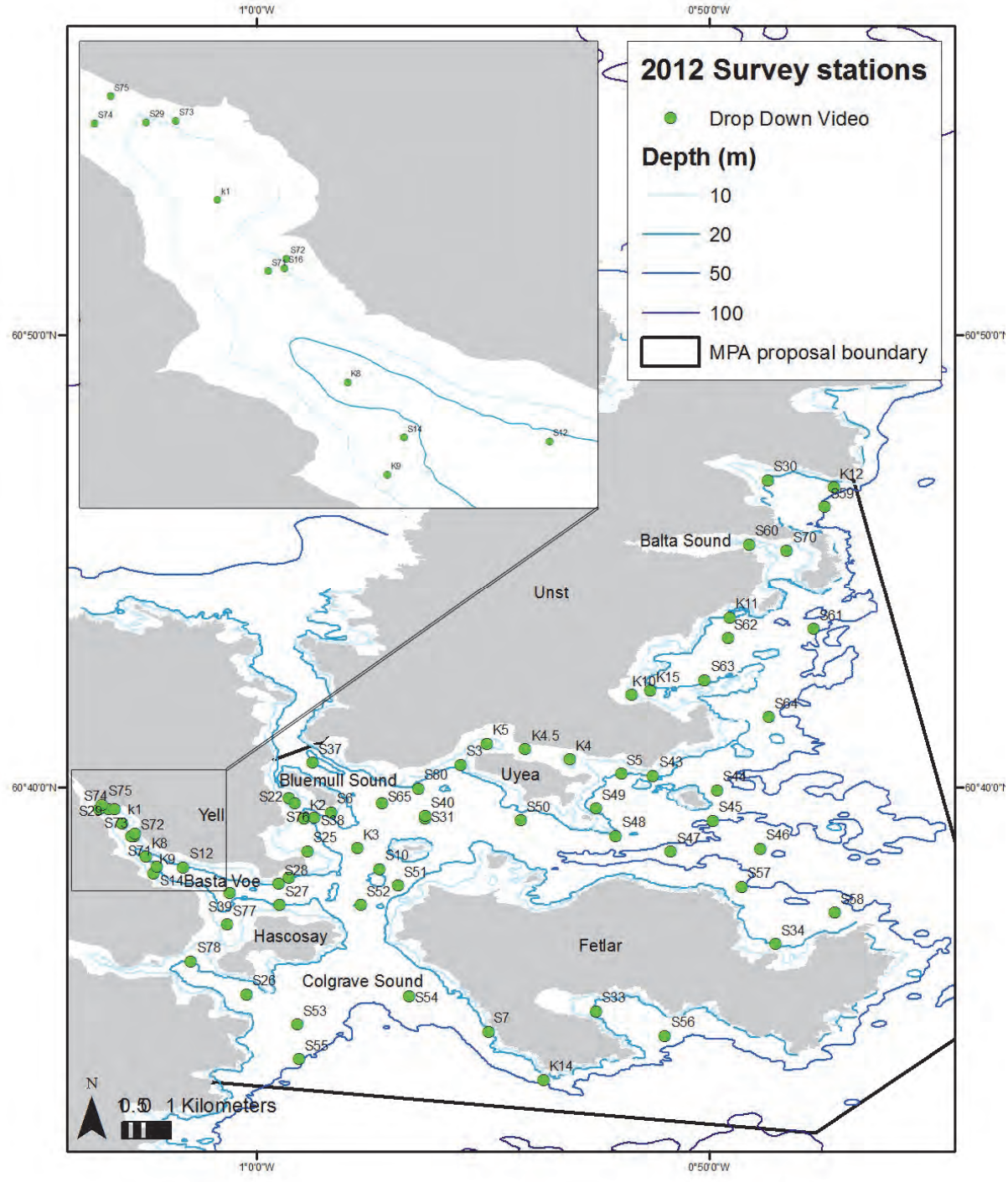

Figure 5. DDV stations visited during this survey.

2.1.1 Analysis of drop down video

In total 69 DDV stations were recorded. The video footage was analysed in Adobe Premier Pro. The proportions of different substrate types, and the species present were recorded

using either numerical abundance, or SACFOR scales (Hiscock, 1996) where the terms Superabundant, Abundant, Common, Frequent, Occasional or Rare were allocated to each species. Biotopes were assigned according to Connor *et al*. (2004). The presence of proposed protected features was specifically noted for each tow.

Where an obvious biotope change occurred during a tow the species counts were started from zero again and a secondary station label added, e.g. S1 and S1a. In these instances the area of the biotope was established using the length of GPS track of each section.

2.2 Infaunal survey

A Van Veen grab was used to collect 0.1 m^2 samples of seabed sediment (Figure 6). Winch speeds for deployment did not exceed 1 ms^{-1} on descent, and 3 ms^{-1} on ascent once clear of the sea bed. Before emptying the grab the sample was checked for acceptable volume. This was done by opening inspection hatches and measuring sediment depth with a ruler: a target depth was used of no less than 5 cm for sand (Rumohr, 1990). If the grab gear was wedged open on retrieval by stones or other organisms the sample was rejected and repeated but epifauna were retained for other HWU research. A *circa* 150 ml subsample was taken from each grab for particle size analysis.

Figure 6. Van Veen grab sampling from the Moder Dy.

Once the sample had been inspected, the content was washed into the receiving container and the inside of the grab was rinsed through to ensure the entire sample was removed. After checking the sample was adequate, a visual inspection was made and the location, depth, and description of the sample was recorded in the appropriate recording form (Appendix 1.1). A waterproof label was added to the sample with the following information: survey, site, station number and date. The grab was washed down between deployments to prevent cross contamination of samples.

The samples were washed through a 1 mm sieve (Figure 7). Contents of the sample retained after sieving were placed in a sample bucket with the appropriate waterproof label and sealed. The sample bucket was then labelled according to the waterproof label inside. Samples were preserved in a 4% borax buffered formalin solution upon return to shore.

Figure 7. Grab samples processed through 1mm sieve (Stations SG20 and SG14).

In total 19 grab stations were sampled (Figure 8). Only one grab was collected per station – replicate samples to enable statistical comparison of infaunal community composition were collected from a selection of sites during diving surveys, so the grab survey was designed to cover as much unknown ground as possible. As wide areas of the MPA proposal had not been investigated by grab yet, it was deemed more beneficial to be able to assign biotopes to a greater number of stations. Grab samples were analysed for infaunal species with a sub sample undergoing particle size analysis (PSA). Biotopes were assigned to grab stations according to Connor *et al*. (2004) incorporating key species' presence and abundances with PSA descriptions from the grab samples.

2.2.1 Infaunal analysis

Infaunal organisms were processed in the laboratory after the survey. Each sample was split into a light and coarse fraction, by repeated elutriation over a 0.5 mm mesh sieve. The light fraction was further divided into material retained on a 1.0 mm mesh and the smaller fraction separated. Each fraction was then examined under a dissecting microscope. Individual macrofaunal specimens were extracted using forceps. The coarse fraction was also subdivided, the material retained on a 2.0 mm mesh being retained separately. This 2.0 mm fraction was examined in an enamel tray, using magnifying goggles, and the fauna extracted. The remaining coarse material was examined in the same way as the light fraction, under a dissecting microscope. All extracted fauna were identified as far as was practical, using the available literature. A voucher collection was also retained and sent to the Scottish Natural History Museum for quality assurance and reference purposes.

Multivariate analyses were conducted on Bray-Curtis similarity coefficients of square root transformed species abundance data using PRIMER v6 software (Clarke & Warwick, 2001).

Similarity profile (SIMPROF) analysis was used to examine any structure between sites followed by a similarity percentage (SIMPER) analysis to describe the species most contributing to the differences between groups.

The infaunal species results were then used to aid biotope assignment by comparing key species and their abundances to the biotope description and to what was seen on the DDV footage.

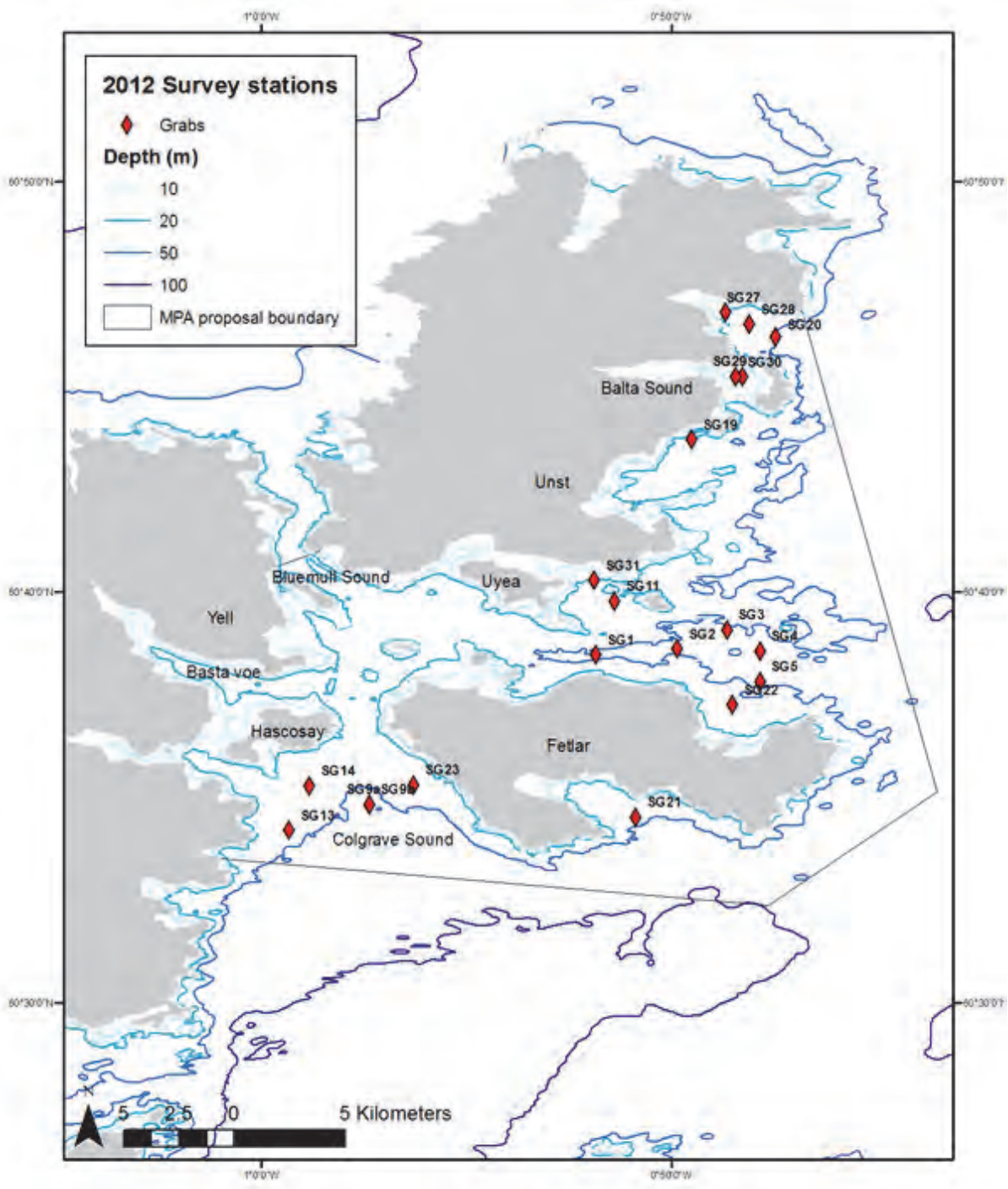

Figure 8. Grab stations visited during this survey.

2.2.2 Particle size analysis

PSA was conducted following The National Marine Biological Analytical Quality Control Scheme (NMBAQC)'s "Best Practice Guidance notes" (Mason, 2011). Each sample was stirred with a spatula to homogenise the sample. Live and dead shell was removed from the sample. A subsample of approximately 100 g (mud and sand), or a minimum of 200 g for gravel was taken. A glass petri dish was pre-weighed to 2 decimal places; this measurement was then subtracted from future measurements.

The sample was placed in the pre-weighed petri dish and dried in a drying oven at around 60°C for 24 hours. The sample was allowed to cool for approximately 5 minutes then re-weighed. The first few samples were put back into the oven for another 24 hours and then re weighed. If they had lost more water (got lighter) then the drying process was repeated until the mass was stable. This then gave a bench mark for drying times of the remaining samples.

Each sample was wet sieved through a 63µm sieve, using distilled water and 3 - 5% sodium hexametaphosphate. The contents of the sieve were washed back into the beaker and dried again for 12 hours, then re-weighed. This weight minus the first dry weight gave the fines fraction (<63µm). The 63µm sieve was gently cleaned and allowed to dry.

The coarse sample (>63 µm) was added to the top sieve of a sieving stack, and left running for 20 minutes, making sure all sieves were clean and in the right order. Each of the sieved fractions was weighed, with any material that fell through the final 63µm sieve added to the original (<63µm) fine fraction.
The percentage of each size fraction was classified according to the Wentworth scale e.g. 0.9 % medium sand (grain size of 250 - 500µm). This allowed the overall average grain size to be used in the modified Folk triangle soft sediment matrix (Connor *et al*., 2004), to help in biotope classification.

2.3 *In situ* diver survey

In situ MNCR-style phase 2 surveys (see Hiscock *et al*., 1996) were carried out at five sites (three horse mussel bed sites and two maerl bed sites: Figure 9). The diver surveys were used to assess the quality of these proposed protected features. The locations of the dive survey sites were determined using the initial results of the DDV survey. Surveys were carried out in a suitably representative area of the respective bed. A 25 m tape was laid out from a shot line. Two divers surveyed a 2 m band either side of the tape and recorded the presence and where possible, an estimate of the abundance of conspicuous biota using standard MNCR recording forms. Samples were taken of any unidentified species to examine in the laboratory. The transect band was also recorded using a hand held video camera (Cannon HF G10 in a Light and Motion housing) and still photographs were taken of the proposed protected features and associated communities using a digital stills camera (Nikon D70 digital SLR, and using the camera function on the video camera).

2.3.1 MNCR clump / core analysis

For community analyses, at maerl bed sites divers took four replicate core samples (Figure 10), which were sieved through a 1 mm mesh screen and the remaining sample was preserved in borax-buffered 5% formalin. A 20 cm sediment core of 5 cm diameter was also taken for PSA. Processing of these samples followed the same procedure as stated previously for grab samples. At horse mussel beds, four replicate clump samples were taken and placed in 5 litre buckets as a corer was not effective on horse mussel beds. Biotope codes were assigned to the records using *in situ* observations and clump/core data. Clump samples were split into infauna and epifauna for species analysis. Epifauna consisted

of colonial and encrusting fauna including bryozoans, hydroids, sponges, etc. Infauna was considered to be animals living within the substrate. In some cases organisms could not be counted and were marked as present or absent. For the later diversity analyses they were given the count of 1. Infaunal analysis of clump and core samples used ANOSIM to test any structure between sites followed by a similarity percentage (SIMPER) analysis to describe the species most contributing to the differences between groups. During sorting, a representative sample of each type of epifaunal and infaunal organism was collected and retained for a voucher collection.

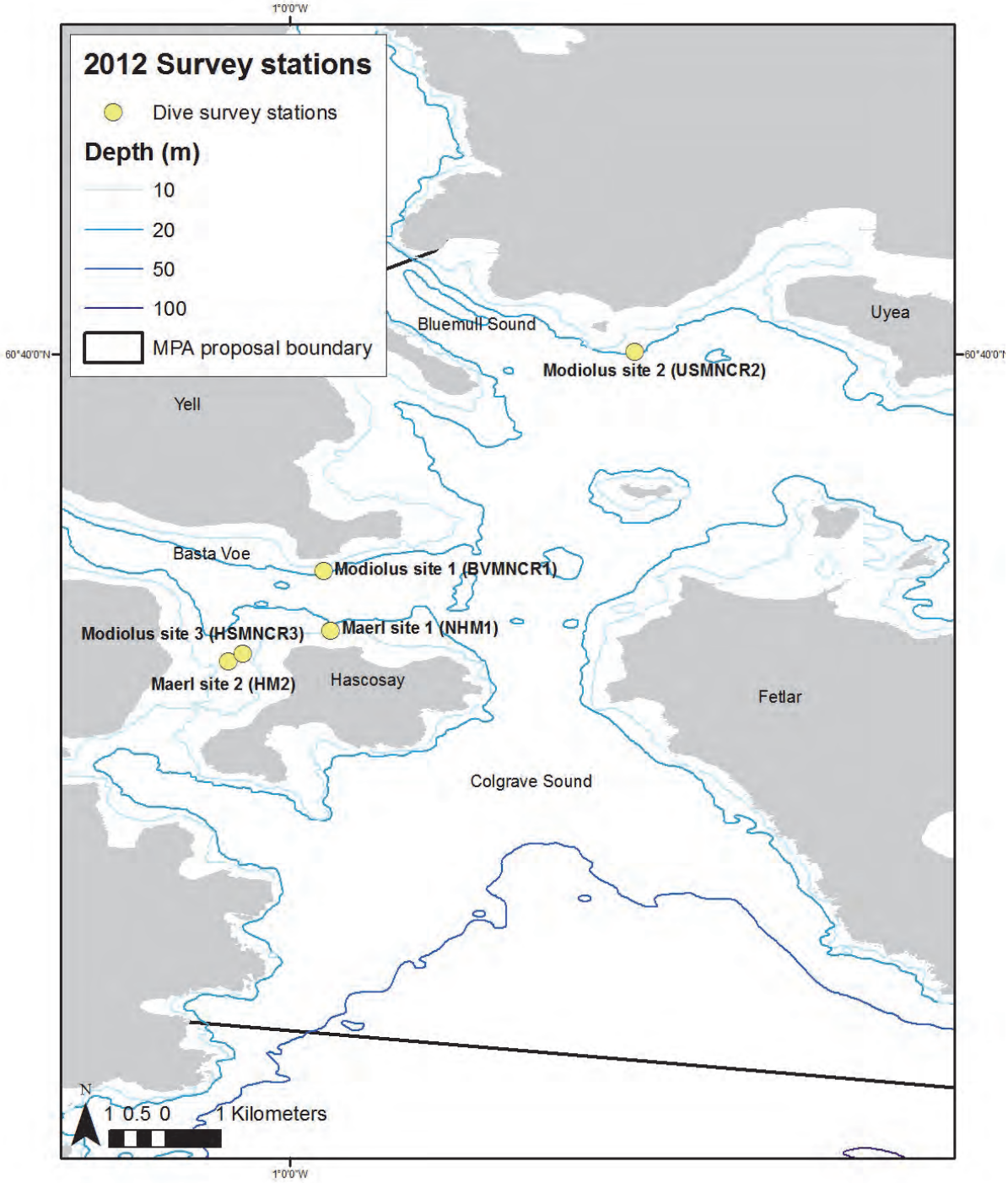

Figure 9. In situ *diver survey and clump/core sample collection stations.*

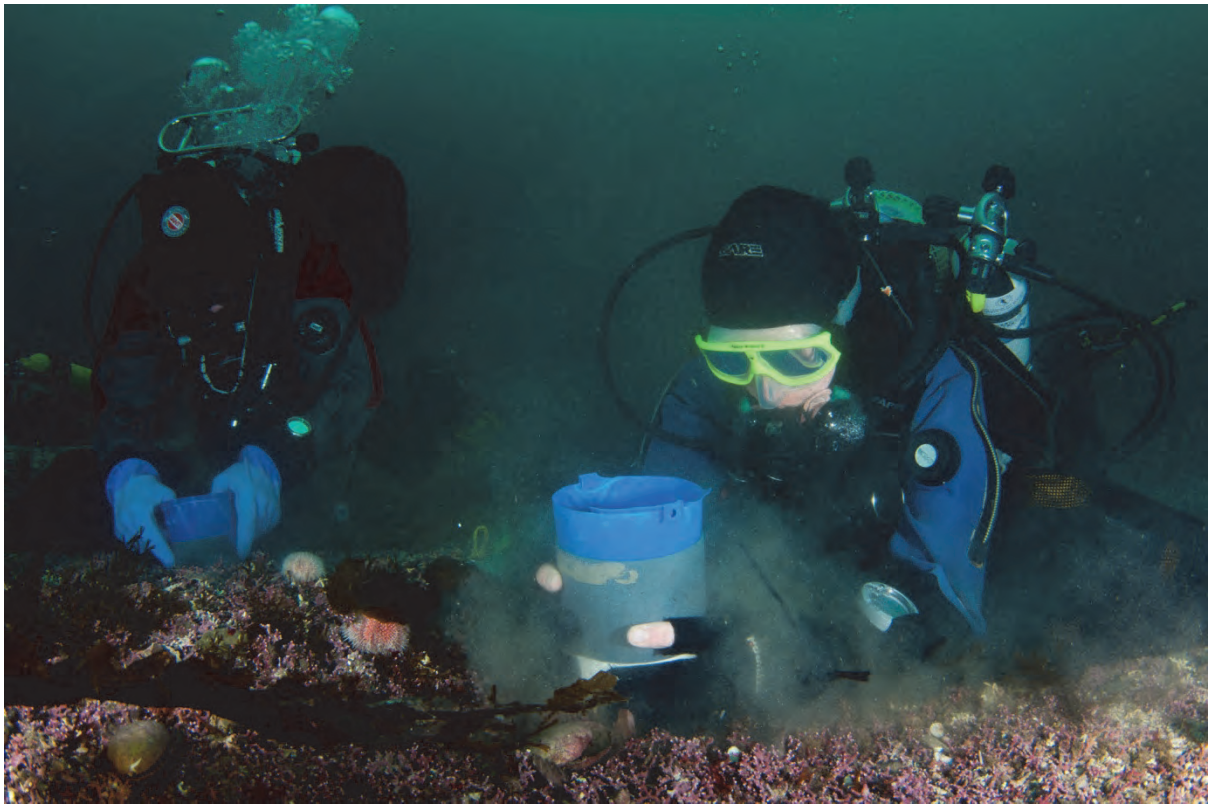

Figure 10. Maerl core sample collection (photo credit Richard Shucksmith).

3. RESULTS

Twenty-six biotopes were recorded within the survey area using DDV (Table 2). Habitat descriptions, biotopes and proposed protected features for the 93 records are summarised in the following section.

3.1 General description of biotopes

Seventy drop down video deployments were carried out in the Shetland survey area ranging in depth from 4.1 m - 54.6 m. Where a station contained more than one biotope the tow was split into several records as necessary, creating in some cases more than one biotope record for one station. Field notes taken during the video deployments can be seen in the drop down video log in Appendix 1.2 with results of the more detailed analysis of the video transects in Appendix 2. A photographic inventory of the biotopes listed in Table 2 can be seen in Appendix 3.

Table 2. Shetland biotope classification descriptions.

Rock biotopes (IR = infralittoral rock; CR = circalittoral rock)		**Sublittoral Sediment biotopes** (SS)
High energy infralittoral rock (HIR)	High energy circalittoral rock (HCR)	Sublittoral coarse sediment (SCS)
Moderate energy infralittoral rock (MIR)	Moderate energy circalittoral rock (MCR)	Sublittoral sand (SSa)
Low energy infralittoral rock (LIR)	Low energy circalittoral rock (LCR)	Sublittoral mud (SMu)
Feature of infralittoral rock (FIR)	Feature of circalittoral rock (FCR)	Sublittoral mixed substrata (SMx)
Examples IR.HIR = Habitat complex (level 3 in classification) **IR.HIR.KFaR** = Biotope complex (level 4 in classification) IR.HIR.KFaR.**LhypR**= Biotope level (anything longer = sub-biotope)		Sublittoral macrophytes on sediment (SMp)
		Sublittoral biogenic reefs on seds (SBR)

Biotope	Description	Count
CR.MCR.EcCr	Echinoderms and crustose communities	4
CR.MCR.EcCr.FaAlCr	Faunal and algal crusts on exposed to moderately wave-exposed circalittoral rock	4
CR.MCR.EcCr.FaAlCr.Bri	Brittlestar bed on faunal and algal encrusted, exposed to moderately wave-exposed circalittoral rock	3
IR.MIR.KR.Lhyp.GzFt	Grazed *Laminaria hyperborea* forest with coralline crusts on upper infralittoral rock	1
IR.MIR.KR.LhypT	*Laminaria hyperborea* on tide-swept, infralittoral rock	1
SS.SCS.CCS	Circalittoral coarse sediment	17
SS.SCS.ICS	Infralittoral coarse sediment	1
SS.SMp.KSwSS.LsacR.CbPb	Red seaweeds and kelps on tide-swept mobile infralittoral cobbles and pebbles	1
SS.SMp.KSwSS.LsacR.Gv	*Saccharina latissima* and robust red algae on infralittoral gravel and pebbles	4
SS.SMp.KSwSS.LsacR.Sa	*Saccharina latissima* and filamentous red algae on infralittoral sand	1
SS.SMp.KSwSS.Pcri	Loose-lying mats of *Phyllophora crispa* on infralittoral muddy sediment	3
SS.SMp.KSwSS.Tra	Mats of *Trailiella* on infralittoral muddy gravel	2
SS.SMp.Mrl.Pcal	*Phymatolithon calcareum* maerl beds in infralittoral clean gravel or coarse sand	5
SS.SMp.Mrl.Pcal.R	*Phymatolithon calcareum* maerl beds with red seaweeds in shallow infralittoral clean gravel or coarse sand	4
SS.SMu.CSaMu	Circalittoral sandy mud	3
SS.SMu.CSaMu.VirOphPmax	*Virgularia mirabilis* and *Ophiura* spp. with *Pecten maximus* on circalittoral sandy or shelly mud	5
SS.SMu.ISaMu	Infralittoral, cohesive sandy mud, typically with over 20% silt/clay, in depths of less than 15-20m.	3
SS.SMx.CMx	Mixed (heterogeneous) sediment habitats in the circalittoral zone (generally below 15-20m) including well mixed muddy gravelly sands or very poorly sorted mosaics of shell, cobbles and pebbles embedded in or lying upon mud, sand or gravel.	15

SS.SMx.CMx.OphMx	*Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment	3
SS.SMx.CMx.FluHyd	*Flustra foliacea* and *Hydrallmania falcata* on tide swept circalittoral mixed sediment	1
SS.SSa.CFiSa	Circalittoral fine sand	1
SS.SSa.IMuSa.AreISa	*Arenicola marina* in infralittoral fine sand or muddy sand.	2
SS.SSa.IMuSa.EcorEns	*Echinocardium cordatum* and *Ensis* spp. in lower shore and shallow sublittoral slightly muddy fine sand	1
SS.SSa	Sublittoral sands and muddy sands. Clean medium to fine sands or non-cohesive slightly muddy sands on open coasts, offshore or in estuaries and marine inlets.	1
SS.SSa.CMuSa	Circalittoral non-cohesive muddy sands with the silt content of the substratum typically ranging from 5% to 20%.	1
SS.SBR.SMus.ModT	*Modiolus modiolus* beds with hydroids and red seaweeds on tide-swept circalittoral mixed substrata	6

The most frequently recorded biotope complexes within the Fetlar to Haroldswick MPA proposal were circalittoral coarse sand and circalittoral mixed sediment (**SS.SCS.CCS** and **SS.SMx.CMx**)**.** Circalittoral coarse sand was found at 17 stations almost exclusively from around the south of Fetlar, whilst circalittoral mixed sediment was found at 15 stations scattered throughout the survey area between 14.5 m and 45.5 m bcd.

The next most abundant biotope was the horse mussel bed community **SS.SBR.SMus.ModT** which was found at 6 stations within Bluemull Sound and in the entrance to Basta Voe. Similarly abundant biotopes included maerl bed communities **SS.SMp.Mrl.Pcal** and **SS.SMp.Mrl.Pcal.R** at 5 and 4 stations respectively. **SS.SMp.Mrl.Pcal** was found at the entrances to Balta Sound, Basta Voe, and Bluemull Sound as well as the southern edge of Uyea.

Other biotopes recorded in similar abundance included the rocky community **CR.MCR.EcCr.FaAlCr** (4 stations mainly on the eastern edge of the survey area between Southern Fetlar and north eastern Unst) and a dense seapen community on sandy mud, **SS.SMu.CSaMu.VirOphPmax**, at 5 stations within Basta Voe.

The distribution of all biotopes is shown in Figures 11-14, with more detail on proposed protected feature biotopes given later in this section.

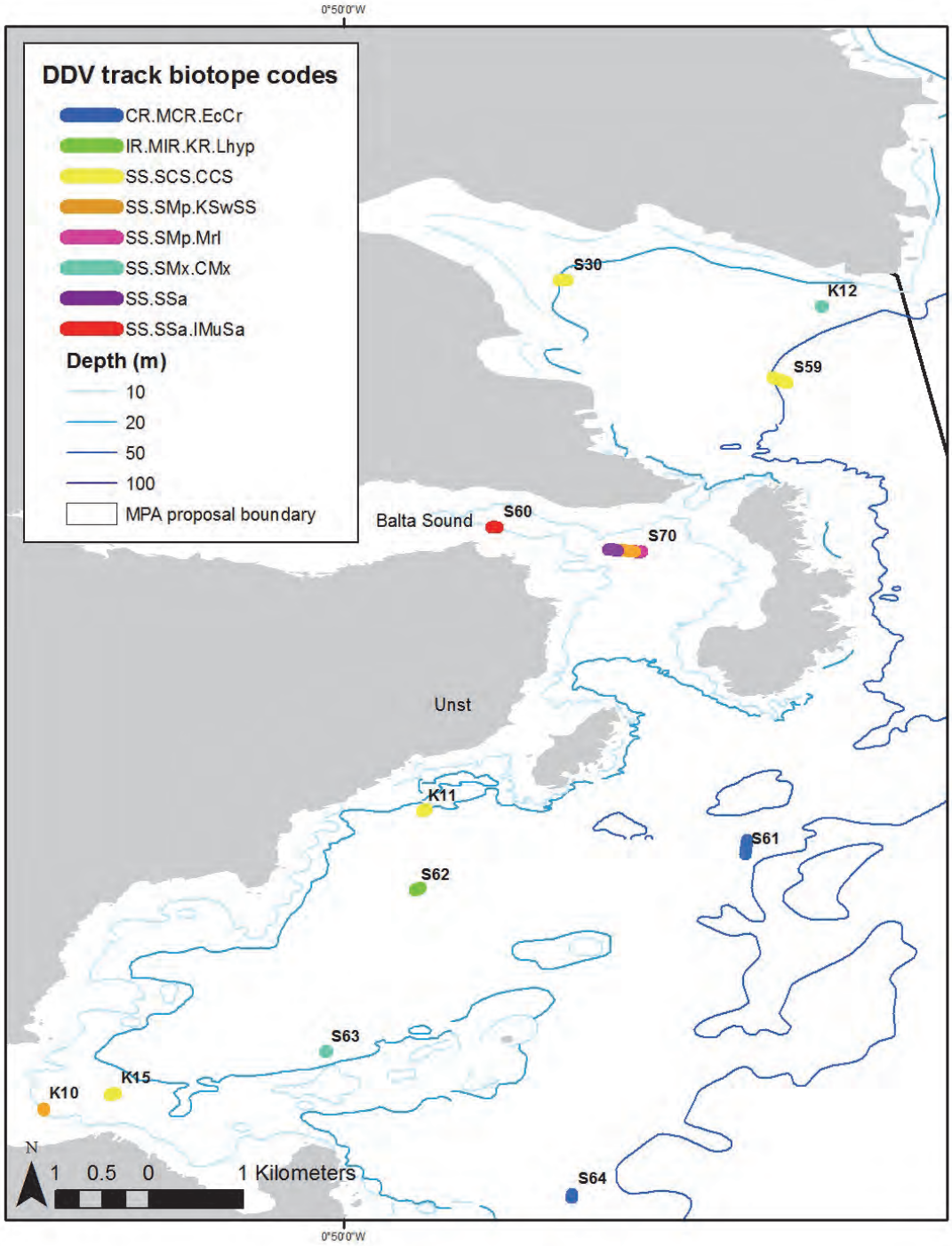

Figure 11. DDV biotope tracks for the Balta Sound and Haroldswick area. ***SS.SMp.KSwSS*** *is inclusive of* ***SS.SMp.KSwSS.LsacR.CbPb*** *and* ***SS.SMp.KSwSS.Pcri***, ***SS.SSa.IMuSa*** *is inclusive of* ***SS.SSa.IMuSa.AreISa***, *and* ***SS.SMx.CMx*** *is inclusive of* ***SS.SMx.CMx.FluHyd***.

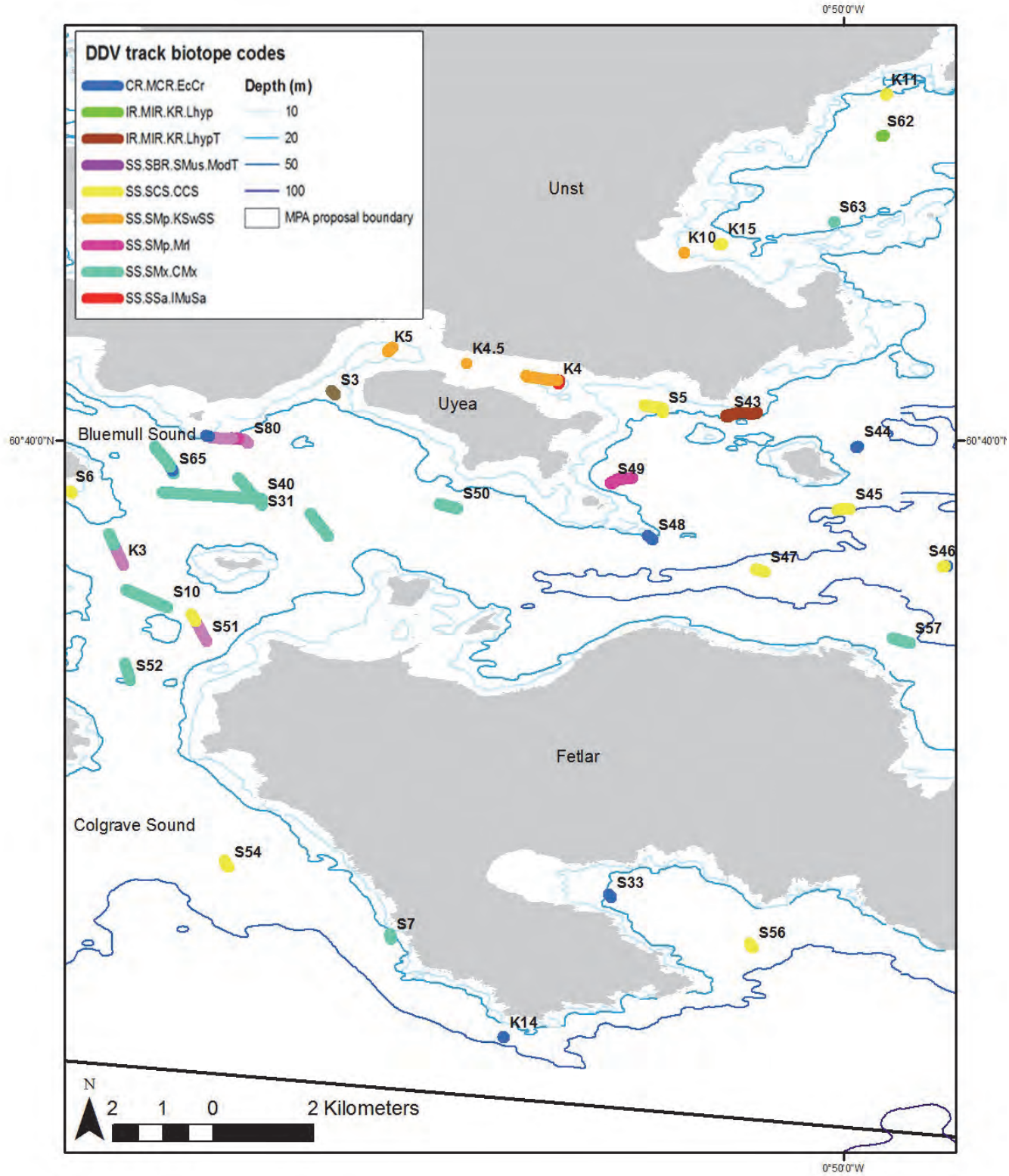

Figure 12. DDV biotope tracks for the central survey area. ***SS.SMp.KSwSS*** *is inclusive of* ***SS.SMp.KSwSS.LsacR.CbPb***, ***SS.SMp.KSwSS.LsacR.Gv***, *and* ***SS.SMp.KSwSS.LsacR.Sa***. ***SS.SSa.IMuSa*** *is inclusive of* ***SS.SSa.IMuSa.AreISa.*** ***CR.MCR.EcCr*** *is inclusive of* ***CR.MCR.EcCr.FaAlCr*** *and* ***CR.MCR.EcCr.FaAlCr.Bri***.

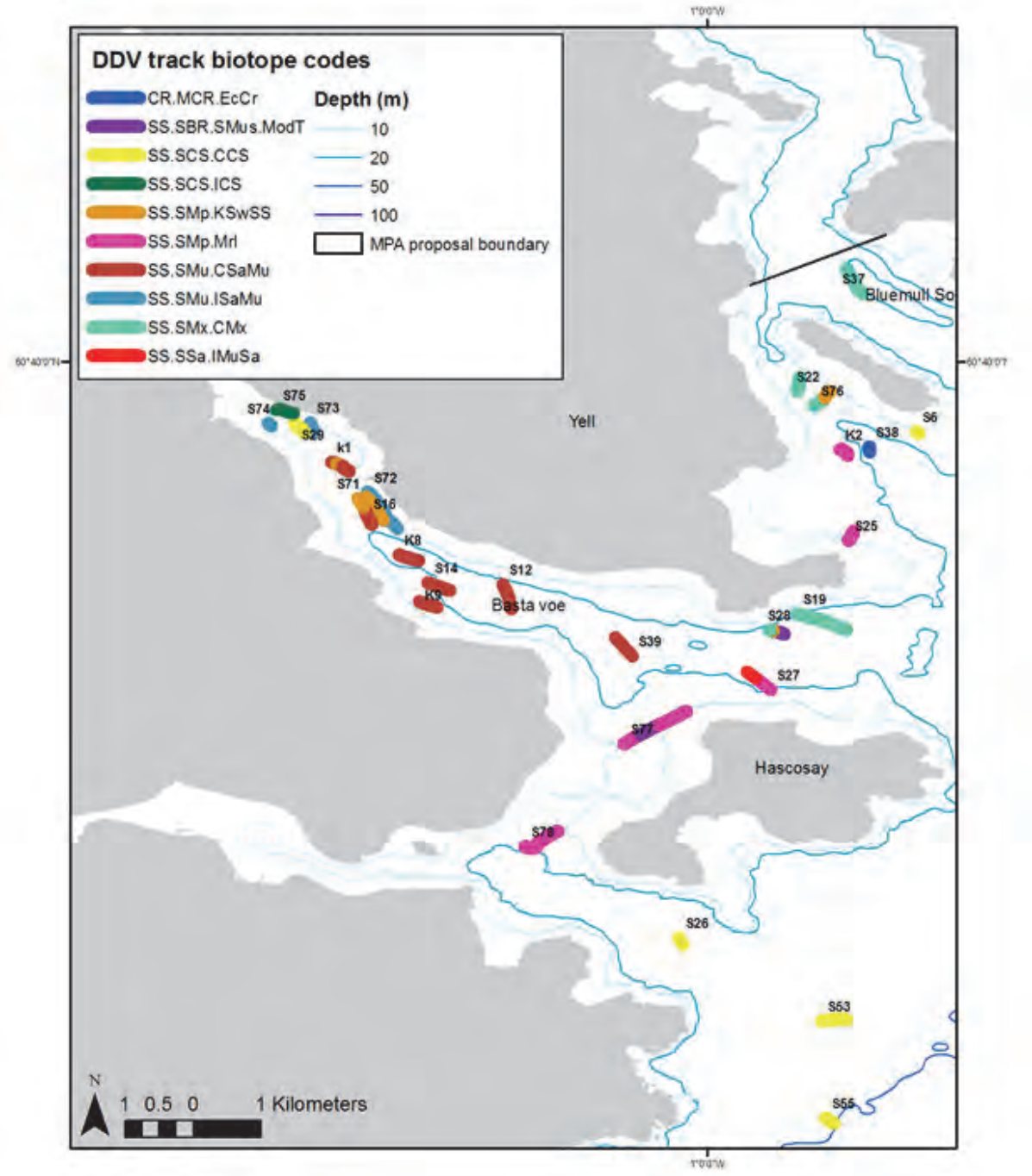

Figure 13. DDV biotope tracks for the central - west survey area. ***SS.SMp.KSwSS*** *is inclusive of* ***SS.SMp.KSwSS.Tra*** *and* ***SS.SMp.KSwSS.Gv, SS.SMx.CMx*** *is inclusive of* ***SS.SMx.CMx.OphMx.***

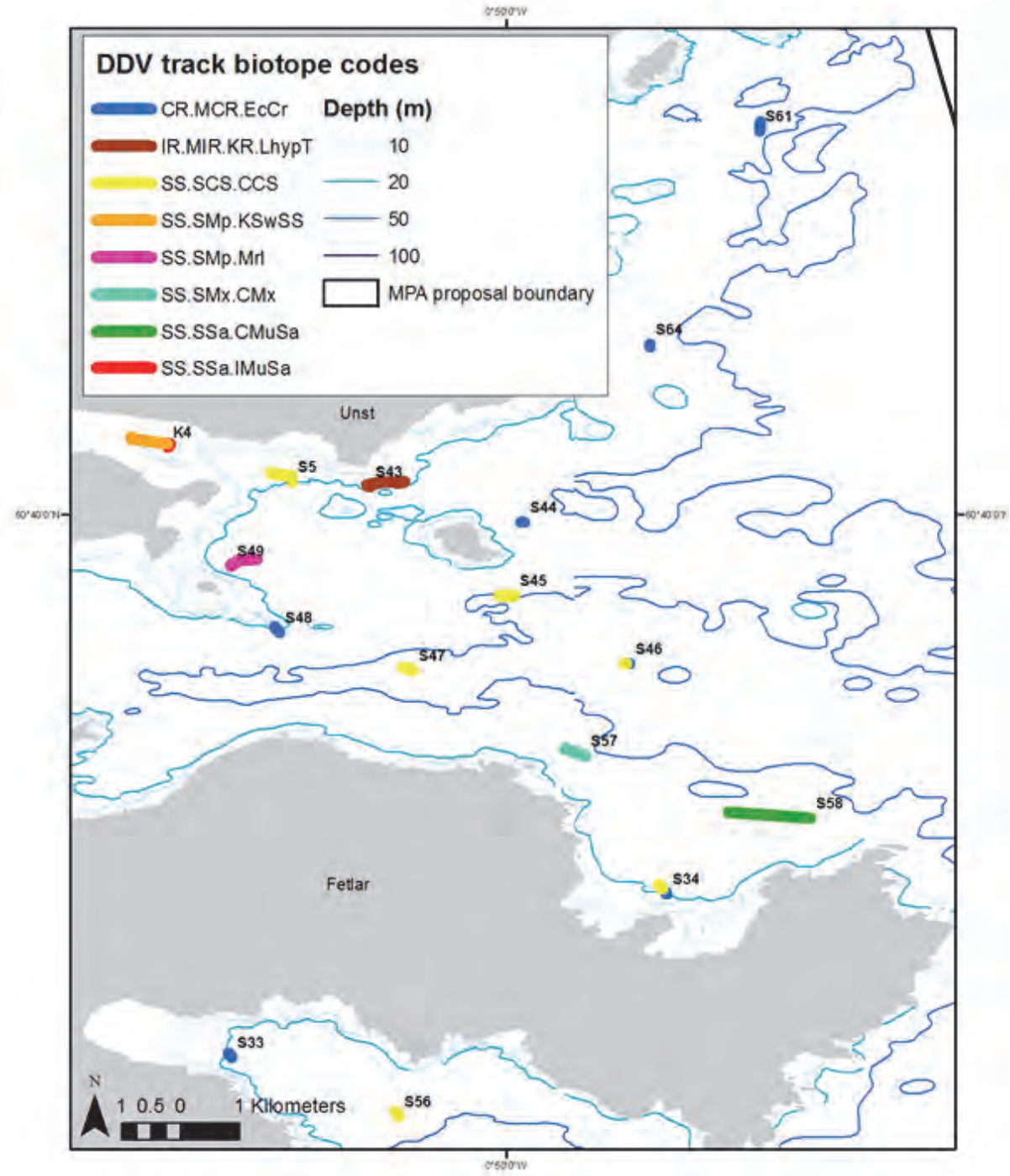

Figure 14. DDV biotope tracks for southern and northern Fetlar. ***SS.SMp.KSwSS*** *is inclusive of* ***SS.SMp.KSwSS.LsacR.Sa, SS.SSa.IMuSa is inclusive of SS.SSa.IMuSa.ArelSa, and CR.MCR.EcCr is inclusive of CR.MCR.EcCr.FaAlCr and CR.MCR.EcCr.FaAlCr.Bri.***

3.2. Proposed protected feature records

Several proposed protected features of the Fetlar to Haroldswick MPA proposal were observed during the 2012 Shetland survey: horse mussel beds, maerl beds, kelp and seaweed communities on sublittoral sediment, and shallow tide-swept coarse sands with burrowing bivalves.

3.2.1 Horse mussel beds

Modiolus modiolus was found at 22 stations but the proposed protected feature 'horse mussel bed' (as **SS.SBR.SMus.ModT)** was found at 6 stations (K3a, S51a, S28b, S77b, S80a, S80c; Figure 15). *M. modiolus* was considered to form a bed biotope when abundances were at least 'Frequent' (1-9 / 0.1 m^2). The stations where *M. modiolus* were observed were spread throughout Bluemull Sound and interspersed with records of other biotopes, making an estimation of bed size impractical. Transects of horse mussel beds ranged from 0.086 km (S28b) to 0.418 km (K3a) in length and were found between 8 m (S77b) and 27.1 m bcd (S80c).

Stations neighbouring horse mussel bed records (K3b, S10, S52, S19, S28c, S42, S31a, S65c, S65a, S50) with circalittoral mixed sediment and dead *M. modiolus* shells (**SS.SMx.CMx**) may well have contained some live *M. modiolus* but this was not visible on the video footage. The dead shell can either obscure live individuals, or just be wash-off from a neighbouring live bed (See Figure 7 previously).

The abundance of *M. modiolus* where it was found as a bed varied. At station S51a individuals were 'Frequent' (1-9 / 0.1 m^2), at stations K3a, S28b, S77b, and S80c they were 'Common' (1-9 / 0.01 m^2), and at station S80a *M. modiolus* was 'Abundant' (1-9 / 0.001 m^2: see SACFOR scale; Hiscock, 1996).

Overall there was no obvious pattern in the patchy distribution of *M. modiolus*, with areas where they were rare, frequent, common or abundant interspersed throughout the central survey area. Surface sediment composition in these areas (where visible) was ~20% dead empty shell, 20% shell gravel, 15% cobbles, 15% pebbles and the rest of the sediment poorly sorted sands. Stations where **SS.SBR.SMus.ModT** was recorded were patchy in substrate composition with no obvious pattern.

Appendix 9 shows the abundance of associated species at each horse mussel bed biotope station (see also Figure 16). In summary, *Crossaster papposus*, *Corallinaceae* sp., *Ophiothrix fragilis* and *Ophiopholis aculeata* were recorded at all stations with the exception of S51a where no brittlestar species were observed. Also present at all but one station was *Echinus esculentus* which was predominantly seen in large numbers with the exception of station K3a where only 8 individuals were observed. Only six other species occurred at half or more of the **SS.SBR.SMus.ModT** stations, these were *Halecium halecium*, *Pomatoceros triqueter*, *Bryozoa* sp., *Porania pulvillus* and *Ophiocomina nigra*. *Asterias rubens* was observed at 4 stations in low numbers (1 - 4), but was more abundant (34 individuals) at station S51a.

Other species observed were recorded at only 1 or 2 stations and in relatively low numbers with the exception of *Alcyonium digitatum* recorded as 'Abundant' at station S51a, and *Antedon bifida* recorded as 'Abundant' at station S28b.

Points of interest included the presence of *Suberites* sp. growing on a large proportion of the *Aequipecten opercularis* throughout the area, as well as the large numbers of *A. bifida* at station S28a, and the northern sea urchin *Strongylocentrotus droebachiensis* in clumps at station S51a, both species recorded as 'Abundant'.

The station with the most recorded species was S51a with 19 species, whilst stations S28b and S80c only had 14 species. Overall there was no conspicuous spatial pattern in species abundances between stations. A full description of each video station is provided in Appendix 2.

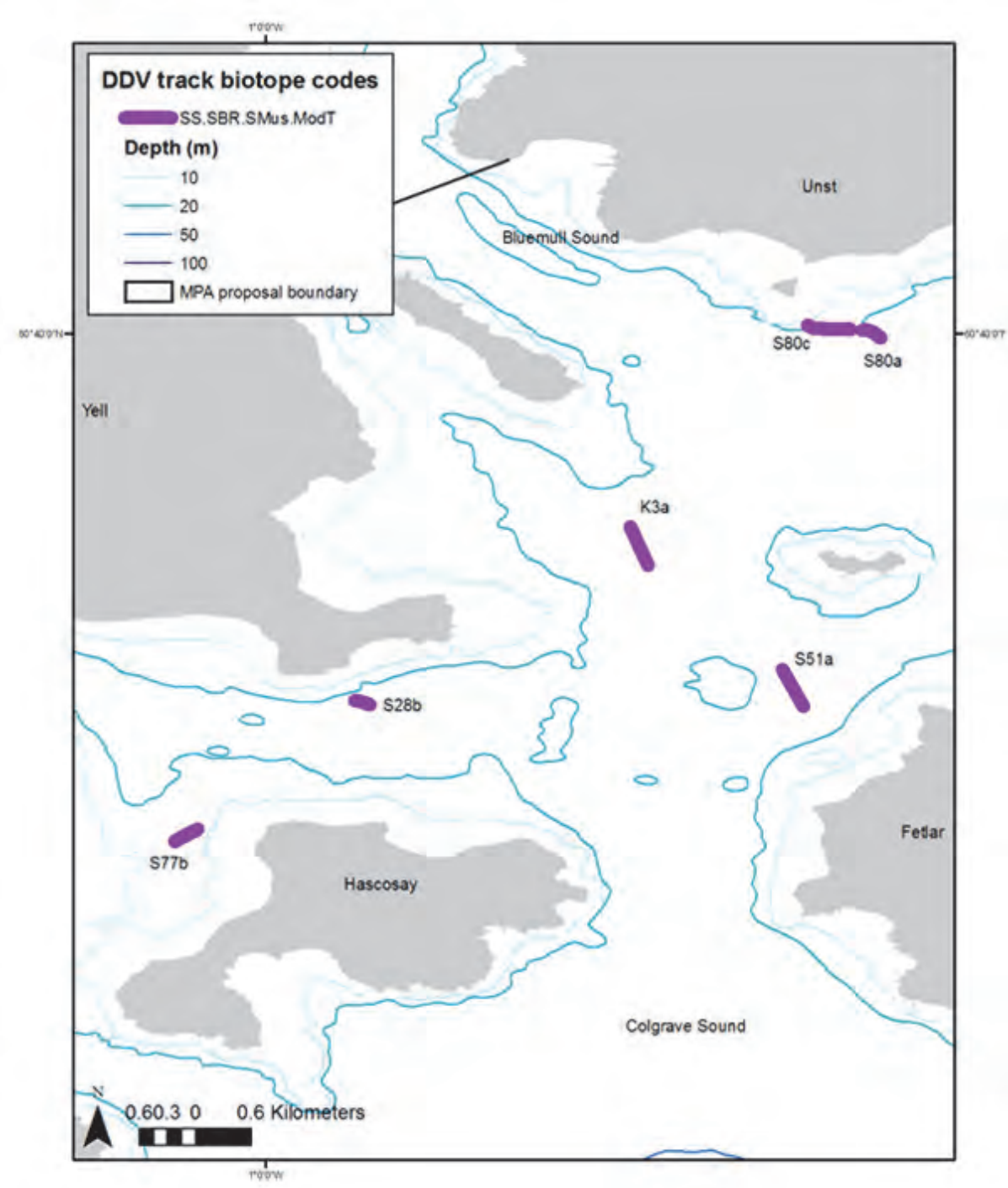

*Figure 15. Horse mussel bed **(SS.SBR.SMus.ModT)** biotope stations.*

Figure 16. The typical community associated with a horse mussel bed in the Fetlar to Haroldswick MPA proposal (photo credit Paul Kay).

3.2.2 Maerl beds

Maerl was observed at 16 stations but was identified as the proposed protected feature 'maerl bed' at 9 of these: as **SS.SMp.Mrl.Pcal** at S70a, K2, S77a, S77c and S80b and as **SS.SMp.Mrl.Pcal.R** at S27a, S25, S78 and S49 (Figure 17). Maerl was considered to form a bed when at abundances of at least 'Common' (20-39% cover).

The stations where maerl was recorded were spread throughout the survey area making an estimation of bed size difficult. The biggest aggregation of maerl biotope stations ran down the east side of Yell into Hascosay Sound with patches also in the Bluemull Sound area, off Uyea and at the entrance to Balta Sound. Transect lengths along which the proposed protected feature was recorded ranged from 0.0345 km (S70a) to 0.366 km (S78) and lay in water between 8 m (S77a) and 22.8 m bcd (S49). Stations S77a and S77c were only separated by a small patch of **SS.SBR.SMus.ModT** and were close to DDV tows at S78 and S27 so maerl around Hascosay is perhaps more extensive than the transect figures would suggest**.** Maerl and horse mussel beds were sometimes intermixed as was seen for example at station S80. Overall, the eastern coast of Yell in the Bluemull Sound area and south into Hascosay Sound was the area with the greatest aggregation of maerl bed records.

Maerl was observed in low abundances (R-F) at stations neighbouring those where the proposed protected feature habitat was recorded (S51a, S27b, S19, S76b, K4.5, K4b, and K5), indicating that maerl extended patchily over wider areas.

The abundance of maerl at stations where the proposed protected feature was recorded was fairly consistent: recorded as 'Abundant' (40-79% cover) at all stations except K2 where maerl was 'Common' (20-39%).

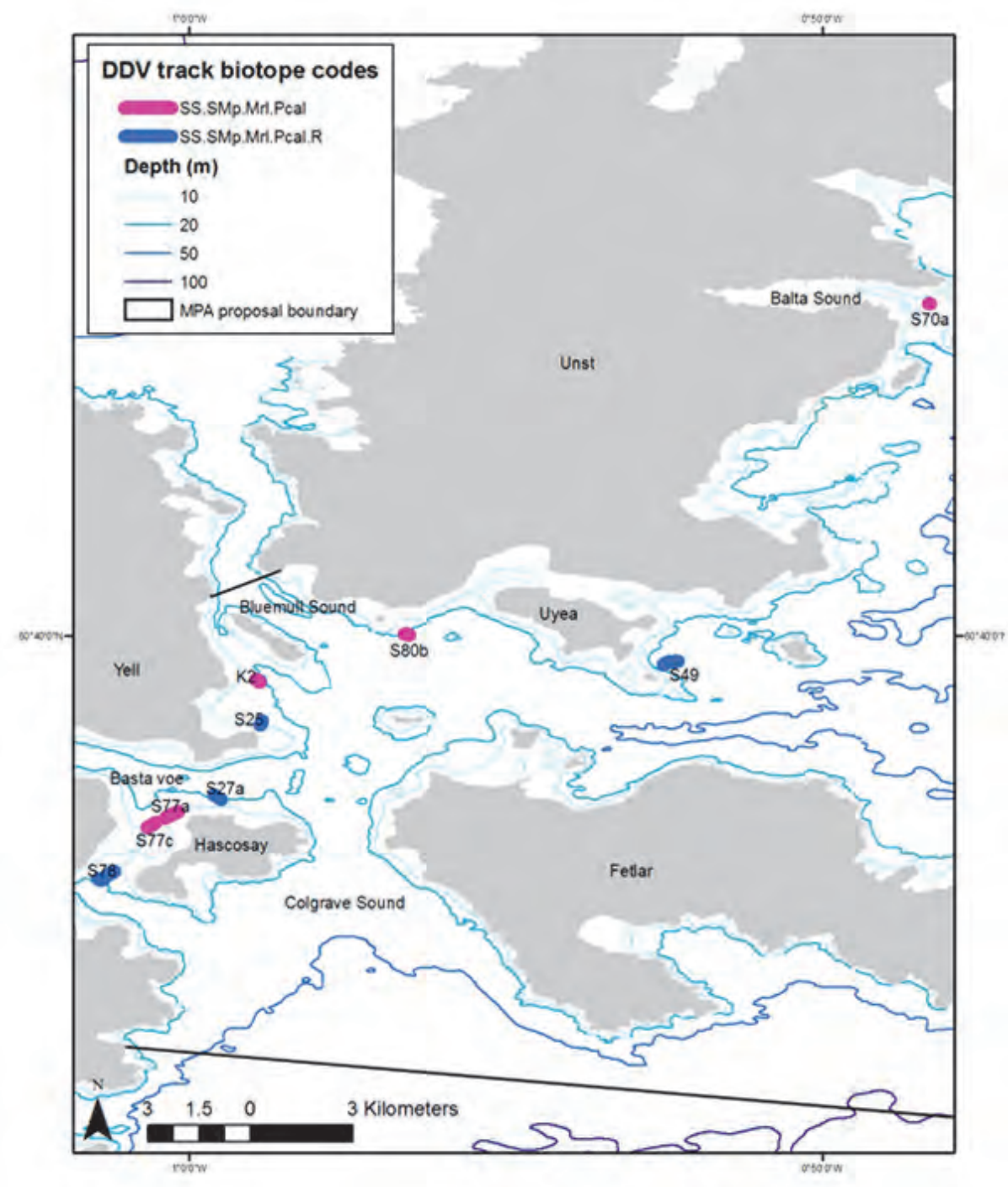

*Figure 17. Maerl bed (**SS.SMp.Mrl.Pcal** and **SS.SMp.Mrl.Pcal.R**) biotope stations in the central survey area.*

Surface sediment composition in maerl beds (where visible) was generally ~ 50% live maerl, 15% dead maerl, 10% empty shell and mixtures of sands, shell and pebbles making up the rest. Stations where maerl beds were recorded were inherently patchy in sediment composition with no consistent pattern.

Appendix 10 shows the abundance of species at each maerl biotope station (see also Figure 18). The only species present at all stations was the brown alga *Dictyota dichotoma*. Species present across all but 1 stations were *A. rubens* and *E. esculentus* whilst those recorded at

Figure 18. Typical maerl bed in the Fetlar to Haroldswick MPA proposal.

more than half of the maerl biotope stations were *Saccharina latissima*, *Pomatoceros triqueter* and *Membranipora membranacea*. The species recorded at half of the stations were Hydrozoa sp., *Pagurus bernhardus*, Pisces spp. *Pomatoschistus pictus*, *Scinia* sp. and Corallinaceae spp. All other species recorded were present at only 1-3 stations, in relatively low abundances across both maerl biotopes.

Although some species were found only at either **SS.SMp.Mrl.Pcal** or **SS.SMp.Mrl.Pcal.R**, this was only in small numbers, and not likely to be a significant difference in community composition between the two biotopes. The difference between them was the greater abundance of Rhodophyceae spp. at **SS.SMp.Mrl.Pcal.R** stations.
In maerl habitats, *Suberites* sp. was also growing on a large proportion of the *Aequipecten opercularis* (as seen in horse mussel bed habitats), and 'Rare' *M. modiolus* were recorded among maerl at station S80b. Conversely, maerl was recorded 'Frequent' at the **SS.SBR.SMus.ModT** station S51a.

The station with the most recorded species was S27a with 25, whilst only 9 species were recorded at station S70a. Overall there was no conspicuous spatial pattern in species abundances between stations. A full description of each video station is provided in Appendix 2.

3.2.3 Kelp and seaweed communities on sublittoral sediment

The proposed protected feature kelp and seaweed communities on sublittoral sediment (**SS.SMp.KSwSS**) was recorded at 11 stations (K10, S28a, S76b, K4.5, K5, K4b, S70b, S16b, S71a, S16a, K1b; Figures 19). Sub-biotopes of this complex were also recorded: **SS.SMp.KSwSS.LsacR.CbPb** (K10), **SS.SMp.KSwSS.LsacR.Gv** (S28a, S76b, K4.5, K5), **SS.SMp.KSwSS.LsacR.Sa** (K4b), **SS.SMp.KSwSS.Pcri** (S70b, S71a, S16a,) and **SS.SMp.KSwSS.Tra** (K1b, S16b).

The stations where **SS.SMp.KSwSS** biotopes were observed were restricted to the northern part of the survey area around Bluemull Sound and within Basta Voe and Balta Sound. The biotope was largely found in channel environments between islands and at the entrance to voes where the current was strongest. Stations were between 8.8 m (K4b) and 15.8 m (S71a) bsl.

Species found in the **SS.SMp.KSwSS** biotopes throughout the survey area were the kelp *S. latissima*, the bootlace weed *Chorda filum* and various red and brown seaweeds, particularly filamentous types (in lower abundances). The abundance of *S. latissima* at each station varied. At stations S76b and K5 *S. latissima* was 'Common' (1-9/m^2), at stations K4.5, and K4b it was 'Frequent' (1-9/ 100m^2) and at stations K10, S70b, and S28a it was 'Occasional' (1-9/1000m^2). Species composition was similar across most of the **SS.SMp.KSwSS** biotope stations which were dominated by kelp, with the exception of four stations (S71a, S16a, K1b, S16b). At these stations no kelp was recorded but instead *Trailiella* and *Phyllophora crispa* dominated, but also covered the underlying substrate making other species identification difficult.

Appendix 11 shows the abundance of species at each **SS.SMp.KSwSS** biotope station (see also Figure 20). No species were present at all stations. Only 5 species were present at more than half the stations: Rhodophyceae spp. at 9 stations*, M. membranacea* and *E. esculentus* at 7 stations, and Corallinaceae sp. at 6 stations. All other species were recorded at less than half the stations and in relatively low abundance with the exception of *Gobiusculus flavescens* where 110 individuals were recorded at station S70b, and Rhodophyceae sp. which was recorded as 'Abundant' at station S16 b. The station with the most recorded species was K5 (25 species), whilst at station K1b only 4 species were recorded. Overall there was no conspicuous spatial pattern in species abundances from video records between stations. A full description of each video station is provided in Appendix 2.

Surface sediment composition in these areas, where visible, was ~ 45% sands, 10% empty shell and the rest made up mostly of differing mixtures of shell gravel, cobbles, pebbles, and live and dead maerl. **SS.SMp.KSwSS** stations were inherently patchy in substrate composition with no obvious pattern.

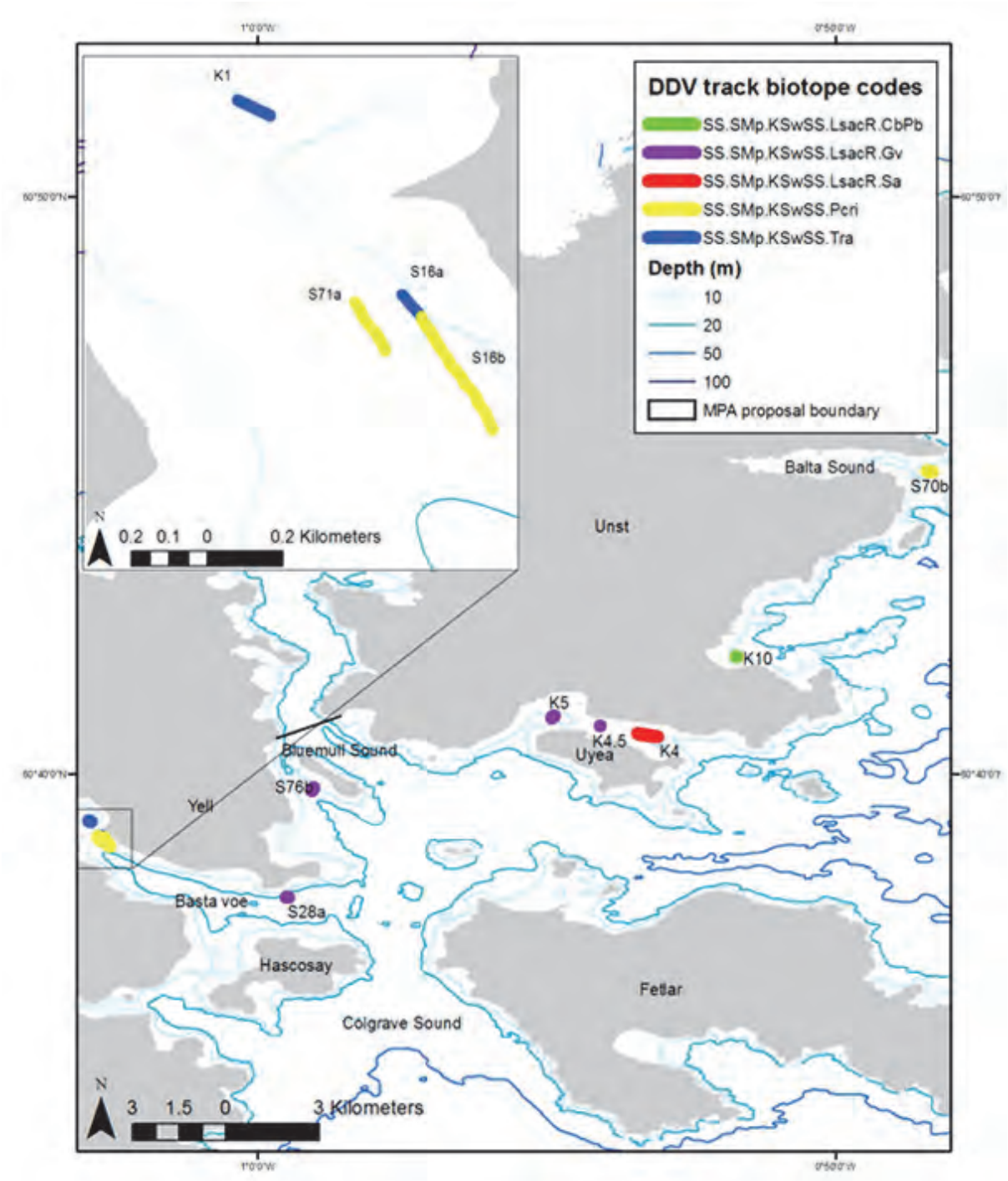

*Figure 19**. SS.SMp.KSwSS** biotope stations in central survey area.*

3.2.4 Circalittoral sand and coarse sediment communities, and shallow tide-swept coarse sands with burrowing bivalves

The proposed protected feature circalittoral sand and coarse sediment communities was recorded as **SS.SCS.CCS** at 17 DDV stations (S34b, S51b, S54, S56, K15, K11, S30, S6, S26, S53, S55, S46b, S47, S45, S5, S59, S29), and as the biotope complex circalittoral fine sand **SS.SSa.CFiSa** at only 1 station (S3) at a depth of 17.1 m off the NW coast of Uyea. The sediment composition at this station was estimated to be 30% fine sand, 25% empty shell and medium sand with 20% coarse sand and 'Rare' casts on the surface.

The stations where **SS.SCS.CCS** was recorded were spread throughout the survey area, with stations at the far end of Basta Voe and other inlets as well as a concentration of stations around the south and north-east of Fetlar. Stations were between 4.1 m (S75) and 54.6 m deep (S46b). Surface sediment composition in these areas was up to about ~ 75% sands, of which ~ 45% appeared coarse. Shell gravel and empty shell made-up to ~ 25% of the remainder of the sediment. At some stations a lot of scattered dead shell at the sediment surface indicated a possible underlying burrowing bivalve community (e.g. S53). Stations where **SS.SCS.CCS** was recorded appeared consistent in substrate type.

Appendix 12 shows the abundance of species at each circalittoral sand and coarse sediment biotope station (**SS.SCS.CCS** and **SS.SSa.CFiSa**). No conspicuous species were present at all stations but *Lanice conchilega*, *Pagurus bernhardus* and *Pomatoschistus* sp. were recorded at 8 of the stations. All other species recorded were present at 5 stations or less in relatively low abundances. Species abundances across all stations were low, i.e. up to 8 individuals or abundances of 'Occasional' or less. The exceptions were 'Common' Rhodophyceae sp. and 30 *P. bernhardus* at station S75. The station with the most recorded species was S54 (20 species), whilst at stations K11 and S30 only 1 and 2 species (respectively) were recorded. Overall there was no conspicuous spatial pattern in species abundances between stations, but species abundances across all stations were low when recorded by DDV.

Additional points of interest to be noted for **SS.SCS.CCS** stations were *Ascidiacea* sp. recorded at stations S47 and S75. *Ascidiacea* sp. was recorded in greater numbers at stations S29 and S59. Two stations, S29 and S59, at 10.8 m and 47.2 m deep (respectively) although recorded as **SS.SCS.CCS** appeared to show a slightly altered habitat due to the high abundance of *Molgula occulta*. The two stations were not located in the same area: S29 was at the far end of Basta Voe, whilst S59 was located at the entrance to Balta Sound. The sediment compositions for these two stations were different, with station S29 almost entirely fine sand and mud (99%) and a small amount of empty shell, whilst station S59 was approximately 45% coarse sand with the remaining fraction made up of poorly sorted medium, fine sands, mud and shell gravel. At both stations the number of species (4 species at station S59 and 6 species at station S29) and overall epifaunal species abundance was very low with the exception of the sea squirt species *Molgula occulta* which was 'Abundant' at station S59 and 'Occasional' at station S29. The sea squirts were living semi-infaunally with the siphons visible at the surface. This habitat description and species composition does not fit well with the **SS.SCS.CCS** biotope.

The infralittoral coarse sand biotope (**SS.SCS.ICS**) was recorded at 1 DDV station (S75) (see Figure 20), but could not be proven to be the protected feature biotope **SS.SCS.ICS.MoeVen** with burrowing bivalves from video analysis alone therefore the record was used to target grab sampling (reported later in the results section).
A full description of each video station is provided in Appendix 2.

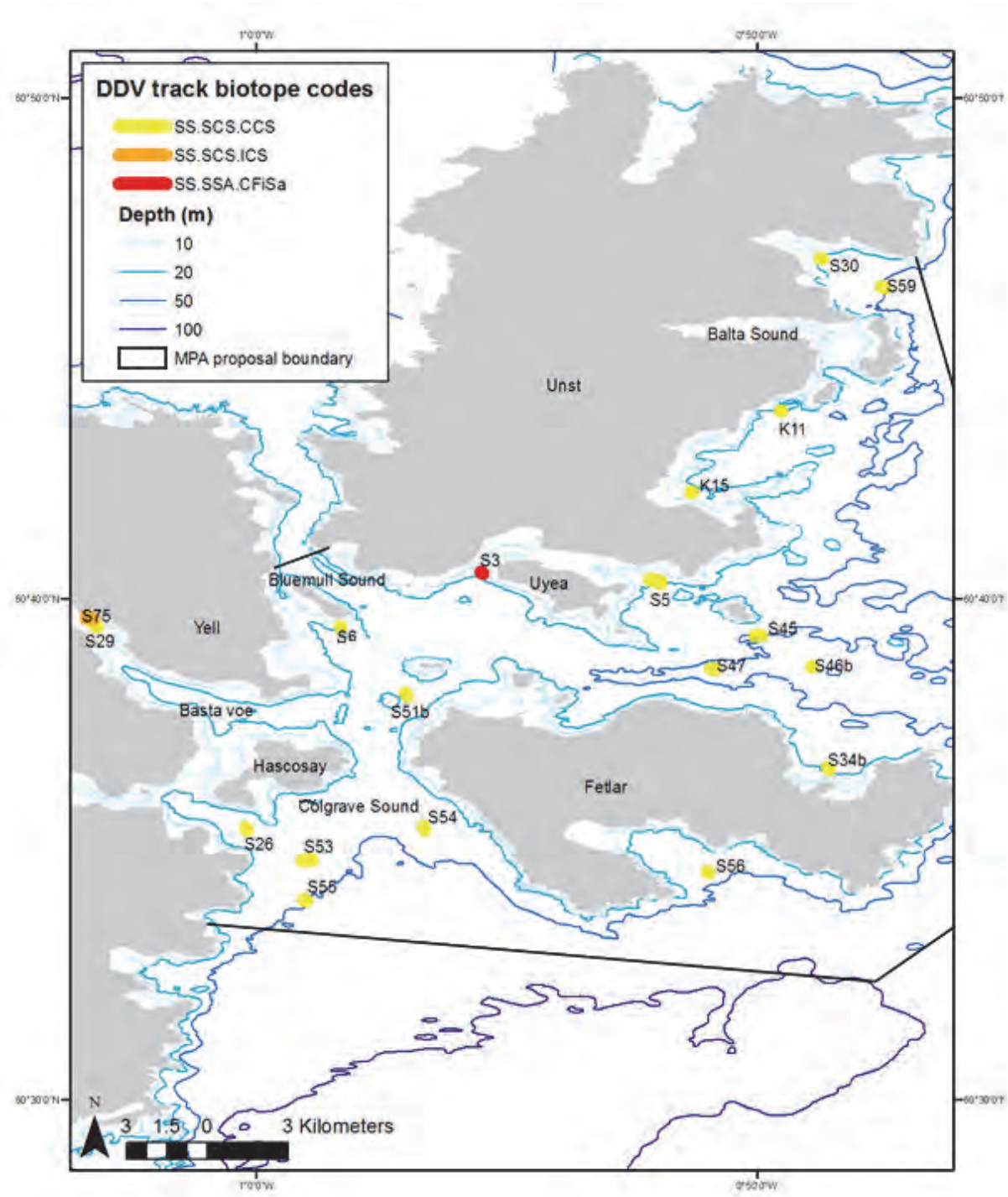

*Figure 20. **SS.SCS.CCS, SS.SSa.CFiSa,** and **SS.SCS.CFiSa** biotope stations in the Fetlar survey area*

3.3 Distribution of other biotopes

Other biotopes, not listed as proposed protected features, were also recorded within the Fetlar to Haroldswick survey area: **CR.MCR.EcCr**, **CR.MCR.EcCr.FaAlCr**, **CR.MCR.EcCr.FaAlCr.Bri**, **SS.SMu.CSaMu**, **SS.SMu.CSaMu.VirOphPmax**, **SS.SMu.ISaMu**, **SS.SMx.CMx**, **SS.SMx.CMx.OphMx**, **SS.SMx.CMx.FluHyd**, **SS.SSa.IMuSa.AreISa**, **SS.SSa.IMuSa.EcorEns**, **SS.SSa, SS.SSa.CMuSa** and **IR.MIR.KR.LhypT** (Figures 11-14).

The echinoderms and crustose community biotope complex (**CR.MCR.EcCr**) was recorded at 4 stations (S34a, S48, S65b, S80d) between 14 m (S80d) and 36.5 m bcd (S48) across the central survey area. Typically, the composition among the **CR.MCR.EcCr** stations was estimated to be ~50% bedrock, 25% large boulders interspersed with poorly sorted sand. The **CR.MCR.EcCr** biotope supported a narrow range of species that could be identified from DDV with *E. esculentus* (R-A) and Corallinaceae sp. present at all stations except S34a. There was no conspicuous geographic variation in species composition or abundances between **CR.MCR.EcCr** stations.

The faunal and algal crusts on the exposed to moderately wave-exposed circalittoral rock biotope complex (**CR.MCR.EcCr.FaAlCr**) was recorded at 4 stations (K14, S46a, S61, S64) between 42 m (K14) and 54.6 m (S46a) bcd. Stations were located down the east of the survey area with the exception of station K14. Typically, the habitat composition among the **CR.MCR.EcCr.FaAlCr** stations was estimated to be ~ 70% bedrock with 25% boulders and 5% coarse sand. The **CR.MCR.EcCr.FaAlCr** biotope was dominated by *E. esculentus* (45-56 individuals) and Corallinaceae sp. (C-A), *Parasmittina trispinosa* (F-A), *P. triqueter* (C-S), Porifera sp. (O-C), Bryozoa (absent to A) and Gadidae sp. (0-60 individuals). There was no conspicuous geographic pattern in species composition or abundances between **CR.MCR.EcCr.FaAlCr** stations.

Brittlestar beds on encrusted circalittoral rock (**CR.MCR.EcCr.FaAlCr.Bri**) were recorded at 3 stations (S33, S38 and S44) between 20.8 m (S33) and 36.8 m (S44) bcd. Stations were scattered throughout the survey area off Fetlar in Bluemull Sound and off Uyea. Much like the **CR.MCR.EcCr** and **CR.MCR.EcCr.FaAlCr** biotopes in our survey the habitat composition among the **CR.MCR.EcCr.FaAlCr.Bri** stations was dominated by ~80% bedrock, 5% cobbles, pebbles, coarse sand, medium sand and 3% large boulders. The **CR.MCR.EcCr.FaAlCr.Bri** biotope supported a range of species but was dominated by *Ophiocomina nigra* (R-C), *E. esculentus* (29-115 individuals), Corallinaceae sp. (F-C) and *P. triqueter* (O-C). Stations S38 and S44 had a similar number of species (15 and 16 respectively), however, station S33 had far less (7 species).

The mixed (heterogeneous) sediment biotope complex **SS.SMx.CMx** was recorded at 15 stations (K3b, S10, S19, S22, S28c, S31a, S37, S42, S50, S52, S57, S63, S65a, S65c, S7) between 14.5 m (S22) and 45.5 m (S57) bcd. Stations were located mainly throughout the Bluemull Sound area with outlying stations near east Unst and Fetlar. Typically, the sediment composition among the **SS.SMx.CMx** stations was estimated to be ~20% empty shell, 20% shell gravel, 15% cobbles, 15% pebbles and the rest composed of poorly sorted sands. The **SS.SMx.CMx** biotope supported many species but was dominated by Corallinaceae sp (R-C across 13 stations), *P. triqueter* (R-A across 13 stations), *E. esculentus* (1-92 individuals across 12 stations), and *A. rubens* (1-9 individuals across 11 stations). There was no conspicuous geographic pattern in species composition or abundances between **SS.SMx.CMx** stations.

The *Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar bed on sublittoral mixed sediment biotope complex **SS.SMx.CMx.OphMx** was recorded at 3 stations (S31b, S40, and S76a) between 13 m (S76a) and 30.8 m (S31b) bcd. The stations were located in close proximity to each other in the central Bluemull Sound area, with stations S31b and S40 adjacent. The sediment composition for these three stations was estimated as ~30% cobbles, 20% pebbles, 15% empty shell, 15% shell gravel, 15% coarse sand, and 5% small boulders. Fewer species were recorded in the **SS.SMx.CMx.OphMx** biotope than in the similar **SS.SMx.CMx** biotope and it was dominated by *Ophiothrix fragilis* (O-A)*, O. nigra* (R-F)*, Ophiopholis aculeata* (A-S)*, E. esculentus* (18-65 individuals)*, P. triqueter* (R-O), Corallinaceae sp. (R-C) and *M. modiolus* (R-O) across all stations. There was no conspicuous geographic pattern in species composition or abundances between **SS.SMx.CMx.OphMx** stations.

The *Flustra foliacea* and *Hydrallmania falcata* on tide swept circalittoral mixed sediment biotope **SS.SMx.CMx.FluHyd** was recorded at 1 station, K12 at a depth of 43.15 m bcd north of Balta Sound. The sediment composition at station K12 was approximately 30% cobbles, 20% pebbles and coarse sand, 15% shell gravel, 10% large boulders and 5% empty shell. Relatively few species were recorded from the **SS.SMx.CMx.FluHyd** biotope and it was dominated by 'Abundant' *Flustra foliacea*, 73 Gadidae sp., and 'Frequent' *A. bifida*.

The circalittoral sandy mud biotope complex **SS.SMu.CSaMu**, was recorded at this higher classification level at 3 stations (K1a, K1c, and K9) between 8.8 m (K1c) and 13.8 m deep (K1a). All of these stations were located within Basta Voe, which contained several other soft sediment biotopes. The sediment composition for these three stations was estimated as 33% mud, 50% fine or medium sand, and 8% empty shell and shell gravel. The **SS.SMu.CSaMu** biotope supported a small range of species, but was dominated by *P. bernhardus* (4-6 individuals across all stations), while other species where present at only 1 or 2 stations including 'Abundant' Rhodophyceae sp, 'Frequent' *Virgularia mirabilis* and *Turritella communis* at station K9, which was also the station with greatest number of species (17). K9 was located on the edge of a group of stations with dense *V. mirabilis* (**SS.SMu.CSaMu.VirOphPmax)** but with lesser numbers of the sea pens.

Exceptional examples of the *Virgularia mirabilis* and *Ophiura* spp. with *Pecten maximus* biotope **SS.SMu.CSaMu.VirOphPmax**, were recorded at 5 stations (K8, S12, S14, S39, and S71b) between 15.8 m (S71b) and 21.0 m deep (S39), with very high densities of seapens. All stations were located within a 3km stretch from the entrance into Basta Voe. Sediment composition for all stations was estimated to be 80% fine sand and mud with the remaining fraction composed of poorly sorted medium and coarse sands, shell gravel and empty shell. Also evident at these stations were 'Rare' to 'Occasional' mounds and burrows. The **SS.SMu.CSaMu.VirOphPmax** biotope was dominated across all stations by *Virgularia mirabilis* (A-S), as well as *Turritella. communis* (O-F), and *Echinus esculentus* (1-88 individuals). Although featuring in the name of the biotope, *P. maximus* was only recorded in low numbers (1-3 individuals) and was absent from station K8. It is important to note that 'Rare' *M. modiolus* were also recorded at stations S39, and S71b, the latter of which is adjacent to a previously recorded **SS.SBR.SMus.ModHAs** station (Howson, 1988). There was no conspicuous geographic pattern in species composition and abundances between **SS.SMu.CSaMu.VirOphPmax** stations.

The Infralittoral, cohesive sandy mud biotope complex **SS.SMu.ISaMu** was recorded at 3 stations (S72, S73, and S74) between 7.1 m (S74) and 16.83 m (S72) bcd. As was the case with all previously described **SS.SMu** biotope complexes (with the exception of S59), all three stations were located at the far end of Basta Voe. Sediment composition for the three stations was typically estimated at 40% mud, 30%fine sand, 20% empty shell, and 10% shell

gravel and medium sand. No conspicuous species occurred at all three stations, and only three species were recorded at station S74. *M. modiolus* was again recorded as 'Occasional' and 'Rare' at stations S72 and S73 respectively where previously the community had been recorded as **SS.SBR.SMus.ModHAs** (Howson, 1988).

The *Arenicola marina* in infralittoral fine sand or muddy-sand biotope **SS.SSa.IMuSa.ArelSa** was recorded at two stations (K4a and S60) at depths of 9.1 m and 10.2 m respectively. Stations were located in similar restricted flow areas, S60 in Balta Sound, and K4a in the channel between Unst and Uyea. Sediment composition varied between the two stations. Station S60 was mostly fine sand (88%), with some mud content and empty shell and 'Occasional' mounds and burrows on the sediment surface whilst station K4a appeared to consist of more poorly sorted sands (~35% fine sand, 30% medium sand, 20% coarse) with some shell gravel, empty shell and 'Occasional' burrows on the seabed surface of both stations. Both stations were dominated by *A. marina,* recorded as 'Abundant' at station S60 and 'Common' at station K4a. At station K4a two other species were recorded at low abundances, compared to eight species at station S60. Relatively few epifaunal species and low abundances were recorded from DDV at both stations, but these habitat types usually have more diverse infaunal- than epifaunal communities.

The *Echinocardium cordatum* and *Ensis* spp. biotope **SS.SSa.IMuSa.EcorEns** was recorded at one station (S27b) at 14 m bcd. The station, close to the entrance of Basta Voe, is adjacent to a maerl biotope (**SS.SMp.Mrl.Pcal.R**). Sediment composition was approximately 60% poorly sorted coarse and medium sands, with 10% fine sand, 30% empty shell, shell gravel and some dead maerl. The station was dominated by 'Abundant' dead *Ensis* sp. shell among 'Occasional' live *Ensis* sp. and 'Occasional' life maerl. The 16 other species present were not recorded in large numbers. The presence of occasional maerl adjacent to other **SS.SMp.Mrl.Pcal.R** stations suggests that this is near the edge of the maerl bed where it potentially changes into a burrowing bivalve community.

The circalittoral non-cohesive muddy-sand biotope complex **SS.SSa.CMuSa** was recorded at one station (S58) at a depth of 41.5 m off the NE of Fetlar. The station had a sediment composition of approximately 70% fine sand, 19% mud, 10% shell gravel and 1% empty shell. The station was extremely sparsely populated with conspicuous fauna. Only *A. rubens* (1) and Pisces sp. (1) were recorded.

The sublittoral sands and muddy-sands habitat complex **SS.SSa** was recorded at 1 station, (S70c) at a depth of 11.9 m at the entrance to Balta Sound. Station S70 consisted of 3 different biotopes; S70a **SS.SMp.Mrl.Pcal**, S70b **SS.SMp.KSwSS.Pcri** and S70c **SS.SSa. S70c** sediment composition was approximately 84% poorly sorted coarse, medium and fine sands, with 5% cobbles, pebbles and shell gravel, and a small amount of empty shell. Only 1-3 individuals of 5 species were recorded from DDV at this station.

The tide-swept algal communities biotope (**IR.MIR.KR.LhypT**) was recorded at two stations on the SE coast of Unst between 20.8 m (S43) and 27.2 m bcd (S62). The component kelp species, *Laminaria hyperborea*, was recorded as 'Abundant' (1-9 / m^2) at station S62 and as 'Frequent' (1-9 / 100m^2) at station S43. Sediment composition in these areas (where visible) was ~30% medium boulders, with 40% more boulders larger or smaller than this and 25% various grades of sand mixed with 5% empty shell. Species present at both stations included *P. triqueter*, *M. membranacea*, *A. rubens*, Rhodophyceae spp., Corallinaceae sp., *D. dichotoma* and *L. hyperborea*. All other species were recorded at only one station and in relatively low abundance with the exception of 170 Pisces sp. and 96 *G. flavescens*, 755 *E. esculentus* and 'Abundant' (1-9/m^2) *L. hyperborea* at station S43. Only 2 stations were recorded as the **IR.MIR.KR.LhypT** biotope, therefore it is not possible to describe any overall spatial pattern in species abundances.

3.4 Grab sampling analysis

Nineteen grab samples were successfully collected as part of the Fetlar to Haroldswick survey, with PSA and infaunal samples for each (Figure 21). At one additional station (SG11) only a PSA sample was obtained, because the grab contents were insufficient for an infaunal sample. A further three grabs were attempted but rocks were found within the teeth of the grab indicating unsuitable hard ground. DDV from neighbouring stations showed patchy hard substrate including bedrock throughout the large areas of coarse sand (see Appendix 1.2). Table 3 shows the infaunal community composition for each station.

In total 5 different biotopes were recorded at the grab stations: *Moerella* spp. with venerid bivalves in infralittoral gravelly sand (**SS.SCS.ICS.MoeVen**) was recorded at SG19, *Phymatolithon calcareum* maerl beds in infralittoral clean gravel or coarse sand (**SS.SMp.Mrl.Pcal**) at SG29, *Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed gravelly sand (**SS.SCS.CCS.Pkef**) at SG31, SG3, SG9A, SG9B, and *Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel (**SS.SCS.CCS.MedLumVen**) at stations SG1, SG2, SG23, SG30, SG13, SG21, SG22, SG27, SG4, SG5, and SG14.

Stations SG20 and SG28 were assigned the 'circalittoral sand' biotope of **SS.SCS.CCS** for lack of a more detailed description, however, this is not a complete fit. The community at these stations was probably more complex, most likely engineered by the stabilising influence of the presence of *Molgula occulta*.

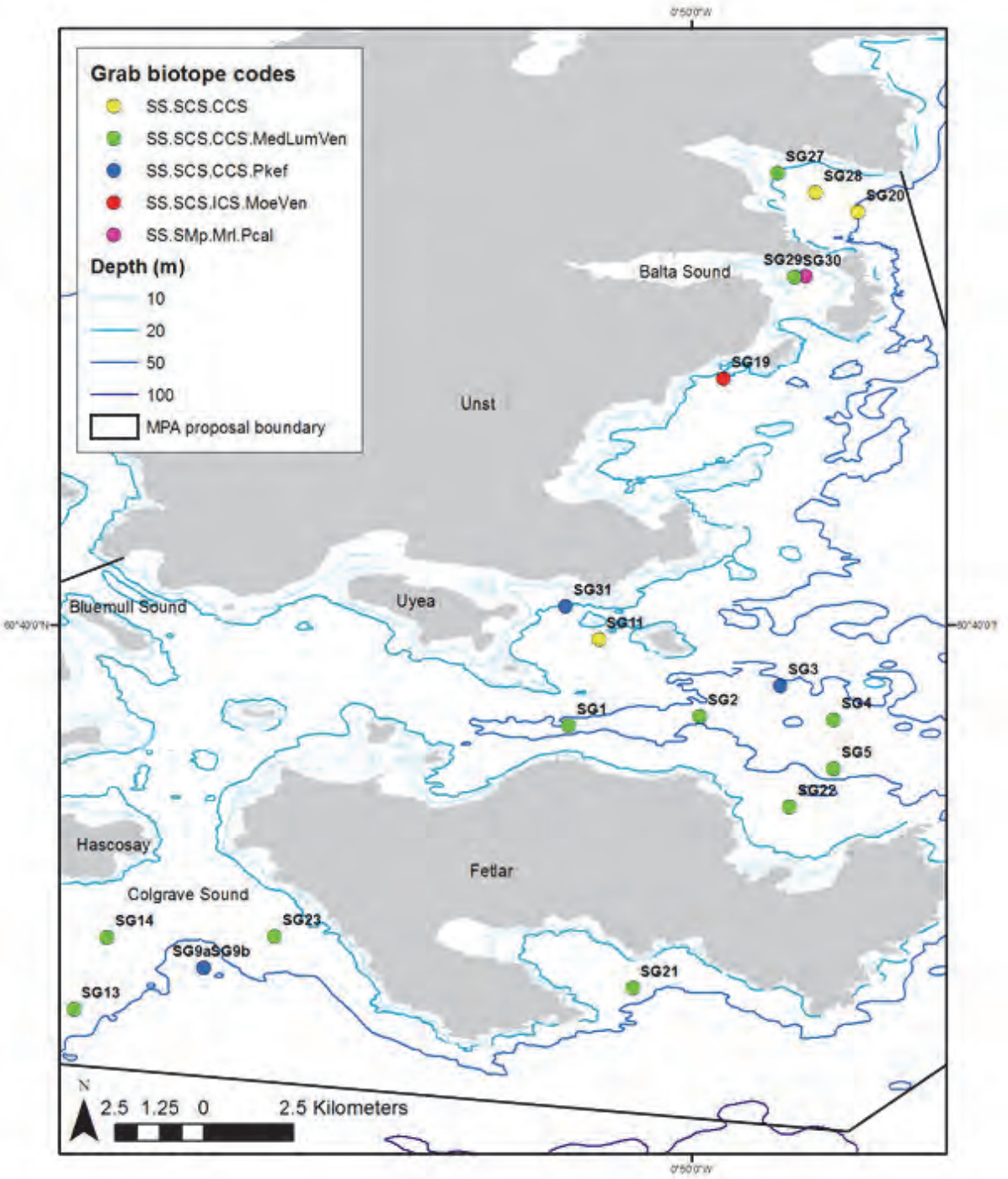

Figure 21. Grab station biotopes.

Table 3. Descriptive statistics of sediment infauna grab sample.

Sample	Species (S)	Abundance (N)	Species richness (d)	Pielou's evenness (J')	Shannon's diversity index H'(loge)	Simpson's diversity index 1-Lambda'
SG1	86	320	14.740	0.8425	3.753	0.9569
SG2	77	263	13.640	0.8765	3.807	0.9703
SG3	64	212	11.760	0.8810	3.664	0.9660
SG4	45	102	9.514	0.8507	3.238	0.9307
SG5	37	91	7.981	0.8867	3.202	0.9485
SG9A	20	44	5.021	0.8655	2.593	0.9133
SG9B	24	110	4.893	0.7452	2.368	0.8545
SG13	31	92	6.635	0.9222	3.167	0.9596
SG14	37	103	7.767	0.8720	3.149	0.9423
SG19	19	30	5.292	0.9647	2.841	0.9678
SG20	64	360	10.700	0.6829	2.840	0.8183
SG21	32	254	5.598	0.7583	2.628	0.8869
SG22	41	101	8.667	0.8412	3.124	0.9127
SG23	92	346	15.570	0.8809	3.983	0.9734
SG27	28	83	6.110	0.8736	2.911	0.9330
SG28	46	193	8.551	0.8491	3.251	0.9466
SG29	65	911	9.392	0.6957	2.904	0.8835
SG30	38	240	6.751	0.8091	2.943	0.9096
SG31	48	269	8.401	0.7159	2.771	0.8726

The station with the smallest number of infaunal species and individuals (SG19; Table 3) was located at the shallowest open coast station (24m) in a sparse area of **SS.SCS.ICS.MoeVen.** As well as low species numbers and abundance of individuals, station SG19 also had low (but not the lowest - this was recorded at station SG9B) species richness and diversity. While having low species richness and diversity, station SG19 recorded the highest species evenness. At the other extreme, SG23 contained more than four times the number of species (92); the most abundant being *Owenia fusiformis* (26), *Spio* sp. (25), *Thelepus cincinnatus* (21), Anomiidae spp. juv. (16) and *Lumbrineris cingulata/aniara* (15). Station SG23 had the highest species richness and diversity, with species evenness high but not the highest (highest species evenness was recorded at station SG19). The highest number of individuals (911) was found at station SG29 associated with the maerl community (**SS.SMp.Mrl.Pcal**), where there were large numbers of *Socarnopsis filicornis* (96), *Amphipholis squamata* (109), and Nematoda spp. (260). Species evenness and diversity did not otherwise vary greatly between stations, however, species richness showed a greater range between 4.893 - 15.57.

Stations SG1, SG2, and SG23 allocated **SS.SCS.CCS.MedLumVen** (below) were located in deeper water (38-54m) than **SS.SCS.ICS.MoeVen** along open coast sites. The samples from these sites were quite species rich compared to other stations. Stations SG31, SG9A, SG9B, and SG3 (**SS.SCS.CCS.Pkef** – see below) occurred between 22-53m depth in coarser sediments than other samples and had slightly lower species richness and abundances compared to most other stations. There were no other clear spatial patterns between stations, with stations with the most and least number of species and abundances spatially interspersed.

PSA analysis from the grab samples broadly matched the sediment records from video footage from the same locations. A full table of sediment analysis data is given in Appendix 4. All grab samples were dominated by medium, coarse and very coarse sand. PSA samples here do not represent the entire survey area because the Van Veen grab did not penetrate hard packed mixed sediments and fine sediment voe communities were not targeted. It was apparent from video footage that large expanses of the survey area were dominated by dead shell and mixed rocky / cobble sediments, particularly around the horse mussel bed areas, where grab sampling was not possible. The biotopes assigned to the grab stations reflect the sediment type, species composition, and take into consideration the nearest DDV station biotopes, confirming the biotope assignment process was satisfactory for both visual DDV assessment and infaunal species and substrate assessment.

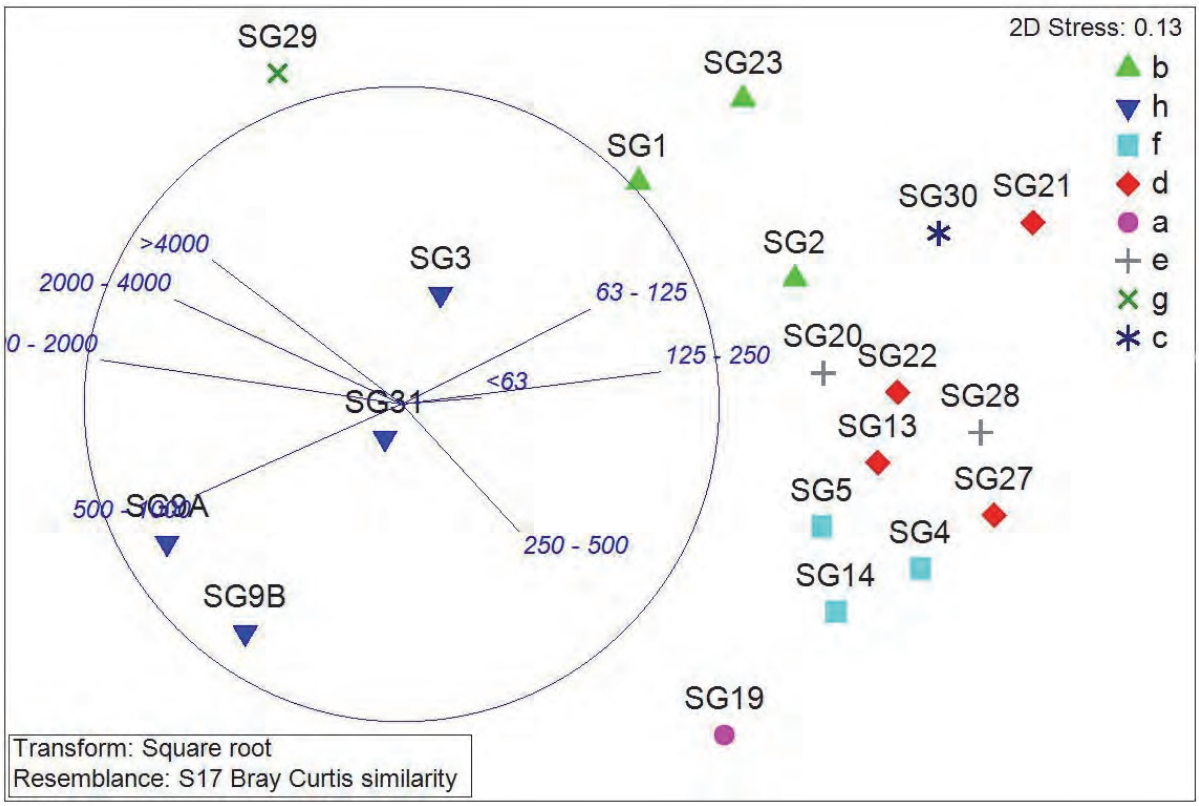

Figure 22. MDS plot of grab infaunal data showing similarity of samples according to species composition and PSA results. Samples are split into post hoc *assigned groups a-h according to SIMPROF results (groups a, c and g are stand alone stations) and labelled by grab number. Radiating blue lines denote influence of PSA in 'RELATE' test. Clustering of SIMPROF groups can not be represented fully in a 2-dimensional MDS plot, so some groups appear split in the plot.*

Figure 22 shows a 2D multi-dimensional scaling (MDS) plot which shows similarities between samples according to species composition, overlaid with the PSA results. A 'Relate' test showed a significant relation between PSA and species abundances (R=0.661, P=0.001). Groups a - f were assigned *post hoc* as results of a SIMPROF analysis, which examines the species abundance matrix for any significant groupings. SIMPROF identified 5 groups of stations and 3 stand-alone stations within the grab sample data. The groups appear split in some cases because the 2D MDS plot can not represent the relationships fully.

Three groups are clearly separated on the plot: group g (SG 29) as the only representative of a maerl biotope (**SS.SMp.Mrl.Pcal**), group a (SG 19) as the only representative of shallow

tide-swept coarse sands with burrowing bivalves (**SS.SCS.ICS.MoeVen**), and group h (SG 3, SG 9A, SG 9B, SG 31) as a cluster of **SS.SCS.CCS.Pkef** stations with medium to very coarse substrate.

All remaining stations were representatives of the biotope **SS.SCS.CCS.MedLumVen**. The SIMPROF analysis divided these stations into 5 further groups based on more subtle differences in species composition within the biotope.
Group e (SG 20 and SG 28) was characterised by the presence of the burrowing ascidian *Molgula occulta* which was not present at the other stations, and by a more complex community with high species counts and abundances, perhaps engineered by the stabilising influence of *M. occulta*.
Samples in group b (SG 1, SG 2 and SG 23) are all from deeper open coast sites (38 - 54 m), with higher species richnesses and abundances than other stations of the **SS.SCS.CCS.MedLumVen** biotope, and medium to very coarse substrate.
Groups c (SG 30) and f (SG 4, SG 5, and SG 14) were also found in medium to very coarse substrate but with differing abundances of ubiquitous species such as *Lumbrineris cingulata*, *Owenia fusiformis* and *Echinocyamus pusillus* (SIMPER).
Group d (SG 13, SG 21, SG 22, SG 27) consists of samples from 21- 43 m of mostly open coast but all sheltered to some extent. *Owenia, Siophanes, Timoclea* and species of *Ampelisca* point to this being an **SS.SCS.CCS.MedLumVen** biotope despite low numbers of venerids, for the detection of which more and bigger samples would be required. There are elements of the shallower water **ICS.MoeVen** biotope in this group, which suggests that these biotopes might transition into each other.

3.5 Horse mussel bed clump sample analysis

Three sites where densities of *Modiolus modiolus* had met 'bed' status from DDV records were investigated further (Appendix 1.3). 4 replicate clump samples were collected at each site and analysed for epi- and infaunal species diversity (Figure 9).

3.5.1 Horse mussel bed epifaunal species analysis

Analysis of the epifauna at the three horse mussel bed sites revealed that Site 1 (BVME) had the highest epifaunal species diversity (H' range 1.71 to 2.64) and highest number of species (S range 31 to 35) of the three sites, while Site 3 (HSME) had the lowest epifaunal species diversity (H' range 0.55 to 1.31) and Site 2 (USME) had the lowest number of species (S range 18 to 21) (Table 4).
The video footage corresponding to the clump sampling sites (see Appendix 1.3) shows that the epifauna of all three sites was dominated by brittlestars. Site 1 (BVME, on DDV station S28) with the highest epifaunal diversity, however, had the lowest abundance of brittlestars i.e. Common, as opposed to Superabundant and Abundant at Sites 2 and 3 respectively.
Site 3 (HSME) with the lowest species diversity contained the two samples with the highest abundances (HSME_B N = 441 and HSME_ D N = 638) which were mainly made up of very high numbers of Anomiidae sp. (402 and 493 respectively).

Table 4. Descriptive statistics of M. modiolus *clump epifauna samples.*

Sample	Species (S)	Abundance (N)	Species richness (d)	Pielou's evenness (J')	Shannon's diversity index H'(loge)	Simpson's diversity index 1-Lambda'
USME_A	22	152	4.180	0.4217	1.3030	0.5033
USME_B	21	120	4.178	0.4540	1.3820	0.4940
USME_C	21	179	3.856	0.4889	1.4880	0.6617
USME_D	18	144	3.421	0.3209	0.9274	0.3269
BVME_A	35	211	6.353	0.4812	1.7110	0.6429
BVME_B	32	150	6.187	0.5569	1.9300	0.7033
BVME_C	31	165	5.876	0.5339	1.8330	0.7135
BVME_D	31	76	6.927	0.7700	2.6440	0.8618
HSME_A	23	159	4.340	0.4170	1.3080	0.4628
HSME_B	25	441	3.942	0.1712	0.5512	0.1688
HSME_C	21	223	3.699	0.2497	0.7603	0.2504
HSME_D	28	638	4.181	0.2794	0.9311	0.3847

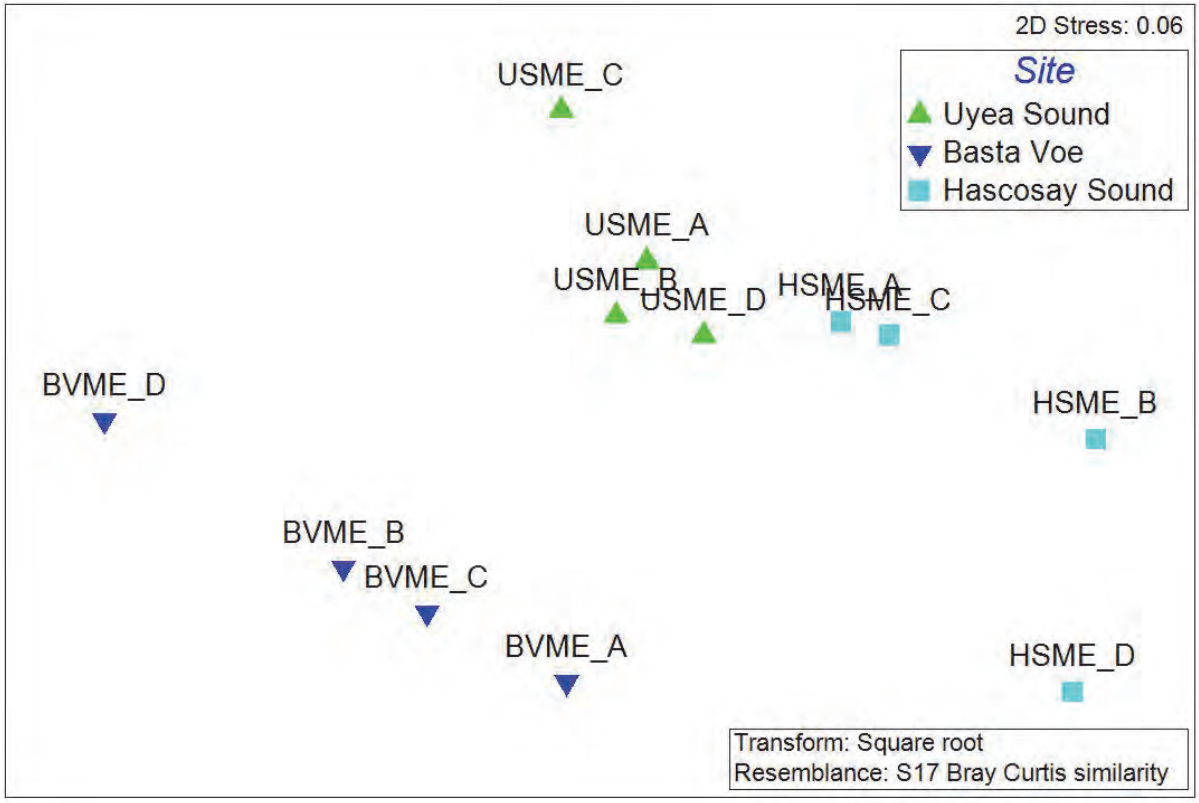

Figure 23. Multidimensional scaling plot of M. modiolus *clump epifauna data labelled by sample number.*

There were significant differences in the epifaunal species composition between the three clump survey sites (ANOSIM, R=0.78, P=0.002). The pairwise tests showed all three sites were significantly different from each other (R always >0.583, P=0.029). SIMPER analysis showed within group variation was similar at all sites (67-72% similarity) with Anomiidae sp.

contributing a minimum of 20% of the similarity within sites. Dissimilarity between sites was also of a similar scale (38-47%) with Anomiidae sp. again contributing a minimum of 18% of the dissimilarity. With the exception of Uyea and Basta Voe, where *P. triqueter* was the major contributor to dissimilarity, all other dissimilarities were driven by small differences in abundance of a large number of polychaete species (Figure 23).

3.5.2 Horse mussel bed infaunal species analysis

Table 5. Descriptive statistics of M. modiolus *clump infauna samples.*

Sample	Species (S)	Abundance (N)	Species richness (d)	Pielou's evenness (J')	Shannon's diversity index H'(loge)	Simpson's diversity index 1-Lambda'
USM_A	30	726	4.402	0.6422	2.184	0.8268
USM_B	48	524	7.506	0.6789	2.628	0.8723
USM_C	48	882	6.930	0.5795	2.244	0.8154
USM_D	41	482	6.475	0.5621	2.088	0.7151
HSM_A	62	1008	8.820	0.6502	2.683	0.8868
HSM_B	68	804	10.020	0.7020	2.962	0.9127
HSM_C	48	549	7.451	0.6860	2.656	0.8844
HSM_D	56	619	8.556	0.7144	2.876	0.9033
BVM_A	69	364	11.530	0.8341	3.532	0.9559
BVM_B	84	589	13.010	0.8376	3.711	0.9582
BVM_C	79	399	13.020	0.8432	3.684	0.9617
BVM_D	64	183	12.090	0.8982	3.735	0.9686

Infaunal analysis combined abundance counts and 'Presence' of species which were unable to be counted either due to only parts of individuals recorded or where counts were impossible due to the growth form of the species e.g. colonial organisms. To allow analysis of species, 'Present' species were recorded as a count of 1. The stations with the lowest number of infaunal species were all located within Uyea Sound (30-48, see Table 5). At the other extreme, samples from Basta Voe contained up to almost 3 times the number of species (84). The most abundant species found at BVM_B were *Ostracoda* sp. (86), *Ophiopholis aculeata* (40), *Tubificoides pseudogaster* agg (28), *Stenothoe marina* (27) and *Nereimyra punctata* (24). Although the Basta Voe site contained the greatest number of species, samples with the lowest abundances also came from this site. The highest species evenness and diversity was recorded at another Basta Voe station (BVM_D), whilst highest species richness was recorded at BVM_C. All Basta Voe stations were in fact very similar in high species richness, evenness and diversity. The highest count of individuals was at station HSM_A on account of NEMATODA spp. (202), *Capitella capitata* agg. (132), *Tubificoides pseudogaster* agg. (166), and *Ophiopholis aculeata* (141) (Table 5).

ANOSIM showed significant differences between the infauna of *M. modiolus* clumps at the three different survey sites (R=0.692, P=0.001). A pairwise test showed that all three sites were significantly different from each other (R>0.531, P=0.029). SIMPER analysis showed all sites had high levels of similarity (58-70%), with no single species contributing more than 14% to this similarity within sites. Groups were driven by small differences in the abundance of a large number of polychaete species. Dissimilarity between sites was between 37 and 60% with no single species contributing more than 6% to this dissimilarity. These differences were again driven by small differences in abundance of a large number of polychaete species (Figure 24).

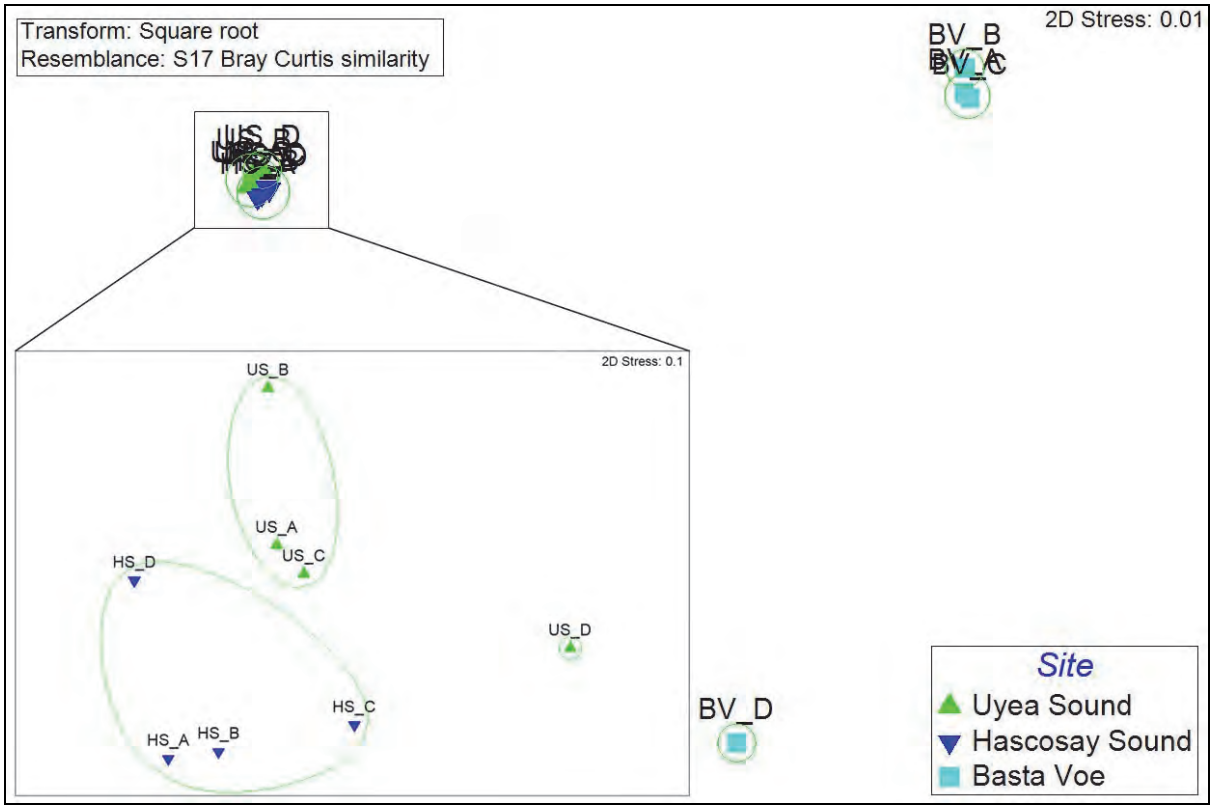

Figure 24. Multidimensional scaling plot of Modiolus modiolus *clump infauna data clustered into groups and labelled by sample number, light blue line denotes 65% similarity.*

3.6 Maerl core sample analysis

When comparing the two maerl bed sites, overall the number of species and abundances are very similar with 115 different species, and 976 individuals recorded in Hascosay Sound compared to 110 species, and 1039 individuals recorded at North Hascosay, and means of diversity indices are very similar (Table 6). The mean number of species per sample was 55 for Hascosay Sound and 53 for North Hascosay, with mean abundances of 244 and 260 individuals respectively.

From the corresponding DDV footage the North Hascosay site (S 27) was assigned the biotope **SS.SMp.Mrl.Pcal.R**, while the Hascosay Sound site (S 77a) was assigned **SS.SMp.Mrl.Pcal** and was located adjacent to a horse mussel bed. The infaunal analysis revealed that these two biotopes did not differ substantially in species composition other than a higher proportion of red algae at North Hascosay.

Table 6. Descriptive statistics of maerl core infauna samples.

Sample	Species (S)	Abundance (N)	Species richness (d)	Pielou's evenness (J')	Shannon's diversity index H'(loge)	Simpson's diversity index 1-Lambda'
Hascosay_A	57	315	9.735	0.7977	3.225	0.9314
Hascosay_B	73	348	12.300	0.8129	3.488	0.9490
Hascosay_C	37	81	8.192	0.8887	3.209	0.9448
Hascosay_D	54	232	9.731	0.8020	3.199	0.9301
Mean	*55*	*244*	*9.990*	*0.8253*	*3.280*	*0.9388*
North Hascosay_A	42	206	7.695	0.8384	3.134	0.9369
North Hascosay_B	62	236	11.160	0.8594	3.547	0.9574
North Hascosay_C	52	330	8.794	0.7306	2.887	0.8973
North Hascosay_D	54	267	9.486	0.8056	3.214	0.9342
Mean	*53*	*260*	*9.284*	*0.8085*	*3.196*	*0.9315*

3.7 *In situ* diver survey analysis

Table 7. Descriptive statistics from in situ *diver survey (MNCR style).*

Station	Sample	Species (S)	Species richness (d)	Pielou's evenness (J')	Shannon's diversity index H'(loge)	Simpson's diversity index 1-Lambda'
Modiolus Station 1	BVMNCR1	54	13.29	1.00	3.99	1.00
Modiolus Station 2	USMNCR2	33	9.15	1.00	3.50	1.00
Modiolus Station 3	HSMNCR3	30	8.53	1.00	3.40	1.00
Maerl Station 1	NHM1	45	11.56	1.00	3.81	1.00
Maerl Station 2	HM2	54	13.29	1.00	3.99	1.00

In situ records for the horse mussel beds reflected the epifaunal data derived from collected clumps. *In situ* survey data does not compare with infaunal samples because infauna is not visible to divers. Overall the *in situ* data show a greater number of species at the Basta Voe horse mussel bed than the other two beds (USMNCR2 and HSMNCR3). The Basta Voe site had the highest species richness and Shannon's diversity, although evenness and Simpson's diversity could not be calculated effectively due to the presence or absence nature of the data. The Hascosay maerl bed had the highest number of species recorded *in situ*, species richness and Shannon's species diversity of the two maerl sites. There is little to differentiate the two maerl beds surveyed *in situ* (Table 7). Full *in situ* species data are available in Appendix 5.

Comparing results between methods of sample collection at each horse mussel bed surveyed is not valid because each method targets a different component of the community. Clump infauna species diversity may appear high (2.08-3.73), compared to clump epifauna diversity (0.55-2.64) but these are not helpful comparisons because the majority of organisms collected in a clump sample would classify as infaunal. Furthermore, *in situ* diver

surveys generally record fewer species than clump sampling as it does not include sediment infauna, however, they do allow for a greater scope of species (especially mobile) and abundances from a larger area which can show a greater number of species not captured by smaller clump samples. When comparing horse mussel beds either within the present survey or to other UK beds, comparisons of species numbers provide a quick and simple way of comparing beds, when the same methods are used.

4. DISCUSSION

4.1 Horse mussel beds

Previous surveys of Shetland (Howson, 1988) identified 5 stations where *M. modiolus* could be found in the study area as the **SS.SBR.SMus.ModCvar**, **SS.SBR.SMus.ModT**, or **SS.SBR.SMus.ModHAs** biotopes. The present survey revisited these stations and found a horse mussel bed biotope at only one of these locations (Figure 31; station S28b) at the entrance to Basta Voe. The Basta Voe horse mussel bed biotope in the present study (**SS.SBR.SMus.ModT**) was adjacent to stations where circalittoral mixed gravels and kelp and seaweeds on sublittoral sediment were recorded (see S28a, S28c and S19 in Figure 31). *M. modiolus* was recorded at station S28b as 'Common', but was not recorded from the neighbouring stations. Large abundances of dead shell and other mixed sediment (**SS.SMx.CMx**) at neighbouring stations (S19 and in particular S28c) may have concealed further live *M. modiolus* that have not been observed in DDV records.

No other revisited stations where horse mussel beds had been recorded previously qualified as horse mussel beds in the present study although scattered individuals were recorded in the vicinities. *M. modiolus* was recorded at S76a (R), S22 (O), and S38 (R) in the Bluemull Sound area, and S72 (O), S16b (F), S71a, (R), S71b (R) and S73 (R) in Basta Voe.

The sparse *M. modiolus* recorded in the Bluemull Sound at S76a, S22 and S38 were accompanied by large numbers of brittle stars on circalittoral mixed substrate where it is entirely possible that a horse mussel bed community may have been concealed and not accounted for using DDV. It therefore remains possible that a horse mussel bed may occur within this 0.378km area where it had previously been recorded (Howson, 1988; Figure 25). However, the more likely possibility is that the previously recorded horse mussel bed has deteriorated and no longer meets the standard of a 'bed' or that the patchy mosaic of horse mussel beds throughout the Bluemull Sound to Basta Voe area is such that the previous record was a small patch that was not located this time.

The historic records of horse mussel beds at the far end of Basta Voe (Howson, 1988) near stations S72, S16b, S71a, S71b and S73 were intensively and unsuccessfully searched for. Although the DDV survey vessel was unable to position itself on the exact historic station due to the presence of a mussel farm the habitat in the area seemed to be inappropriately muddy. It is possible that changes in the use of this part of the Basta Voe have led to the decline of the previously recorded horse mussel bed to the relatively few individuals recorded in the present survey.

Areas of the MPA search feature 'horse mussel bed' (**SS.SBR.SMus.ModT**) not previously recorded were found at 5 other stations (K3a, S51a, S77b, S80a and S80c) within Bluemull Sound and Hascosay Sound.

The **SS.SBR.SMus.ModT** stations in Bluemull were surrounded by neighbouring stations where **SS.SMx.CMx** and **SS.SMx.CMx.OphMx** were recorded. As previously discussed, further live horse mussel beds may be concealed at these stations and not detected by DDV sampling. At stations S52, S40, and S31b near to areas of definitive **SS.SBR.SMus.ModT** *M. modiolus* were recorded as 'Rare' to 'Occasional', which may indicate that horse mussel beds extend patchily beyond those station transects where they were recorded (Figure 25).

The pockets of confirmed **SS.SBR.SMus.ModT** interspersed with other habitats in the present study are small compared to other beds in Scotland and the UK. Given the patchiness of their occurrence we are unable to interpolate between horse mussel bed records at different stations and can only estimate a total transect length of 0.418km for this

biotope which equates to a known area of approximately 0.128km^2 using the known width of view of the camera (undoubtedly highly conservative). The horse mussel beds in the present study therefore compare favourably with those recorded at Loch Creran (0.02km^2), Port Appin (0.02km^2), and Loch Leven (0.01km^2) but are reasonably small compared to the largest known examples off the Llyn Peninsula, North Wales (3.75 km^2: Lindenbaum *et al*., 2008) and Noss Head, NE Scotland (3.84km^2: Hirst *et al.,* 2012b) (Table 8). There are reports of another potentially large bed off the Ards Peninsula in Northern Ireland (Edwards pers. comm. 2012) but work is currently underway to measure the size, health and species composition of it.

Horse mussel bed species numbers from the present survey are comparable to those of similar size beds (Table 8) despite different sampling methodologies. Thus, although only moderate of size, the horse mussel bed complex recorded in the Fetlar to Haroldswick survey area is of comparable biodiversity interest to other protected beds in the UK.

Also highlighted in the present survey were differences in infaunal and epifaunal species composition from horse mussel clump samples taken from different sites. This shows variation in the associated communities of the different horse mussel beds despite their geographic proximity, which highlights the collective biodiversity importance of the horse mussel beds.

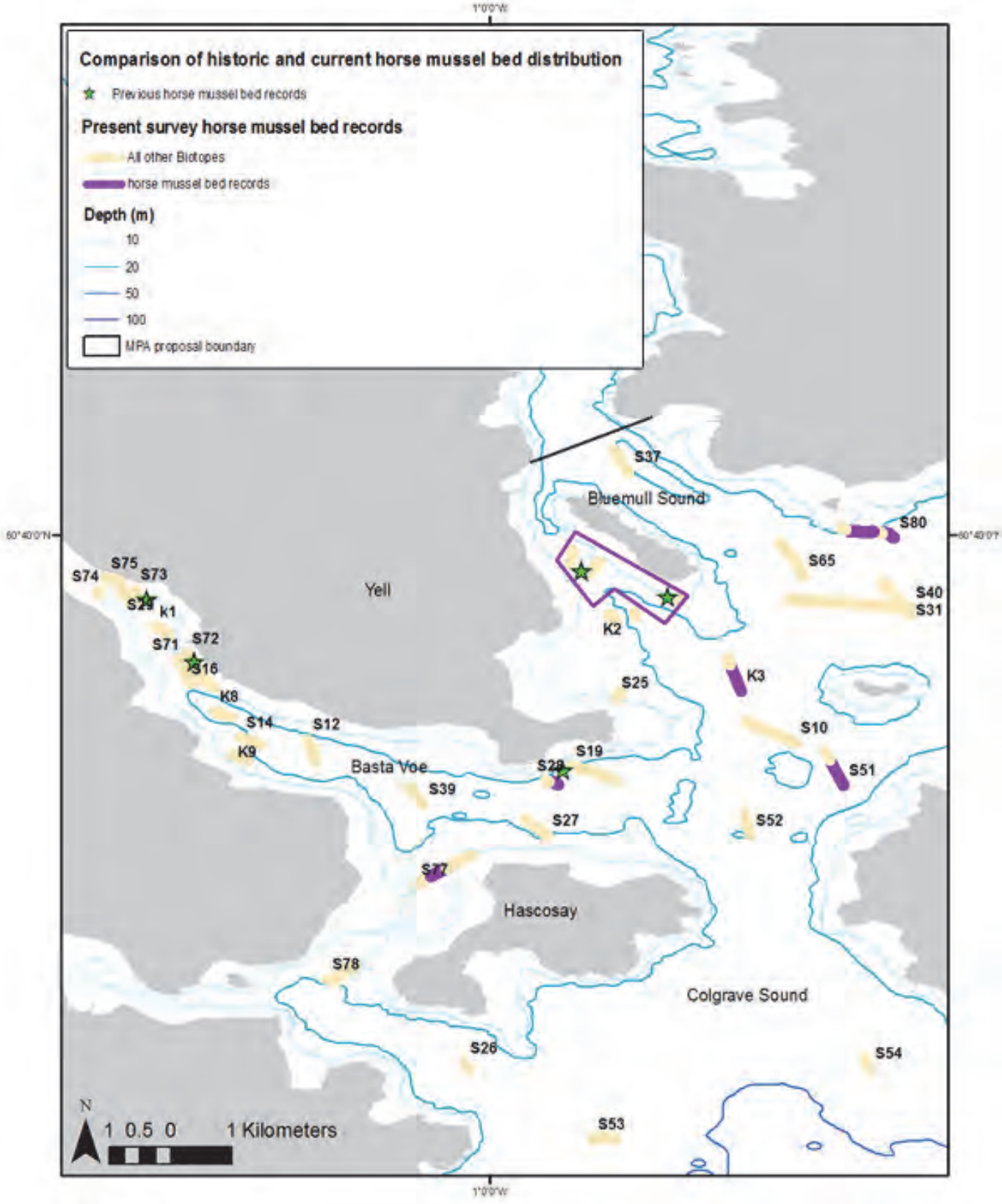

Figure 25. Previous records of horse mussel beds and present survey findings. Purple line ▬ highlights possible horse mussel bed obscured by epifauna, with only few individuals seen on DDV.

Table 8. Comparison of known UK horse mussel beds: MNCR = in situ *diver records using MNCR techniques (*Hiscock, 1996).

Number of species	Type of coast	Bed (s)	Sampling method	Bed size	Author
297 (total)	Open	Shetland, Fetlar to Haroldswick MPA proposal	Drop down video (x3), Diver clump samples (x12), Diver MNCR (3 sites)	0.128km^2	Hirst *et al.* (this volume)
283 (total)	Enclosed	Gutter Sound, Orkney	Diver clump samples (x4), video transect and diver MNCR	Unknown	Hirst *et al*. (2012a)
270 (total)	Open	Point of Ayre, N. Isle of Man	Grab gear and video. Details unknown.	Within 6 km^2	Holt and Shalla, unpublished (in Holt *et al*., 1998)
268 (total)	Enclosed	Strangford Lough, N.I.	Diver samples (3x 0.25m2 quadrats), video and diver MNCR at 3 sites	0.5km^2 remaining	Roberts *et al*. (2004)
237 (total)	Enclosed	Loch Alsh, N.W. Scotland	Diver clump samples (x4), and MNCR	0.13km^2	Mair *et al.* (2000)
230	Open	Pen Llyn, N. Wales	Diver suction samples (3x0.25m2 cores)	3.75km^2	Rees *et al*. (2008) Lindenbaum *et al.* (2008)
222 (total)	Enclosed	North Cava, Orkney	Diver clump samples (x4), video transect and diver MNCR	Unknown	Hirst *et al*. (2012a)
175 (total)	Enclosed	Loch Creran (upper basin), W. Scotland	Diver clump samples (x4), and MNCR	0.02km^2	Mair *et al.* (2000)
160 (total)	Enclosed	Busta Voe, Shetland	Diver clump samples (x4), and MNCR	Unknown	Mair *et al.* (2000)
75	Open	Noss Head, N.E. Scotland	Drop down video	3.84km^2	Hirst *et al.* (2012b)
50	Enclosed	Annant Narrows (nr Corpach) W. Scotland	Diver MNCR	0.10km^2	Moore *et al*. (2012)
44	Enclosed	Loch Leven (An Dunan) W. Scotland	Diver MNCR	0.01km^2	Moore *et al*. (2012)
36	Open	Copinsay, Orkney	Drop down video	0.42km^2	Hirst *et al.* (2012a)
35	Enclosed	Port Apin, W.Scotland	Diver MNCR	0.02km^2	Moore *et al*. (2012)

4.2 Maerl beds

Maerl bed biotopes **SS.SMp.Mrl.Pcal** and **SS.SMp.Mrl.Pcal.R** were recorded at nine stations concentrated in Hascosay Sound and along the Yell coast of Bluemull Sound. Records of less abundant scattered maerl also occurred throughout the survey area. Maerl was recorded as a mosaic with other habitat types, forming distinct sections, e.g. S77 where maerl occurred either side of a horse mussel bed. In the case of station S25 maerl formed the underlying basis for an **SS.SMp.KSwSS** habitat, such that biotopes were overlayed. Although the maerl bed biotopes were recorded at nine stations, records were no more than 0.366km in DDV length. The present records may represent a continuous bed in places such as Hascosay Sound as well as a complex of smaller beds interspersed with other biotopes. Nevertheless, interpolation around just those areas where contiguous maerl beds were encountered produces a conservative extent estimate of approximately 0.67km^2 off Hascosay, and 0.27km^2 further north in Bluemull Sound (Table 9).

Table 9. Comparison of extents of known UK maerl beds.

Bed size	Type of coast	Bed	Author
9.07km^2	Open	Sound of Barra	Harries e*t al*., 2007
4.26 km^2	Open	Sound of Arisaig	Moore *et al*., 2004 SNH/Biomar- Davies, 1997
7 km^2	Open	Antrim Coast	Wilson *et al*., 2007
1.5 km^2	Estuary	Milford Haven	Bunker and Camplin, 2007
0.118 km^2	Loch	Badluarach, Little Loch Broom	Moore *et al*., 2011
12.88 km^2	Open	Wide Firth and Kirkwall Bay	Hirst *et al*., 2012a
1.98 km^2	Open	Gairsay	Hirst *et al*., 2012a
0.46 km^2	Open	Shapinsay	Hirst *et al*., 2012a
0.48 km^2	Open	Veantrow Bay	Hirst *et al*., 2012a
3.71 km^2	Open	Wyre and Rousay	Hirst *et al*., 2012a
1.75 km^2	Open	Eday	Hirst *et al*., 2012a
0.67km^2	Open	Hascosay	Hirst *et al*. 2013 (this volume)
0.27km^2	Open	Bluemull Sound	Hirst *et al*.2013 (this volume)

Several maerl beds in the UK have been mapped with some accuracy, although the amount of live maerl cover and degree of patchiness is rarely reported. Extensive known beds in the UK include those off Antrim, Northern Ireland (Wilson *et al*., 2007), the Sound of Barra (Harries *et al*., 2007) and the complex of beds in Orkney (Hirst *et al*. 2012a). These are undoubtedly large systems but as the Millford Haven study (Bunker and Camplin, 2007) demonstrates, the mapped extent (1.5 km^2) can be quite different to the total extent of live maerl when the ratio of live versus dead thalli are accounted for (0.5 km^2: Bunker and Camplin, 2007). Given the patchiness of maerl in the present survey area it is not possible to assert that it is one of the largest maerl beds in Scotland. It is nevertheless of moderate size compared to other sites.

Comparisons of associated community data with other Scottish maerl beds are complicated by methodological differences and a general lack of extent data; however, similar methods were used for the survey of Scotland's largest complex of maerl beds in Orkney (Hirst *et al.,* 2012a), allowing direct comparison with the present study. Each of the maerl beds had a slightly different community composition but similar total species when DDV, *in situ* and core

sample records were considered together (Table 10). Maerl beds are known to support an extremely rich fauna and flora (e.g. Steller *et al*., 2003) because they have significantly greater structural heterogeneity than adjacent habitats (Kamenos *et al*., 2004) and our records would concur with these assertions. Further comparisons can be made with maerl beds recorded at Ullapool (Moore *et al*., 2011), the maerl beds recorded from Orkney (Hirst *et al*., 2012a) and the present survey. Beds seen in the present survey especially those seen by divers during MNCR phase 2 style surveys appear to be healthy with good species numbers, comparable to Orkney and Ullapool stations (Table 10).

The two sites in the present study differ in associated species composition, highlighting the biodiversity importance of maerl biotopes throughout the survey area.

Table 10. Comparison of biodiversity of known UK maerl beds surveyed using similar methods (authors of studies can be found in Table 9).

	Shetland (present survey)	Wide Firth and Kirkwall Bay	Gairsay	Shapinsay	Veantrow Bay	Wyre and Rousay	Eday	Ullapool ML01	Ullapool ML02	Ullapool ML03	Ullapool ML04
Average overall live maerl density (SACFOR)	A	A	A-R	A	A	A	A-R	A	C	F	C
DDV species	53	64	44	27	24	52	62	69	63	45	62
Epifauna recorded by divers	68	-	-	-	36	48	48	-	-	-	-
Infauna from cores	156	-	-	-	86	117	80	-	-	-	-

4.3 Kelp and seaweed communities on sublittoral sediment

Kelp and seaweed communities on sublittoral sediment **(SS.SMp.KSwSS**) were observed at 11 stations concentrated in the narrows between Unst and Uyea, one station at the entrance to Balta Sound, and a cluster of stations interspersed with shallow muddy habitats at the far north-western end of Basta Voe. Although not prolific throughout the survey area, **SS.SMp.KSwSS** was spread over a large distance. The *Saccharina latissima* dominated stations were found in areas of moderate tidal flow. **SS.SMp.KSwSS** stations where *S. latissima* (**SS.SMp.KSwSS.Tra** and **SS.SMp.KSwSS.Pcri**) were not recorded were at the far end of Basta Voe. Although recorded as **SS.SMp.KSwSS** habitats, none of the stations were excellent examples of an **SS.SMp.KSwSS** habitat; most had relatively low kelp abundances. The broad distribution of these habitats is of interest particularly with regard to black guillemot foraging.

4.4 Shallow tide-swept coarse sands with burrowing bivalves and circalittoral sand and coarse sediment communities

Only one record of the shallow tide-swept coarse sands with burrowing bivalves proposed protected feature biotope **ICS.MoeVen** was found during this survey. However, a recent survey incorporating grab sampling around Fetlar by the North Atlantic Fisheries College recorded the deeper coarse sediment biotope with burrowing bivalves **SS.SCS.CCS.MedLumVen** at several sites around Fetlar (NAFC pers. comm; Moore, 2012), including five around the south of the island. All grabbing revisits to the 2011 MSS video stations in this survey were also identified as **SS.SCS.CCS.MedLumVen** with the exception of stations SG9a, SG9b, and SG3 which were identified as **SS.SCS.CCS.Pkef**. In addition, new stations SG23, SG9a, SG9b, SG21, and SG22 from the present survey were also identified as **SS.SCS.CCS.MedLumVen**. Bivalve numbers found at each station were low if present at all, most likely due to the depth penetration capability and low sample area of the sampling gear.

Although grab sampling is likely to under-estimate larger venerid bivalves and deep-burrowing dispersed species such as *Paphia* and *Ensis*, we are able to conclude with evidence of other species including *Lumbrineris* spp., *Glycera lapidum, Echinocyamus pusillus, Owenia fusiformis, Spiophanes bombyx* and *Amphipholis squamata* along with amphipods such as *Ampelisca spinipes*, and some conspicuous venerid bivalves, particularly *Timoclea ovata* and other robust bivalve species such as *Moerella* spp. and *Glycymeris glycymeris* that there are highly likely to be extensive burrowing bivalve communities in the survey area. These would be captured in the combination of the proposed protected features shallow tide swept coarse sands with burrowing bivalves and circalittoral sand and coarse sediment communities.

4.5 Distribution of proposed protected features in the MPA proposal

Through the work presented in this report we are able to refine and improve the data underpinning the Fetlar to Haroldswick MPA proposal. Our knowledge of the distribution and extent of several of the proposed protected features has been increased by achieving the highest resolution of records yet throughout the proposal area. We were also able to confirm the continued presence of proposed protected features at a number of sites with historic records, and discovered the present-day absence of these features at other sites with historic records. Figure 26 gives an overview of key knowledge pre- and post- this survey.

4.6 Human activities observed

Fish and mussel farming facilities were present in many of the sheltered voe areas. It is possible that these could be the cause of decreased abundances of *M. modiolus* in Basta Voe and other areas but there is no conclusive evidence of this. Mair *et al.* (2000) surveyed a horse mussel bed in Busta Voe, on the west of Shetland. Similar to the sites surveyed in Basta Voe in the present survey, there were several salmon cage farms there. As seen in the present survey, Mair *et al*. (2000) noted the presence of a dense mat of filamentous red algae at stations sampled in the shallow areas around Linga. This could be indicative of nutrient enrichment, but since Howson (1999) reported similar observations from the MNCR Phase 2 studies carried out there in 1986/87 before the salmon cages were in place, and Earll (1982) also reported loose lying mats of filamentous algae in this part of Shetland, this is unlikely. In this survey loose lying mats of filamentous algae were seen at numerous stations on muddy sediment in Basta Voe adjacent to **SS.SMu.CSaMu.VirOphPmax** and residual *M. modiolus*.

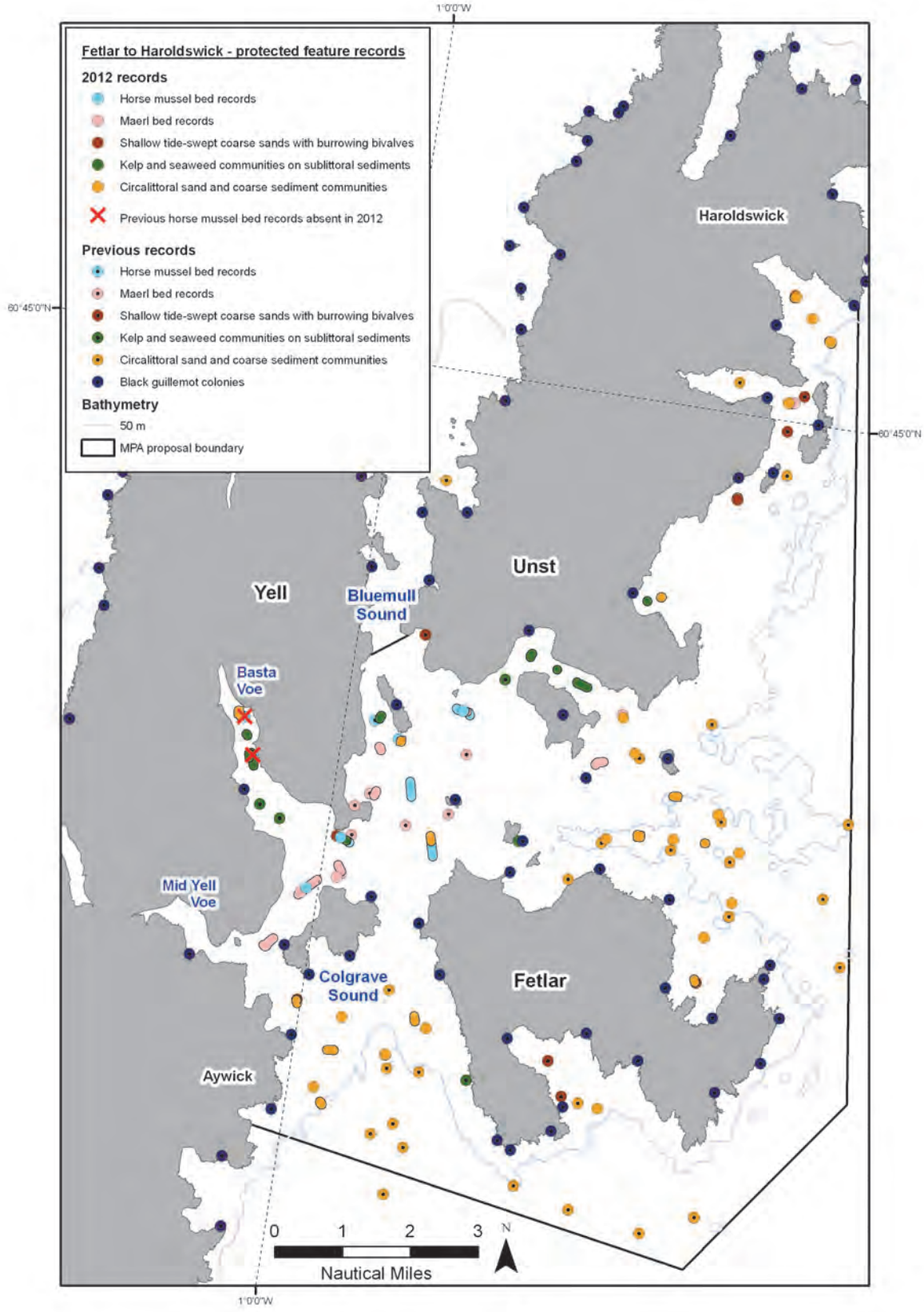

Figure 26. Protected feature records in the Fetlar to Haroldswick MPA proposal.

Shetland is a prime area for potential marine renewable energy development. The oil industry is also still thriving in Shetland. Without sensitive spatial planning these activities present potential risks to the fragile proposed protected feature habitats observed in the present survey. To help guide the placement of renewable energy developments and associated cable landfalls, spatial data have been mapped and integrated on resource opportunities and development constraints. This assessment incorporates environmental, social and economic considerations into the site selection process for marine renewable energy and will form part of the 'The Marine Spatial Plan for the Shetland Islands' which has guided the siting of marine developments in Shetland since 2008 (NAFC, 2012).

The outputs from the Shetland Marine Spatial Plan (SMSP) will be integrated into the fourth edition of the SMSP through an additional marine renewables policy (NAFC, 2012). Within this model, proposed protected features in MPA proposals have been highlighted with exclusion buffers of 50m (high constraint level). The Bluemull Sound is highlighted as a key tidal region; however, it also includes many proposed protected feature habitats with areas of high constraint, and is likely to be an area with high levels of conflict. The presence of a high degree of constraint in the SMSP does not, however, explicitly prohibit the development of marine renewable energy devices in the area. The present findings, therefore, are of paramount importance to the consideration of future spatial plans.

Whilst undertaking the present survey 8 small vessels were observed dredging on **SS.SCS.CCS.MedLumVen** habitats to the north east of Fetlar. It is possible that these activities may reduce certain fauna such as bivalves in these habitats. Dredging or exploratory dredging for scallops on proposed protected feature habitats in the central Bluemull Sound area (horse mussel and maerl beds especially) is likely to be highly damaging (Strain *et al*., 2012; Cook *et al.*, in prep).

4.7 Further work

Although a number of new proposed protected feature biotope records have been found in the Fetlar to Haroldswick MPA proposal, greater resolution on the abundance of *M. modiolus* in the Bluemull Sound area is needed to establish whether or not large contiguous beds are present. *M. modiolus* can be easily missed among dead shell and mixed sediment, especially with high brittlestar cover, when recording with DDV. Greater sampling intensity by *in situ* diver surveys in the suspected horse mussel bed regions in the central and western sounds will evaluate the presence of larger beds.

Due to the high degree of biotope mosaicking encountered in the survey, a higher resolution study in the central west of the sounds using ground truthed hydroacoustics would help to better establish the extent and distribution of the proposed protected features maerl beds and horse mussel beds

Summary of main findings:

- Horse mussel beds were recorded in the central Bluemull Sound and in the entrance to Basta Voe. Only one of the five stations where horse mussels had been recorded in 1987 still contained horse mussel beds. Also present in this area are extensive maerl beds interspersed with horse mussel beds and **SS.SMp.KSwSS** habitats.
- An exceptional seapen community **SS.SMu.CSaMu.VirOphPmax** in Basta Voe was recorded, which neighbours sparse *M. modiolus*, possibly the remnants of a bed recorded in 1987. This habitat is immediately next to a mussel farm.
- There is an extensive area of the **SS.SCS.CCS.MedLumVen** biotope which is representative of a large proportion of the Fetlar coast.

- NE Hascosay, leading to Bluemull Sound, contains excellent examples of maerl beds interspersed by horse mussel beds (S77 and S27a) in particular. Horse mussel beds are a northern habitat therefore these Shetland records are less likely to be affected by climate change in the U.K. than horse mussel beds further south.
- A *Molgula occulta* biotope was recorded on sandy mud sediment at 4 stations which appears not to be an ideal fit with the **SS.SCS.CCS.MedLumVen** biotope. Further survey work might provide evidence that a new biotope should be proposed instead.

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APPENDIX 1. STATIONS COMPLETED (ACCORDING TO SURVEY METHOD)

Appendix 1.1 Grab stations

Station	**Latitude** (decimal degrees)	**Longitude** (decimal degrees)	**Depth** (m)	**Revisit/new**	**Biotope code**	**Protected feature**	**Habitat description**	**Notes**
SG1	60.641300	-0.864130	50	Revisit MSS 2011 video site	**SS.SCS.CCS.MedLumVen**	Circalittoral sand and coarse sediment communities	Medium sand and shell fragments with tube worms and sea squirts	
SG2	60.643600	-0.831100	54	Revisit MSS 2011 video site	**SS.SCS.CCS.MedLumVen**	Circalittoral sand and coarse sediment communities	Medium sand and shell fragments with sea squirts	
SG3	60.651400	-0.810900	48	Revisit MSS 2011 video site	**SS.SCS.CCS.Pkef**	Circalittoral sand and coarse sediment communities	Coarse shelly sand with tube worms and sea squirts	First attempt failed with rock in teeth, 2nd attempt grab empty, third attempt successful
SG4	60.642800	-0.797600	57	Revisit MSS 2011 video site	**SS.SCS.CCS.MedLumVen**	Circalittoral sand and coarse sediment communities	Fine sand	First attempt grab opened on recovery, loosing sample. Second attempt successful
SG5	60.630400	-0.797590	54	Revisit MSS 2011 video site	**SS.SCS.CCS.MedLumVen**	None	Fine sand with worm tubes	First attempt grab opened on recovery, loosing sample. Second attempt successful

Station	Latitude (decimal degrees)	Longitude (decimal degrees)	Depth (m)	Revisit/new	Biotope code	Protected feature	Habitat description	Notes
SG9	60.580500	-0.956020	53	Revisit MSS 2011 video site	**SS.SCS.CCS.Pkef**	Circalittoral sand and coarse sediment communities	Gravelly sand with Live and dead maerl	Two samples A&B from same site
SG11	60.663100	-0.856500	32	Revisit MSS 2011 video site	**SS.SCS.CCS**	Circalittoral sand and coarse sediment communities	Coarse sand	PSA Sample only - Basic species recorded
SG13	60.570000	-0.988614	42	New	**SS.SCS.CCS.MedLumVen**	Circalittoral sand and coarse sediment communities	Sand with *Lanice conchilega*	
SG14	60.588100	-0.980192	44	Revisit of 1987 MNCR	**SS.SCS.CCS.MedLumVen**	Circalittoral sand and coarse sediment communities	Medium sand with fine shell fragments	
SG19	60.728500	-0.825200	24	New	**SS.SCS.ICS.MoeVen**	Circalittoral sand and coarse sediment communities	Medium sand	
SG20	60.770400	-0.791340	47	New	**SS.SCS.CCS**	Circalittoral sand and coarse sediment communities	Fine sand with *Echinocardium* sp. and *Ascidea* sp.	
SG21	60.575400	-0.848018	29	Revisit of 1962 DAFS survey	**SS.SCS.CCS.MedLumVen**	Circalittoral sand and coarse sediment communities	Medium sand and shell with venerid bivalves	

Station	Latitude (decimal degrees)	Longitude (decimal degrees)	Depth (m)	Revisit/new	Biotope code	Protected feature	Habitat description	Notes
SG22	60.621000	-0.808630	43	Revisit of 1962 DAFS survey	**SS.SCS.CCS.MedLumVen**	None	Fine sand with sea squirts	
SG23	60.588400	-0.938078	38	New	**SS.SCS.CCS.MedLumVen**	Circalittoral sand and coarse sediment communities	Fine sand and broken shell with worm casts	
SG27	60.780100	-0.811540	21	Revisit of 1987 MNCR	**SS.SCS.CCS.MedLumVen**	Circalittoral sand and coarse sediment communities	Medium sand with polychaetes	Additional grab site added according to observed coarse sand on DDV
SG28	60.775300	-0.802040	35	New	**SS.SCS.CCS**	Circalittoral sand and coarse sediment communities	Medium sand with maerl and shell gravel with *Ascidea* sp.	Additional grab site added according to observed coarse sand on DDV
SG29	60.754200	-0.804550	12	New	**SS.SMp.Mrl.Pcal**	Circalittoral sand and coarse sediment communities	Maerl	Additional grab site added according to observed coarse sand on DDV
SG30	60.754000	-0.807380	11	New	**SS.SCS.CCS.MedLumVen**	Circalittoral sand and coarse sediment communities	Fine sand and broken shell	Additional grab site added according to observed coarse sand on DDV
SG31	60.671400	-0.864920	22	New	**SS.SCS.CCS.Pkef**	Circalittoral sand and coarse sediment communities	Coarse sand and large shell fragments	Additional grab site added according to observed coarse sand on DDV

Appendix 1.2 DDV stations

Video file name	**St. No.**	**Location**	**Start time (UTC)**	**End time**	**Start coordinates N** (decimal degrees)	**Start coordinates W** (decimal degrees)	**End coordinates N** (decimal degrees)	**End coordinates W** (decimal degrees)	**Mini DV tape no**	**Depth (m)**
20120827_S34.avi	S34	NE Fetlar	09:53:00	10:00:00	60.609050	-0.809067	60.610488	-0.810362	1	17.25
20120827_S58.avi	S58	NE Fetlar	10:17:42	10:22:00	60.620580	-0.797057	60.621417	-0.799738	1	41.5
20120827_S57.avi	S57	NE Fetlar	10:33:24	10:39:00	60.630087	-0.821485	60.630997	-0.824553	1	45.5
20120827_S50.avi	S50	NE Fetlar	11:16:47	11:21:52	60.654472	-0.902900	60.655190	-0.906107	1	38.75
20120827_S42.avi	S42	NE Fetlar	11:32:07	11:42:14	60.649402	-0.926142	60.653463	-0.929320	1	29.75
20120827_S31.avi	S31	Bluemull Sound triangle	11:50:06	12:00:07	60.655117	-0.938085	60.659865	-0.942322	1	30.75
20120827_S40.avi	S40	Bluemull Sound triangle	12:09:40	12:19:10	60.656117	-0.938085	60.657373	-0.955823	1	27.75
20120827_K3.avi	K3	Bluemull Sound triangle	12:33:25	12:44:26	60.644192	-0.962967	60.649818	-0.965545	2	25.92
20120827_S10.avi	S10	Colgrave Sound	12:55:28	13:01:28	60.636662	-0.954983	60.639817	-0.962500	2	22.92
20120827_S51.avi	S51	Colgrave Sound	13:14:42	13:24:19	60.630478	-0.947913	60.635390	-0.950712	2	27
20120827_S52.avi	S52	Colgrave Sound	13:36:50	13:42:51	60.623343	-0.961668	60.626483	-0.962585	2	24
20120827_S27.avi	S27	Colgrave Sound	13:58:00	14:06:51	60.623350	-0.991667	60.625687	-0.994830	2	14
20120827_S39.avi	S39	Colgrave Sound	14:15:22	14:25:24	60.627757	-1.010000	60.630232	-1.012248	2	21.01
20120827_S25.avi	S25	Colgrave Sound	14:45:55	14:55:14	60.643098	-0.981415	60.644330	-0.980720	3	9.01

Video file name	**St. No.**	**Location**	**Start time (UTC)**	**End time**	**Start coordinates N** (decimal degrees)	**Start coordinates W** (decimal degrees)	**End coordinates N** (decimal degrees)	**End coordinates W** (decimal degrees)	**Mini DV tape no**	**Depth (m)**
20120828_S54.avi	S54	Colgrave Sound	09:27:50	09:33:40	60.589798	-0.944148	60.591092	-0.944883	3	40
20120828_S7.avi	S7	Colgrave Sound	09:48:00	09:53:00	60.581495	-0.914780	60.577762	-0.915055	3	29
20120828_K14.avi	K14	Colgrave Sound	10:09:45	10:12:03	60.558982	-0.894532	60.559277	-0.894718	3	42
20120828_S56.avi	S56	Colgrave Sound	10:31:20	10:36:10	60.575280	-0.849755	60.576233	-0.833600	3	43.2
20120828_S33.avi	S33	Colgrave Sound	10:47:01	10:52:02	60.584228	-0.875162	60.584852	-0.875638	3	20.8
20120829_S44.avi	S44	SE Unst	09:05:00	09:10:30	60.665533	-0.830702	60.665492	-0.831172	3	36.8
20120829_S64.avi	S64	SE Unst	09:26:54	09:32:23	60.692580	-0.811635	60.692132	-0.811628	3	42.8
20120829_S63.avi	S63	E Unst	09:48:00	09:53:26	60.706013	-0.835235	60.706075	-0.835037	3	26.8
20120829_K10.avi	K10	E Unst	10:06:00	10:10:28	60.700618	-0.862178	60.700475	-0.862038	3	9.2
20120829_K15.avi	K15	E Unst	10:16:19	10:21:33	60.702118	-0.855187	60.701933	-0.855758	4	18.2
20120829_S62.avi	S62	E Unst	10:35:23	10:40:18	60.721443	-0.826652	60.721745	-0.826110	4	27.2
20120829_K11.avi	K11	E Unst	10:46:40	10:50:44	60.729037	-0.825897	60.729177	-0.825477	4	21.2
20120829_S61.avi	S61	E Unst	11:00:23	11:05:30	60.724938	-0.794988	60.726303	-0.794807	4	42.2
20120829_S60.avi	S60	Balta Sound	11:22:53	11:28:07	60.756212	-0.818740	60.756262	-0.819260	4	10.2
20120829_S59.avi	S59	Balta Sound	11:41:09	11:47:14	60.770058	-0.790967	60.770605	-0.792452	4	47.15
20120829_K12.avi	K12	Balta Sound	11:53:51	12:00:54	60.777293	-0.787607	60.777375	-0.787855	4	43.15
20120829_S30.avi	S30	E Unst	12:09:41	12:14:09	60.779820	-0.811943	60.779813	-0.812930	4	21.15

Video file name	**St. No.**	**Location**	**Start time (UTC)**	**End time**	**Start coordinates N** (decimal degrees)	**Start coordinates W** (decimal degrees)	**End coordinates N** (decimal degrees)	**End coordinates W** (decimal degrees)	**Mini DV tape no**	**Depth (m)**
20120829_S70.avi	S70	Balta Sound	13:29:58	13:46:12	60.753862	-0.805110	60.754107	-0.808155	4	12.85
20120830_S19.avi	S19	Balta Sound	09:07:48	09:17:13	60.633292	-0.987900	60.631137	-0.981450	5	21.5
20120830_S28.avi	S28	Balta Sound	09:25:39	09:35:49	60.632188	-0.996912	60.630685	-0.989850	5	9.86
20120830_S12.avi	S12	Balta Sound	09:49:08	09:59:10	60.637173	-1.027012	60.633945	-1.025887	5	20.7
20120830_S14.avi	S14	Basta Voe	10:09:52	10:15:21	60.637505	-1.037032	60.636423	-1.033967	5	16.7
20120830_K9.avi	K9	Basta Voe	10:20:39	10:25:05	60.634923	-1.037932	60.634218	-1.035708	5	13.7
20120830_K8.avi	K8	Basta Voe	10:31:36	10:36:40	60.641217	-1.041020	60.640332	-1.038022	5	20.7
20120830_S16.avi	S16	Basta Voe	10:45:25	10:55:33	60.648808	-1.045053	60.645938	-1.043010	5	10.7
20120830_S71.avi	S71	Basta Voe	11:01:22	11:11:09	60.648698	-1.046235	60.645345	-1.044413	6	15.83
20120830_S72.avi	S72	Basta Voe	11:16:25	11:32:54	60.649425	-1.044907	60.644615	-1.040967	6	7.83
20120830_K1.avi	K1	Basta Voe	11:41:52	11:47:16	60.653472	-1.049862	60.652175	-1.047210	6	13.83
20120830_S29.avi	S29	Basta Voe	11:54:51	12:00:09	60.658590	-1.054500	60.657278	-1.053207	6	9.83
20120830_S73.avi	S73	Basta Voe	12:05:44	12:10:06	60.658707	-1.052468	60.657470	-1.051975	6	7.1
20120830_S74.avi	S74	Basta Voe	12:16:13	12:17:26	60.658522	-1.058023	60.658152	-1.057533	6	7.1
20120830_S75.avi	S75	Basta Voe	12:21:14	12:26:30	60.660370	-1.056952	60.659858	-1.054620	6	4.1
20120830_S22.avi	S22	Linga sound	13:04:35	13:09:52	60.662647	-0.988240	60.664608	-0.987938	6	14.5
20120830_K2.avi	K2	Linga sound	13:18:48	13:28:54	60.655128	-0.982585	60.654340	-0.981508	7	16.5

Video file name	**St. No.**	**Location**	**Start time (UTC)**	**End time**	**Start coordinates N** (decimal degrees)	**Start coordinates W** (decimal degrees)	**End coordinates N** (decimal degrees)	**End coordinates W** (decimal degrees)	**Mini DV tape no**	**Depth (m)**
20120830_S38.avi	S38	Linga sound	13:33:00	13:38:40	60.655365	-0.978705	60.654728	-0.978667	7	21.5
20120830_S6.avi	S6	Linga sound	13:45:13	13:50:12	60.657460	-0.972542	60.657250	-0.972237	7	12.5
20120830_S76.avi	S76	Linga sound	13:56:18	14:06:54	60.660818	-0.985958	60.662802	-0.983900	7	13
20120830_S77.avi	S77	Linga sound	14:34:26	14:47:13	60.616247	-1.010795	60.620457	-1.002787	7	8
20120830_S26.avi	S26	South Hascosay Sound	15:06:24	15:11:32	60.590513	-1.003795	60.589632	-1.003293	7	25
20120830_S53.avi	S53	West Fetlar	15:21:58	15:26:58	60.579428	-0.985307	60.579648	-0.981643	8	38
20120830_S55.avi	S55	West Fetlar	15:37:26	15:42:30	60.566688	-0.984428	60.565988	-0.983353	8	48
20120830_S78.avi	S78	West Fetlar	16:03:43	16:12:16	60.602598	-1.024310	60.604592	-1.019698	8	17
20120831_S46.avi	S46	North Fetlar	10:45:16	10:50:16	60.644030	-0.814680	60.643952	-0.815603	8	54.6
20120831_S47.avi	S47	North Fetlar	11:03:13	11:08:36	60.642903	-0.847415	60.643477	-0.849213	8	52.6
20120831_S45.avi	S45	North of Fetlar	11:21:09	11:26:13	60.654387	-0.831968	60.654182	-0.834362	8	49.6
20120831_S49.avi	S49	Between Unst and Fetlar	11:45	11:50:02	60.658792	-0.875052	60.659925	-0.871342	8	22.75
20120831_S43.avi	S43	South Unst	12:07:05	12:16:56	60.670863	-0.854093	60.671623	-0.849005	8	20.75
20120831_S5.avi	S5	South Unst	12:25:36	12:35:30	60.671695	-0.865878	60.673088	-0.869428	9	18.75
20120831_K4.avi	K4	South Unst	12:43:17	12:53:41	60.676973	-0.884737	60.678395	-0.890413	9	9.05
20120831_K4.5.avi	K4.5	South Unst	13:00:32	13:01:20	60.680528	-0.901392	60.680640	-0.901233	9	6.05

Video file name	**St. No.**	**Location**	**Start time (UTC)**	**End time**	**Start coordinates N** (decimal degrees)	**Start coordinates W** (decimal degrees)	**End coordinates N** (decimal degrees)	**End coordinates W** (decimal degrees)	**Mini DV tape no**	**Depth (m)**
20120831_K5.avi	K5	South Unst	13:07:53	13:13:18	60.682622	-0.915240	60.683490	-0.914518	9	14.05
20120831_S3.avi	S3	South Unst	13:21:35	13:24:02	60.674973	-0.924893	60.675688	-0.925470	9	17.05
20120831_S80.avi	S80	South Unst	13:33:10	13:43:!7	60.666080	-0.940402	60.667547	-0.948220	9	27.05
20120831_S65.avi	S65	SE Unst	15:19:03	15:30:45	60.675438	-0.953817	60.665578	-0.957358	9	25
20120831_S37.avi	S37	SE Unst	15:41:18	15:47	60.675438	-0.979312	60.678980	-0.981670	10	25

Appendix 1.3 MNCR phase 2 style diving survey stations

Date	Station	Location	Corresponding DDV station	Sample name prefix	Latitude (decimal degrees)	Longitude (decimal degrees)	Methods
03/09/12	Maerl site 1	North Hascosay Sound	S 27	NH	60.621900	-0.993283	MNCR, Core, and Sediment
04/09/12	Maerl site 2	Hascosay Sound	S 77	H	60.616900	-1.009870	MNCR, Core, and Sediment
02/09/12	Modiolus site 1	Outer Basta Voe	S 28	BVM	60.631600	-0.994417	MNCR, Clump, and Sediment
03/09/12	Modiolus site 2	Uyea Sound	S 80	USM	60.667000	-0.944023	MNCR, Clump, and Sediment
04/09/12	Modiolus site 3	Hascosay Sound	S 77	HSM	60.618100	-1.007570	MNCR, Clump, and Sediment

APPENDIX 2. DETAILED DDV STATION DESCRIPTIONS

Station	Substrate	Biota	Biotope	Protected feature
S34a	Bedrock and boulders with fine sand patches	Abundant *Echinus esculentus* (143) with occasional unknown Fish sp. and Rare *Laminaria hyperborea* and *Asterias rubens*.	CR.MCR.EcCr	None
S34b	Coarse sand waves with empty shell and shell gravel	Very sparse station with only individual *Echinus esculentus*, and *Asterias rubens*.	SS.SCS.CCS	None
S58	Muddy sand with empty shell and shell gravel	Very sparse station with only individual *Echinus esculentus*, and Fish sp.	SS.SSa.CMuSa	None
S57	Circalittoral mixed substrate of cobbles, pebbles and sand and shell gravel	Common *Flustra foliacea* and *Pomatoceros triqueter*, on hard substrata with rare encrusting Bryozoa sp. And *Halecium halecium*. Individual mobile fauna including *Asterias rubens Echinus esculentus, Cancer pagurus*, and *Luidia ciliaris*.	SS.SMx.CMx	None
S50	Circalittoral mixed substrate of boulders, cobbles, pebbles, sand, shell gravel and dead maerl.	Diverse station with abundant *Alcyonium diaphanum* on hard substrata, as well as other encrusting species including *Pomatoceros triqueter* (O), and encrusting coralline algae (R). Encrusting sponge seen on shells of live *Aequipecten opercularis*. Also dominant *Nemertesia ramosa* (F).	SS.SMx.CMx	None
S31a	Circalittoral mixed substrate of cobbles, pebbles, sand and shell gravel in waves and troughs with higher density of *M. modiolus* shell in troughs.	Sparse station dominated by encrusting fauna such as *Pomatoceros triqueter* (R), and encrusting coralline algae (O).	SS.SMx.CMx	None
S31b	Circalittoral mixed substrate of cobbles, pebbles sand and shell gravel with patches of Brittlestars and occasional *M. modiolus.*	Dense brittlestar coverage of *Ophiothrix aculeata* (S), *Ophiothrix fragilis* (O), and *Ophiothrix nigra* (R) and occasional *M. modiolus*, and other mobile fauna including *Echinus esculentus, Asterias rubens, and Porania pulvillus*.	SS.SMx.CMx.OphMx	None
K3	Live *M. modiolus* bed with empty shell, cobbles, pebbles and patches of shell gravel and coarse sand with Rare boulders and bedrock	Common *M. modiolus* bed with Abundant E*chinus esculentus, Crossaster papposus, Ophiothrix fragilis* and *Ophiopholis aculeata* , with frequent *Alcyonium digitatum*, other dominant species included *Halecium halecium* and *Schizotricha frutescens* (F)	SS.SBR.SMus.ModT	Horse mussel bed

Station	Substrate	Biota	Biotope	Protected feature
S10	Slight waves and troughs of mixed sand and shell gravel with cobbles, pebbles and empty shell, more concentrated in troughs	Common encrusting coralline sp on hard substrata with Rare *Echinus esculentus, Alcyonium digitatum, Scyliorhinus canicula,* and *Pleuronectes platessa*	SS.SMx.CMx	None
S51	Mixed sand, cobbles and pebbles with patches of maerl, dead maerl, and empty shell with rare live *M. modiolus*	Diverse station dominated by Abundant *Echinus esculentus, Strongylocentrotus droebachiensis, Alcyonium digitatum,* and *Asterias rubens* (34), with Frequent maerl patches, and Hydroid species including *Schizotricha frutescens, Halecium* sp., and *Sertularia cupressina*	SS.SMp.Mrl.Pcal	Maerl bed
S52	Waves and troughs of mixed sand and shell gravel with empty shell and pebbles.	Occasional *Strongylocentrotus droebachiensis*, but locally Abundant with rare *M. modiolus*, Hydroid sp., encrusting coralline algae and *Alcyonium digitatum* and *Pomatoceros triqueter*	SS.SMx.CMx	None
S27	Maerl bed with dead maerl, empty shell and pebbles on coarse sand	Abundant maerl and Red branching algae including *Dictyota dichotoma, Ulva* sp., and encrusting coralline algae. Also *Echinus esculentus* (33), Common *Saccharina latissima, Asterias rubens* (32), occasional *Myxicola* sp. and *Aequipecten opercularis* covered in encrusting sponge.	SS.SMp.Mrl.Pcal.R	Maerl bed
S39	Muddy sand with shell gravel, empty shell including Arctica sp, and occasional mounds	Superabundant *Virgularia mirabilis*, also dominated by Abundant *Myxicola* sp., *Pomatoschistus* sp., and *Liocarcinus depurator.*	SS.SMu.CSaMu.VirOphPmax	None
S25	Live and dead maerl on mixed sand and empty shell	Abundant *Saccharina latissima* with frequent red branching algae and abundant goby species including *Pomatoschistus pictus,* and *Gobiusculus flavescens*	SS.SMp.Mrl.Pcal.R	Maerl bed
S54	Coarse sand with shell gravel, empty shell and rare boulders	Diverse station with no particular dominant species. Hydroid sp., *Alcyonium diaphanum*, Holothurian sp., *Pomatoschistus* sp. (4), and occasional burrows.	SS.SCS.CCS	Circalittoral sand and coarse sediment communities
S7	Mixed coarse sand, pebbles, empty shell and shell gravel in waves and troughs.	No dominant species, Occasional *Pomatoceros triqueter* and encrusting coralline algae with Rare encrusting Bryozoans and *Alcyonium diaphanum.*	SS.SMx.CMx	None
K14	Bedrock with small coarse sand patches.	Sparse station dominated by encrusting coralline algae, encrusting Bryozoans such as *Parasmittina trispinosa*, and *Pomatoceros triqueter*	CR.MCR.EcCr.FaAlCr	None

Station	Substrate	Biota	Biotope	Protected feature
S56	Coarse sand with surface ripples. Rare empty shell, pebbles, shell gravel and dead maerl.	Sparse station with only 9 *Lanice conchilega*, 2 *Pomatoschistus* sp., and 1 individual *Pagurus bernhardus*	SS.SCS.CCS	Circalittoral sand and coarse sediment communities
S33	Bedrock with rare large boulders and small patches of mixed sand, shell gravel and empty shell	Brittlestar coverage including *Ophiothrix fragilis* and *Ophiocomina nigra* (C), with Abundant *Echinus esculentus* and frequent encrusting bryozoans and coralline algae, also Rare *M. modiolus*	CR.MCR.EcCr.FaAlCr.Bri	None
S44	Mainly Bedrock with patches of coarse sand, cobbles and pebbles	Dominated by brittlestars *Ophiothrix fragilis* (A) and *Ophiocomina nigra* (R), with Common *Pomatoceros triqueter* and Frequent encrusting Fauna including Hydroids, Porifera sp., *Parasmittina trispinosa* and encrusting coralline algae. Also apparent Occasional featherstars *Antedon bifida.*	CR.MCR.EcCr.FaAlCr.Bri	None
S64	Mainly Bedrock with patches of coarse sand, and Large boulders	Abundant encrusting fauna and flora including Bryozoan sp., Porifera sp., coralline algae, and *Pomatoceros triqueter* (C). Abundant juvenile Gadoid sp. (48), and *Echinus esculentus* (45). Hydroids spp. including *Abietinaria abietina* (R).	CR.MCR.EcCr.FaAlCr	None
S63	Mixed circalittoral cobbles, pebbles and empty shell on mixed sand.	Fairly sparse station dominated by Frequent Encrusting Bryozoans spp., coralline algae, and *Dictyota dichotoma* on hard substrata.	SS.SMx.CMx	None
K10	Cobbles and pebbles with occasional medium boulders on mixed sand.	Abundant *Laminaria hyperborea* forest on cobbles and pebbles encrusted with coralline algae (F), Bryozoan spp. (O), *Pomatoceros triqueter* (O) and Barnacles (R). Epifauna on kelp included *Obelia geniculata* (R), and *Membranipora membranacea* (F).	SS.SMp.KSwSS.LsacR.CbPb	Kelp and seaweed communities on sublittoral sediments
K15	Mobile coarse sand ,shell gravel and empty shell with rare small boulders	Sparse station with Rare *Saccharina latissima* and *Laminaria hyperborea* with epiphytic branching red algae spp.	SS.SCS.CCS	Circalittoral sand and coarse sediment communities
S62	All size boulders on mixed grain sand	Dominated by Abundant *Echinus esculentus* on Frequent Laminaria *hyperborea*, with Common *Ophiothrix fragilis* among other Rare mobile fauna including fish sp., and *Asterias rubens* (5).	IR.MIR.KR.Lhyp.GzFt	None

Station	Substrate	Biota	Biotope	Protected feature
K11	Mobile coarse sand with drift weed	Extremely sparse station with only 2 *Lanice conchilega*	SS.SCS.CCS	Circalittoral sand and coarse sediment communities
S61	Bedrock with small coarse sand patches.	Dominated by Abundant *Echinus esculentus*, Encrusting coralline algae (C), Frequent *Pomatoceros triqueter*, and Bryozoans. Also abundant juvenile Gadoid sp. (84) and occasional *Antedon bifida*.	CR.MCR.EcCr.FaAlCr	None
S60	Muddy sand with Rare shell gravel.	Abundant Diatom film over *Arenicola marina* mounds and unidentified burrows and *Pomatoschistus* sp.	SS.SSa.IMuSa.AreISa	None
S59	Muddy sand with shell gravel and rare empty shell	Dominated by Abundant *Molgula occulta*, on sea bed, with Diatom film, *Lanice conchilega* (5), *Aequipecten opercularis* (1), and *Pleuronectes platessa* (1).	SS.SCS.CCS	None
K12	Circalittoral mixed sediment with coarse sand, shell gravel, empty shell, cobbles pebbles and scattered large boulders	Abundant *Flustra foliacea* and Frequent *Clavelina lepadiformis* with other encrusting bryozoans, coralline algae, and rare *Caryophyllia smithii.*	CR.HCR.XFa.FluCoAs.X	None
S30	Coarse sand and detritus	Diatom film in troughs of sand waves with 5 *Lanice conchilega*	SS.SCS.CCS	Circalittoral sand and coarse sediment communities
S70a	Live maerl bed with dead maerl, empty shell, pebbles shell gravel and coarse sand	Abundant Maerl with Frequent *Dictyota dichotoma, Saccharina latissima* (O), *Pomatoschistus pictus* (11) and occasional other fish spp.	SS.SMp.Mrl.Pcal	Maerl bed
S70b	Mixed substrate of coarse sand shell gravel and maerl, with cobbles, pebbles and some boulders	Abundant *Laminaria hyperborea*, occasional *Saccharina latissima* and frequent branching red algae spp. with *Gobiusculus flavescens* (118).	SS.SMp.KSwSS.Pcri	Kelp and seaweed communities on sublittoral sediments
S70c	Mixed sand with rare shell gravel, empty shell, cobble and pebbles	Sparse station with Rare burrows, *Pomatoschistus* sp. (3), fish spp. (2), juvenile cuttlefish? sp.	SS.SSa	None

Station	Substrate	Biota	Biotope	Protected feature
S19	Coarse circalittoral mixed sediment with Maerl patches	Highly diverse station with Frequent maerl, Common encrusting coralline algae, Abundant *Echinus esculentus*, and *Pomatoceros triqueter* and occasional or rare occurrences of multiple other species including *Asterias rubens, Kirchenpaueria pinnata* and other hydroid spp., *Pecten maximus*, encrusting bryozoan spp., and goby and dragonet spp.	SS.SMx.CMx	None
S28a	coarse sand and shell gravel with empty shell	Common branching and foliose red algae on Frequent *Laminaria hyperborea* and *Saccharina latissima ,* with common *Echinus esculentus* and occasional Hydroid spp.	SS.SMp.KSwSS.LsacR.Gv	Kelp and seaweed communities on sublittoral sediments
S28b	*M. modiolus* bed on mixed soft sediment and dead shell	*M. modiolus* bed with Common brittlestars *Ophiopholis aculeata* and *Ophiothrix fragilis* (F), encrusting coralline algae, *Antedon bifida* (A) and hydroid spp.	SS.SBR.SMus.ModT	Horse mussel bed
S28c	Coarse circalittoral mixed sediment	Sparse station with Rare *Sertularia cupressina, Nemertesia ramosa, Alcyonidium diaphanum* and individual *Luidia ciliaris*	SS.SMx.CMx	None
S12	Sandy mud with shell gravel, empty shell mounds and burrows	Abundant *Virgularia mirabilis, Echinus esculentus* and *Holothuria sp*. Patchy but locally abundant red branching algal mat. Also *Hydractinia echinata* on shells of *Pagurus bernhardus*	SS.SMu.CSaMu.VirOphPmax	None
S14	Sandy mud with shell gravel, empty shell mounds and burrows	Abundant *Virgularia mirabilis,* patchy but frequent red branching algal mat. Also *Aequipecten opercularis* covered with encrusting sponge, possibly *Suberites ficus*?	SS.SMu.CSaMu.VirOphPmax	None
K9	Sandy mud with shell gravel, empty shell rare cobbles and small boulders	Abundant red branching algal mat, frequent *Turritella* shells and *Virgularia mirabilis* (O), with other mobile species including *Liocarcinus depurator, Asterias rubens* and *Pecten maximus* but none in great numbers.	SS.SMu.CSaMu	None
K8	Sandy mud with shell gravel and occasional burrows	Dominated by Abundant *Virgularia mirabilis, Turritella* shells (F), Occasional diatom film, and rare goby sp., *Lanice conchilega* and fish sp. (10).	SS.SMu.CSaMu.VirOphPmax	None

Station	Substrate	Biota	Biotope	Protected feature
S16a	Muddy sand with occasional empty shell	Dense *Trailiella* mat with sparse other species including *Pagurus bernhardus* (2), *Echinus esculentus* (3), *Carcinus maenas* (1), and *Aequipecten opercularis* (2) covered with encrusting sponge *Suberites ficus*?	SS.SMp.KSwSS.Tra	Kelp and seaweed communities on sublittoral sediments
S16b	Circalittoral mixed muddy sediment with empty shell, cobbles, pebbles and shell gravel.	Sparse *M. modiolus* in frequent clumps with *Echinus esculentus* (26), *Pagurus bernhardus* (23), Abundant branching red algal mat, *Aequipecten opercularis* (9) covered with encrusting sponge *Suberites ficus*? *Pecten maximus* (5), *Hyas araneus* (10), and *Inachus dorsettensis.*	SS.SMp.KSwSS.Pcri	Kelp and seaweed communities on sublittoral sediments
S71a	Muddy sand with mixed cobbles, pebbles, shell gravel and empty shell	Abundant loose-lying mats of *Phyllophora crispa* with occasional *Pagurus bernhardus* with *Hydractinia echinata* on shells. *Pecten maximus* (10), *Aequipecten opercularis* (13) covered with encrusting sponge. Rare *M. modiolus* scattered.	SS.SMp.KSwSS.Pcri	Kelp and seaweed communities on sublittoral sediments
S71b	Muddy sand with some mixed shell gravel, empty shell and cobbles.	Superabundant *Virgularia mirabilis*, *Pagurus bernhardus* (13), and individuals of *Asterias rubens*, *Aequipecten opercularis* (13) covered with encrusting sponge, *Pecten maximus*, *M. modiolus*, red branching algae in mats.	SS.SMu.CSaMu.VirOphPmax	None
S72	Sandy mud with scattered empty shell, shell gravel, and sparse Large boulders and recently dead M. modiolus shell	Common *Trailiella* mat covering seabed with Abundant *Pagurus bernhardus* with *Hydractinia echinata* (R) on shells but sparse other species including occasional *Arenicola marina* mounds, *Echinus esculentus* (27), *Hydractinia echinata* (R), and occasional *M. modiolus*.	SS.SMu.ISaMu	None
K1a	Muddy sand with scattered empty and broken shell	Occasional *M. modiolus*, *Hydractinia echinata* on *Pagurus bernhardus*, with Rare fish sp., hydroid sp., and *Hyas araneus*.	SS.SMu.CSaMu	None
K1b	Muddy sand with scattered empty and broken shell	Dense *Trailiella* mat with occasional sea squirt sp?, and Rare *Asterias rubens* and crab sp.	SS.SMp.KSwSS.Tra	Kelp and seaweed communities on sublittoral sediments
K1c	Muddy sand with scattered empty and broken shell	Possible squid eggs, individual *Asterias rubens*, and 4 *Pagurus bernhardus*, with rare Diatom film coverage.	SS.SMu.CSaMu	None

Station	Substrate	Biota	Biotope	Protected feature
S29	Sandy mud with silt layer and broken shell	Frequent *Molgula occulta* with sparse other species with individuals of *Pagurus bernhardus*, goby sp., fish sp., and *Beggiatoa* (R).	SS.SCS.CCS	None
K2	Maerl bed with dead maerl, empty shell, cobbles and pebbles on coarse sand	Common maerl with Frequent *Saccharina latissima, Echinus esculentus* (12), and Abundant *Gobiusculus flavescens*.	SS.SMp.Mrl.Pcal	Maerl bed
S38	Bedrock and boulders with coarse sand patches	Dominated by *Ophiopholis aculeata* and *Ophiothrix fragilis* (A), and *Echinus esculentus* (S), *Ophiocomina nigra* (F), with Frequent encrusting coralline algae, and *Pomatoceros triqueter* (O). Rare *M. modiolus* and Juvenile Gadoid sp.	CR.MCR.EcCr.FaAlCr.Bri	None
S6	Coarse sand and shell gravel with scattered dead Maerl, empty shell (Especially Ensis), pebbles, cobbles, and Rare boulders.	Not highly dominated by any particular species. Occasional *Saccharina latissima* , Branching red algae, *Myxicola* sp. Rare *Pomatoschistus* sp., *Scinia* sp., *Laminaria hyperborea* and *Membranipora membranacea.*	SS.SCS.CCS	None
S76a	Circalittoral mixed sediment with Bedrock, boulders, cobbles, pebbles, mixed sand and shell gravel with scattered empty *M. modiolus* shell	Abundant *Ophiothrix fragilis, Ophiopholis aculeata* and *Ophiocomina nigra* (F).Superabundant *Echinus esculentus*, encrusting coralline algae (F), and Occasional encrusting bryozoa sp., with Rare *M. modiolus*.	SS.SMx.CMx.OphMx	None
S76b	Gravelly coarse sand with scattered cobbles, pebbles and empty shell	Common *Saccharina latissima* and Frequent encrusting coralline algae and Occasional *Pomatoceros triqueter*, branching red algae, and *Membranipora membranacea.*	SS.SMp.KSwSS.LsacR.Gv	None
S77a	Maerl bed with some dead maerl and lots of empty shell	Diverse maerl bed with Common *Dictyota dichotoma, Saccharina latissima* (F), and Abundant *Echinus esculentus* and *Asterias rubens* (16)	SS.SMp.Mrl.Pcal	Maerl bed
S77b	*M. modiolus* bed on mixed gravelly sand, cobbles and dead shell	Abundant brittlestars *Ophiothrix fragilis* and *Ophiopholis aculeata* on *M. modiolus* (C) with abundant *Echinus esculentus* and Occasional *Strongylocentrotus droebachiensis*. Other associated species including *Buccinum undatum* (3), *Cucumaria frondosa* (1)	SS.SBR.SMus.ModT	Horse mussel bed

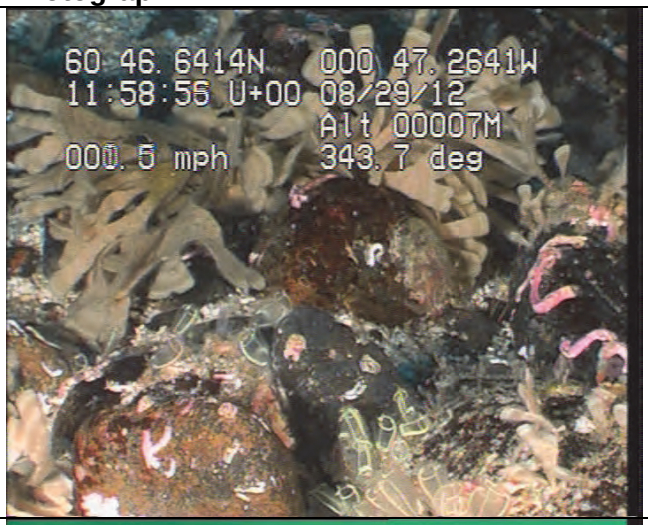
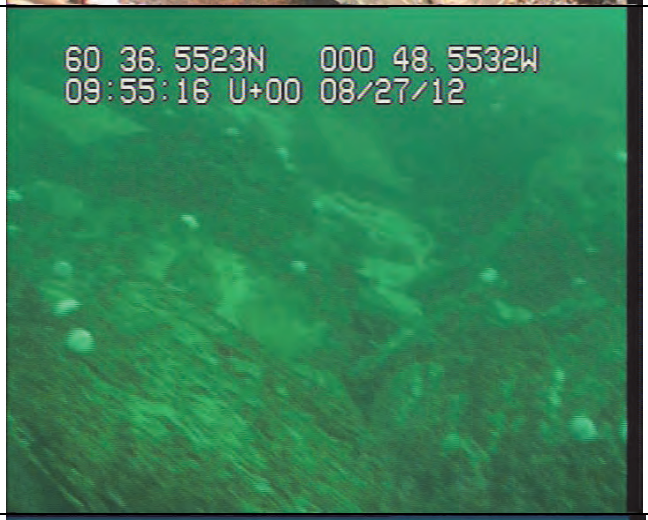
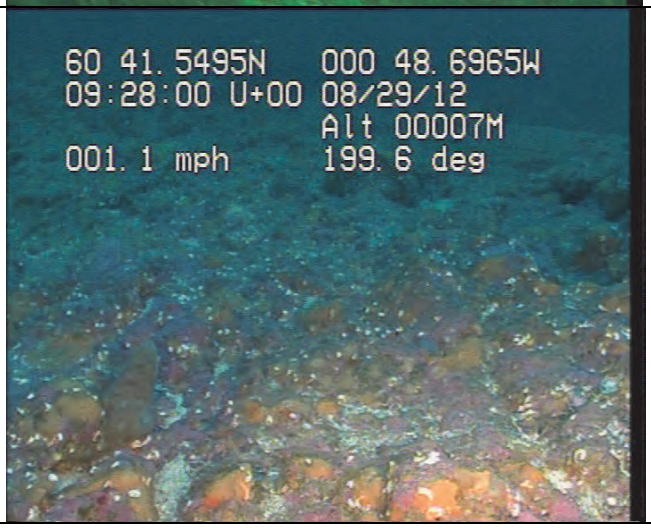
Station	Substrate	Biota	Biotope	Protected feature
S77c	Maerl bed with dead Maerl, and scattered empty shell on coarse gravelly sand.	Abundant maerl in mounds with Common *Dictyota dichotoma*, *Saccharina latissima (*F) and encrusting coralline algae, Pomatoceros *triqueter* (O) and *Membranipora membranacea* (O).	SS.SMp.Mrl.Pcal	Maerl bed
S26	Coarse sand in small waves with shell gravel, and broken shell.	Extremely sparse station with only 3 *Pagurus bernhardus*	SS.SCS.CCS	Circalittoral sand and coarse sediment communities
S53	Coarse sand and shell gravel with scattered broken shell, small mounds and burrows	Sparse station with *Pagurus bernhardus* (8), occasional *Chaetopterus* sp., *Lanice conchilega* (4), and *Pomatoschistus* sp.	SS.SCS.CCS	Circalittoral sand and coarse sediment communities
S55	Coarse sand	Sparse station with only 3 *Pagurus bernhardus*, 1 *Pomatoschistus* sp., and 1 decapod sp. with Rare possible burrowing bivalves?	SS.SCS.CCS	Circalittoral sand and coarse sediment communities
S78	Maerl bed with dead maerl scattered empty shell and pebbles on mixed sand	Diverse maerl bed with *Dictyota dichotoma* (F), Occasional clumps of *Clavelina lepadiformis*, Common *Echinus esculentus*, *Pomatoceros triqueter* (O), hydroid sp. (O), and Frequent branching red algae.	SS.SMp.Mrl.Pcal.R	Maerl bed
S46a	Bedrock and large boulders with patches of coarse gravelly sand and some broken shell	Abundant *Pomatoceros triqueter* with Common encrusting Bryozoa sp., encrusting sponge spp., and coralline algae. *Flustra foliacea* (F), Occasional barnacle sp., and *Porania pulvillus* on boulders.	CR.MCR.EcCr.FaAlCr	None
S46b	Coarse sand with shell gravel and scattered empty shell and small mounds.	Sparse station with Frequent small mounds, *Lanice conchilega* (7), and individual holothurian sp. and *Cancer pagurus*	SS.SCS.CCS	Circalittoral sand and coarse sediment communities
S47	Coarse sand and shell gravel with empty shell	No species in great number, Rare *Flustra foliacea, Pomatoceros triqueter, Lanice conchilega, Pomatoschistus* sp., *Alcyonidium diaphanum* and sea squirt sp., with occasional *Chaetopterus* sp.	SS.SCS.CCS	Circalittoral sand and coarse sediment communities

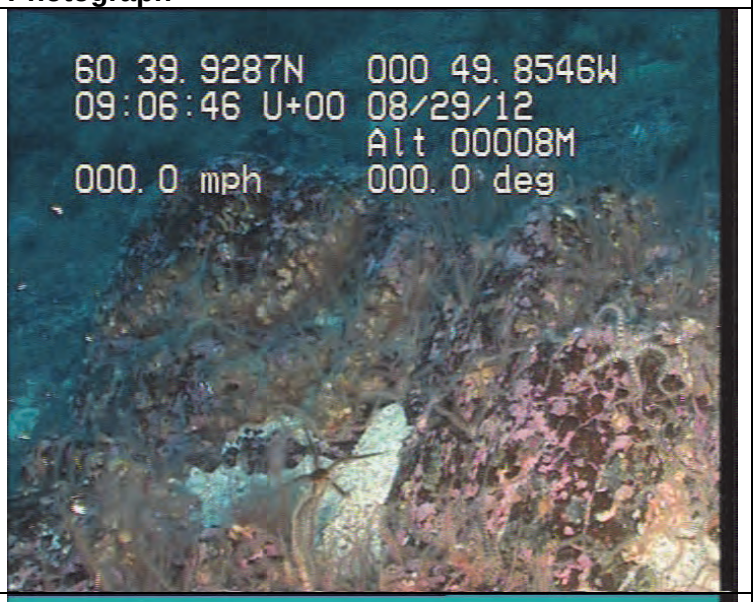
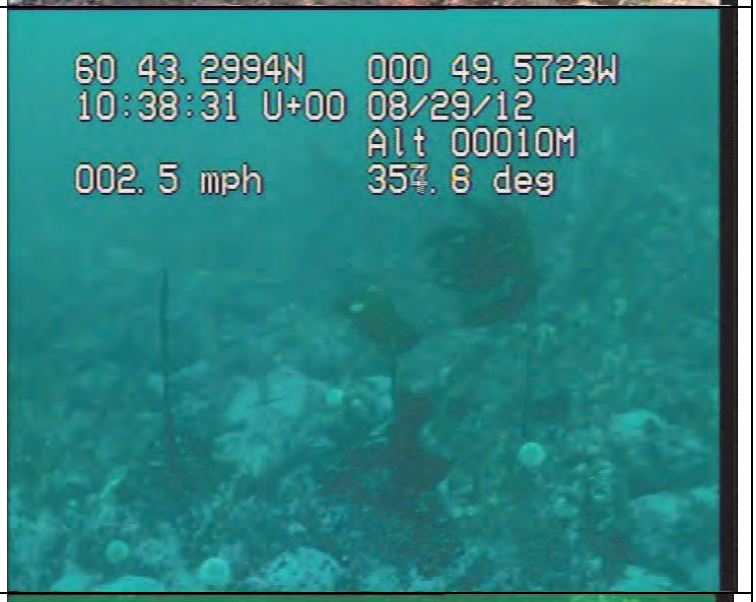
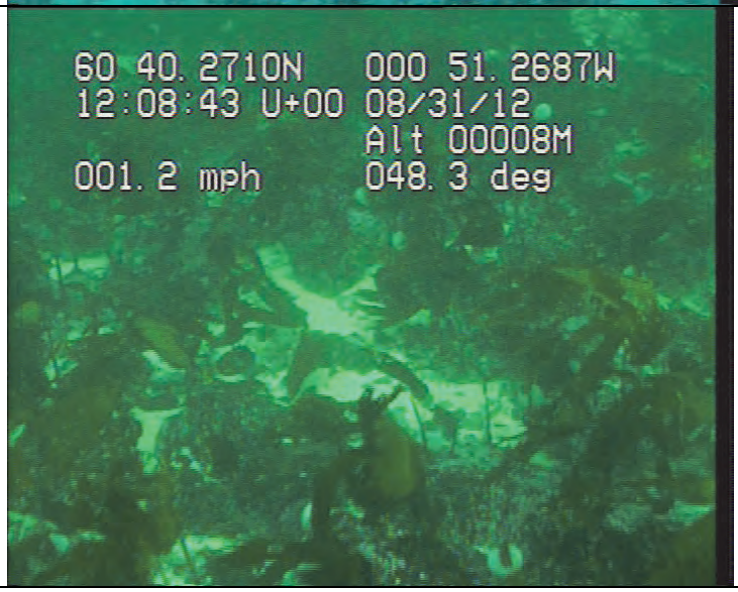
Station	Substrate	Biota	Biotope	Protected feature
S45	Coarse sand waves with empty shell and shell gravel especially in troughs.	No species in great number, Rare *Pomatoceros triqueter*, *Sertularia cupressina* and encrusting bryozoa sp. on hard substrate with *Porania pulvillus* (3), individual *Scyliorhinus canicula*	SS.SCS.CCS	Circalittoral sand and coarse sediment communities
S49	Maerl bed in waves with empty shell especially Ensis shell, dead maerl and coarse sand	Diverse station on Abundant maerl with *Plocamium cartilagineum* (F), *Dictyota dichotoma* (O), filamentous brown algae (F), and clumps of sea squirts *Clavelina lepadiformis* and *Ciona intestinalis* (O).	SS.SMp.Mrl.Pcal.R	Maerl bed
S43	Various size boulders and bedrock with patches of mixed sand and shell.	Superabundant *Echinus esculentus* among *Laminaria hyperborea* (A) , and Frequent coralline red algae, *Pomatoceros triqueter*, and encrusting bryozoa sp. Abundant *Gobiusculus flavescens* and other juvenile fish spp.	IR.MIR.KR.LhypT	None
S5	Coarse sand with dead maerl and empty shell	Occasional *Saccharina latissima* possibly drift? With Epiphytic red branching algae spp., and *Membranipora membranacea* (R). Frequent burrows possibly bivalve. Rare worm casts and individual mobile species including *Scyliorhinus canicula*, and *Cancer pagurus* (2).	SS.SCS.CCS	Circalittoral sand and coarse sediment communities
K4a	Muddy sand with coarse sand patches and empty shell, and abundant mounds	Dominated by *Arenicola marina* mounds (A), with only 2 *Pomatoschistus* sp., and occasional diatom film.	SS.SSa.IMuSa.AreISa	None
K4b	Mixed sand with scattered empty shell and dead maerl	*Saccharina latissima (F)*, and *Desmarestia ligulata (O)*, Branching red algae spp., and *Membranipora membranacea*. Rare *Dictyota dichotoma* and *Phymatolithon calcareum*	SS.SMp.KSwSS.LsacR.Sa	Kelp and seaweed communities on sublittoral sediments
K4.5	Mixed gravelly sand with maerl, dead maerl and empty shell	Dominated by algae species including Frequent *Saccharina latissima*, branching red algae spp., *Phymatolithon calcareum*, and Occasional *Desmarestia ligulata, Plocamium cartilagineum* and *Dictyota dichotoma.*	SS.SMp.KSwSS.LsacR.Gv	Kelp and seaweed communities on sublittoral sediments

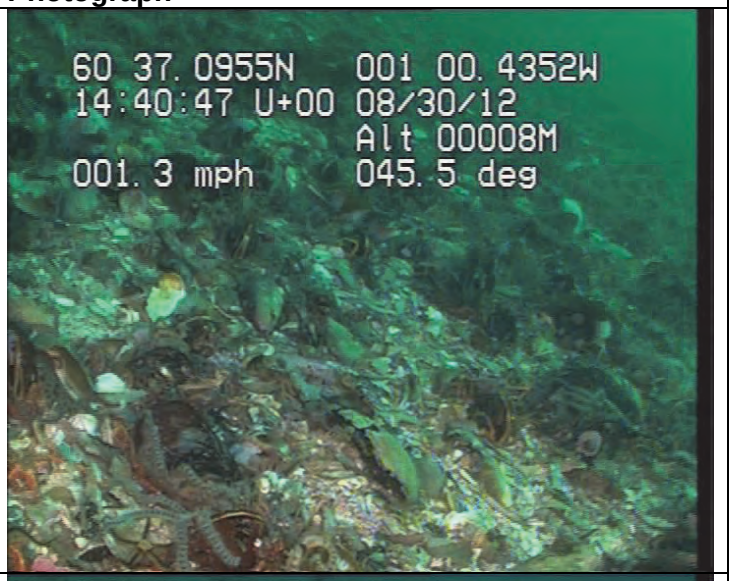
Station	Substrate	Biota	Biotope	Protected feature
K5	Coarse gravelly sand with mixed Maerl, dead maerl, and empty shell with Rare Boulders	Diverse station of algae species, mobile fauna and encrusting flora and fauna. Common *Saccharina latissima* and branching red algae spp including *Plocamium cartilagineum*. Frequent *Dictyota dichotoma*, *Membranipora membranacea*, and *Scinia* sp. Other most abundant species *Pecten maximus* (5), *Echinus esculentus* (4), *Gobiusculus flavescens* (3), and *Asterias rubens* (4).	SS.SMp.KSwSS.LsacR.Gv	Kelp and seaweed communities on sublittoral sediments
S3	Circalittoral mixed sediment with, mixed sand and shell gravel with scattered empty shell	Not dominated highly by one species, Occasional red branching algae and fine worm tubes? With *Pomatoschistus* sp. (5), Hydroid sp. (R), *Mya truncata* siphons (R), and *Lanice conchilega* (3).	SS.SSa.CFiSa	Circalittoral sand and coarse sediment communities
S80a	*M. modiolus* bed with coarse sand and empty shell and shell gravel, cobbles, pebbles and rare small boulders.	Abundant *M. modiolus* underneath bed of brittlestars *Ophiothrix fragilis, Ophiopholis aculeata* (S) and *Ophiocomina nigra* (F). Associated fauna including *Echinus esculentus* (F), *Crossaster papposus* (4), *Halecium halecium* (R), and *Cancer pagurus* (2) among others.	SS.SBR.SMus.ModT	Horse mussel bed
S80b	Maerl bed with mixed coarse gravelly sand, empty shell and scattered dead Maerl.	Abundant *Phymatolithon calcareum*, with Common filamentous brown algae and hydroid sp., Occasional brittlestars *Ophiothrix fragilis, Ophiopholis aculeata* and Rare *M. modiolus.*	SS.SMp.Mrl.Pcal	Maerl bed
S80c	*M. modiolus* bed with coarse sand and empty shell, cobbles, pebbles.	Common *M. modiolus* under bed of Abundant *Ophiothrix fragilis, Ophiopholis aculeata* and *Ophiocomina nigra* (F). Abundant E*chinus esculentus*, Frequent hydroid sp. including *Kirchenpaueria pinnata* as well as other less abundant species such as *Porania pulvillus* (1) and *Ciona intestinalis* (R).	SS.SBR.SMus.ModT	Horse mussel bed
S80d	Bedrock and boulders with patches of coarse sand	Dominated by *Echinus esculentus* (77), Occasional *Laminaria hyperborea*, encrusting coralline and red branching algae spp. as well as encrusting bryozoa sp.	CR.MCR.EcCr	None
S65a	Circalittoral mixed sediment with coarse sand, shell gravel, lots of recently dead empty shell, cobbles pebbles and scattered medium boulders and bedrock	Dominated by only encrusting communities of coralline red algae (O) and *Pomatoceros triqueter* (R) Lots of empty shell wash off.	SS.SMx.CMx	None

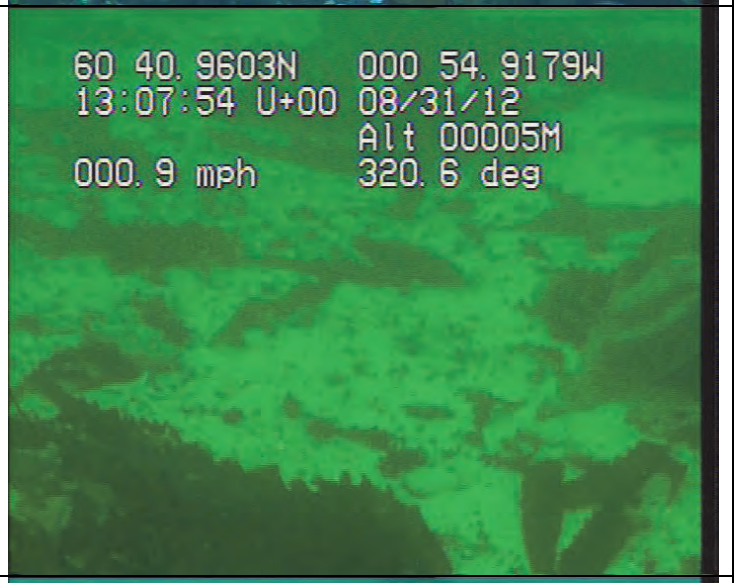
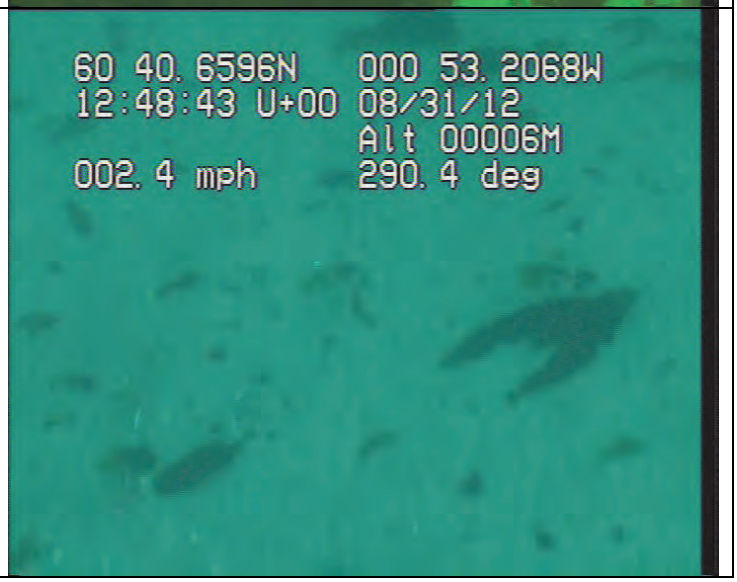
Station	Substrate	Biota	Biotope	Protected feature
S65b	Bedrock with some coarse shell gravel patches	Abundant *Echinus esculentus* with Occasional *Alcyonium digitatum*, encrusting coralline algae and *Pomatoceros triqueter* with Rare *Urticina* sp. and *Crossaster papposus* (1)	CR.MCR.EcCr	None
S65c	Circalittoral mixed sediment with coarse sand, shell gravel, lots of recently dead empty shell, cobbles and pebbles	Sparse station other than encrusting species such as Common coralline algae, Rare *Pomatoceros triqueter*, encrusting Bryozoa sp., Hydroid sp., with Occasional *Alcyonium digitatum* and *Ophiopholis aculeata*	SS.SMx.CMx	None
S37	Circalittoral mixed substrate of cobbles, pebbles, empty shell and shell gravel with mixed sand	Bryozoa (A) sp, coralline algae and *Pomatoceros triqueter (C)*, with *Alcyonium digitatum*, branching red algae, Hydroid spp. including *Halecium halecium* (R), *Taurulus bubalis* (1), *Asterias rubens* (6).	SS.SMx.CMx	None

APPENDIX 3. PHOTOGRAPHIC INVENTORY OF BIOTOPES WITH DESCRIPTION AND ASSOCIATED STATIONS

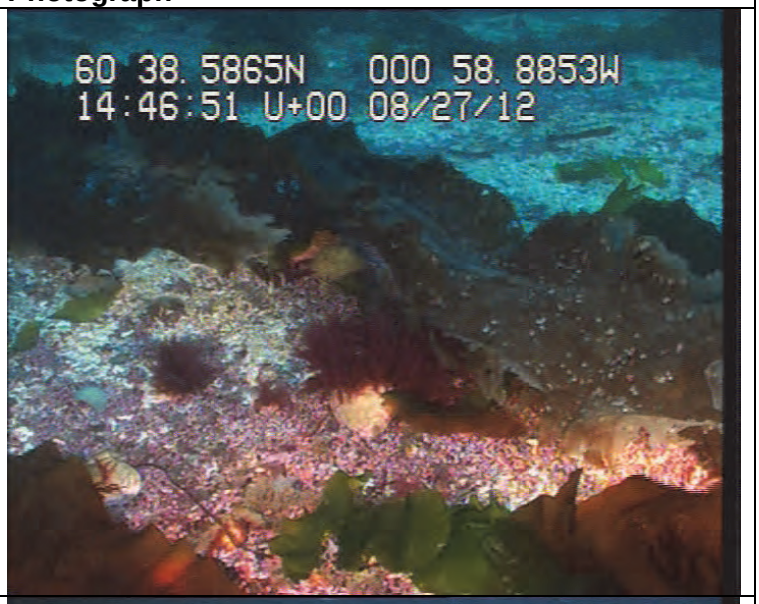
Biotope and Sites	Photograph
CR.HCR.XFa.FluCoAs.X *Flustra foliacea* and colonial ascidians on tide-swept exposed circalittoral mixed substrata K12	
CR.MCR.EcCr Echinoderms and crustose communities S34a, S80d, S65b (Image S34a)	
CR.MCR.EcCr.FaAlCr Faunal and algal crusts on exposed to moderately wave exposed circalittoral rock, typically occurs on the vertical and upper faces of wave-exposed and moderately wave exposed circalittoral bedrock or boulders subject to mostly moderate to weak tidal streams. K14, S64, S61, S46a (Image S64)	

Biotope and Sites	Photograph
CR.MCR.EcCr.FaAlCr.Bri Brittlestar bed on faunal and algal encrusted, exposed to moderately wave-exposed circalittoral rock. S33, S44, S38 (Image S44)	
IR.MIR.KR.Lhyp.GzFt Grazed *Laminaria hyperborea* forest with coralline crusts on upper infralittoral rock S62	
IR.MIR.KR.LhypT *Laminaria hyperborea* on tide-swept, infralittoral rock S43	

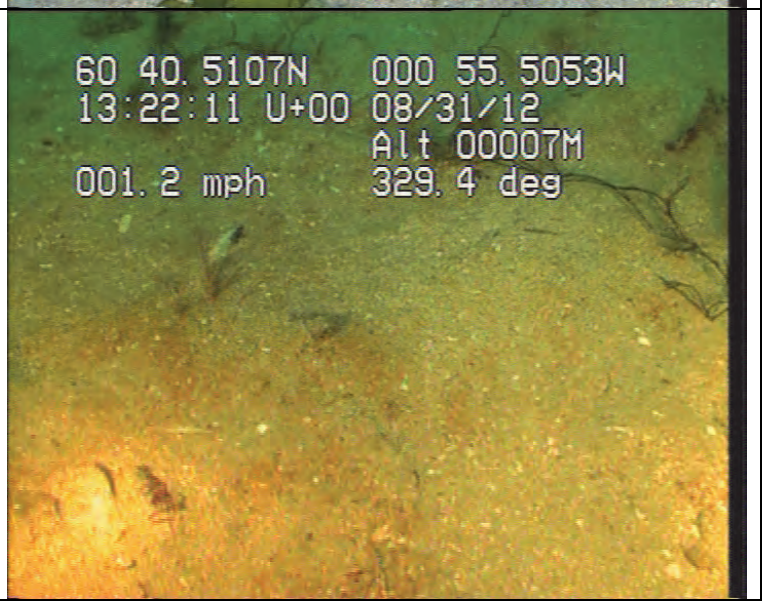
Biotope and Sites	Photograph
SS.SBR.SMus.ModT *Modiolus modiolus* beds with hydroids and red seaweeds on tide-swept circalittoral mixed substrata K3, S28a, S77b, S80c (Image S77b)	
SS.SCS.CCS Tide-swept circalittoral coarse sands, gravel and shingle generally in depths of over 15-20m. S34b, S54, S56, K15, K11, S30, S6, S26, S53, S55, S46b, S47, S45, S5 (Image S54)	
SS.SCS.ICS Infralittoral coarse sediment S75	

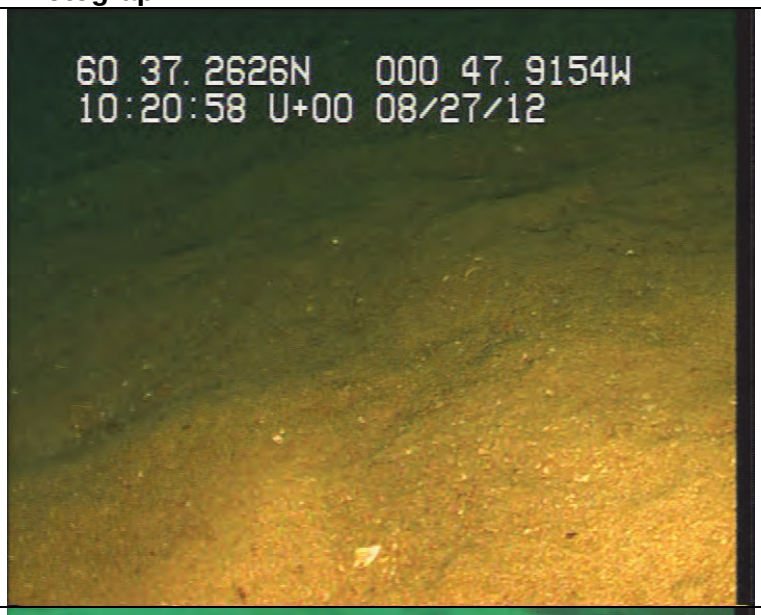
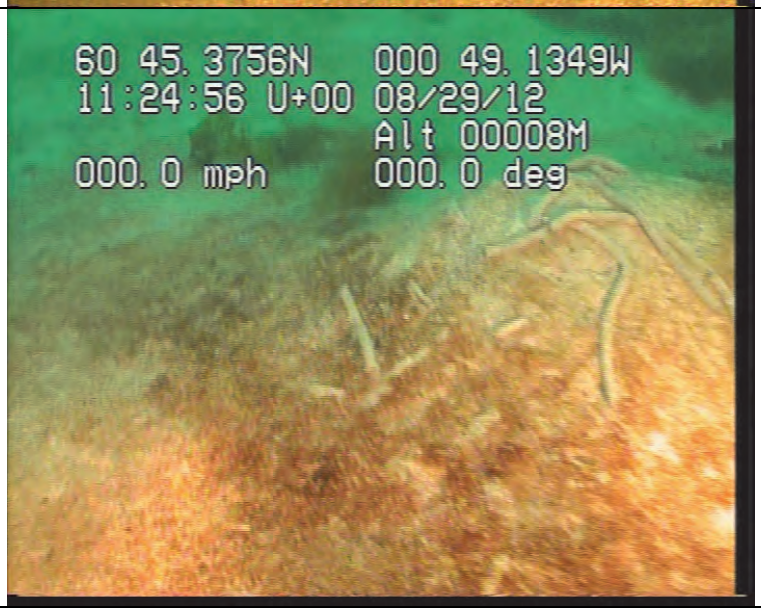
Biotope and Sites	Photograph
SS.SMp.KSwSS.LsacR.CbPb Red seaweeds and kelps on tide-swept mobile infralittoral cobbles and pebbles K10	
SS.SMp.KSwSS.LsacR.Gv *Saccharina latissima* and robust red algae on infralittoral gravel and pebbles S28a, K4.5, K5 (Image K5)	
SS.SMp.KSwSS.LsacR.Sa *Saccharina latissima* and filamentous red algae on infralittoral sand K4b	

Biotope and Sites	Photograph
SS.SMp.KSwSS.Pcri Loose-lying mats of *Phyllophora crispa* on infralittoral muddy sediment S70b, S16b, S71a (Image S16b)	
SS.SMp.KSwSS.Tra Mats of *Trailiella* on infralittoral muddy gravel S16a, K1b (Image K1b)	
SS.SMp.Mrl.Pcal *Phymatolithon calcareum* maerl beds in infralittoral clean gravel or coarse sand S70b, K2, S77a, S77c, S80b, S51 (Image S77a)	

Biotope and Sites	Photograph
SS.SMp.Mrl.Pcal.R *Phymatolithon calcareum* maerl beds with red seaweeds in shallow infralittoral clean gravel or coarse sand S27, S78, S49, S25 (Image S25)	
SS.SMu.CSaMu Circalittoral sandy mud K9, K1a, K1c (Image K1a)	
SS.SMu.CSaMu.VirOphPmax *Virgularia mirabilis* and *Ophiura* spp. with *Pecten maximus* on circalittoral sandy or shelly mud S39, S12, S14, K8, S71b (Image S39)	

Biotope and Sites	Photograph
SS.SMu.ISaMu Infralittoral, cohesive sandy mud, typically with over 20% silt/clay, in depths of less than 15-20m. S72, S73, S74 (Image S72)	
SS.SCS.CCS Adapted coarse sand habitat through presence of *Molgula occulta*. S59, S29 (Image S59)	
SS.SMx.CMx Mixed (heterogeneous) sediment habitats in the circalittoral zone (generally below 15-20m) including well mixed muddy gravelly sands or very poorly sorted mosaics of shell, cobbles and pebbles embedded in or lying upon mud, sand or gravel. S57, S50, S42, S31a, S10, S52, S7, S63, S19, S28c, S22, S65a, S65c, S37 (Image S42)	

Biotope and Sites	Photograph
SS.SMx.CMx.OphMx *Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment. S31b, S40, S76 (Image S76)	
SS.SSa Sublittoral sands and muddy sands. Clean medium to fine sands or non-cohesive slightly muddy sands on open coasts, offshore or in estuaries and marine inlets. S70c	
SS.SSa.CFiSa Clean fine sands with less than 5% silt/clay in deeper water, either on the open coast or in tide-swept channels of marine inlets in depths of over 15-20m. S3	

Biotope and Sites	Photograph
SS.SSa.CMuSa Circalittoral non-cohesive muddy sands with the silt content of the substratum typically ranging from 5% to 20%. S58	
SS.SSa.IMuSa.ArelSa *Arenicola marina* in infralittoral fine sand or muddy sand. S60, K4a (Image S60)	

APPENDIX 4. PSA ANALYSIS

Frac Phi	Frac µm	Went-worth Class	SG 01	SG 02	SG 03	SG 04	SG 05	SG 09 A	SG 09 B	SG 11	SG 13	SG 14	SG 19	SG 20	SG 21	SG 22	SG 23 B	SG 27	SG 28	SG 29	SG 30	SG 31	Hascosay Maerl PSA
> -2	>4000	Gravel	1.53	5.39	0.46	0.08	0.22	10.53	2.34	6.64	0.64	0.00	0.00	0.77	0.37	1.08	8.71	0.05	0.00	14.21	0.33	0.87	22.78
-1 to -2	2000 - 4000	Very fine gravel	6.13	3.87	5.63	0.22	0.41	23.23	11.79	6.26	0.66	0.54	0.04	0.68	0.49	1.52	4.69	0.09	0.05	43.56	0.42	1.08	10.58
0 to -1	1000 - 2000	Very coarse sand	13.60	1.99	26.60	0.34	1.59	27.46	27.62	13.89	0.74	3.15	0.89	0.62	1.32	3.16	5.38	1.61	0.32	29.18	0.65	17.86	10.61
1 to 0	500 - 1000	Coarse sand	11.35	1.73	27.39	2.23	1.60	24.19	38.93	27.61	0.85	17.66	21.76	2.42	3.92	4.11	7.76	13.36	3.00	7.90	3.77	67.50	15.54
2 to 1	250 - 500	Medium sand	35.59	11.13	25.25	23.84	17.61	13.42	15.97	27.25	13.63	50.75	63.57	26.20	16.26	5.18	21.96	53.69	32.89	3.33	37.72	8.90	17.92
3 to 2	125 - 250	Fine sand	27.73	57.72	13.30	62.11	68.29	0.75	0.71	10.60	73.14	25.80	11.40	59.69	53.84	69.00	41.02	29.05	55.61	0.56	48.92	1.72	0.00
4 to 3	63 - 125	Very fine sand	3.67	17.85	1.04	10.69	9.76	0.05	0.07	2.52	8.41	0.83	0.22	7.16	22.10	12.73	7.88	0.74	6.23	0.14	5.00	0.30	5.69
<4	<63	Silt & Clay	0.39	0.31	0.34	0.48	0.53	0.36	2.57	5.22	1.92	1.26	2.12	2.46	1.69	3.23	2.61	1.42	1.90	1.12	3.18	1.78	16.87

	SG 01	SG 02	SG 03	SG 04	SG 05	SG 09 A	SG 09 B	SG 11	SG 13	SG 14	SG 19	SG 20	SG 21	SG 22	SG 23 B	SG 27	SG 28	SG 29	SG 30	SG 31	Hascosay Maerl PSA
$MD_{Ø}$ (median diameter in phi)	1.49	2.44	0.62	2.38	2.41	-0.40	0.20	0.83	2.46	1.56	1.42	2.32	2.51	2.51	2.03	1.65	2.25	-1.18	2.15	0.44	0.40
MD (median diameter in mm)	0.36	0.18	0.65	0.19	0.19	1.32	0.87	0.56	0.18	0.34	0.37	0.20	0.18	0.18	0.24	0.32	0.21	2.27	0.23	0.74	0.76
$QD_{Ø}$ (quartile deviation in phi)	0.96	0.44	0.95	0.43	0.37	0.98	0.73	0.95	0.34	0.53	0.39	0.48	0.47	0.37	0.92	0.51	0.53	0.67	0.57	0.37	1.84
QD (quartile deviation in mm)	0.51	0.74	0.52	0.74	0.77	0.51	0.60	0.52	0.79	0.69	0.76	0.72	0.72	0.78	0.53	0.70	0.69	0.63	0.68	0.78	0.28
Folk substrate class	Med. sand	Med. sand	Coarse sand	Med. sand	Med. sand	Very coarse sand	Very coarse sand	Coarse sand	Med. sand	Med. sand	Coarse sand	Med. sand	Med. sand	Med. sand	Med. sand	Med. sand	Med. sand	Very fine gravel	Med. sand	Very coarse sand	-

APPENDIX 5. MNCR PHASE 2 DIVING SURVEY SPECIES DATA

Species	Species Qualifier column	MCS Code	Authority	*Horse mussel bed* sites (Species abundance SACFORN)			Maerl sites (Species abundance SACFORN)	
				BVMNCR 1	USMNCR 2	HSMNCR 3	NHM1	HM2
Leucosolenia complicata		C55	Montagu, 1818				O	
Suberites ficus		C418	(Linnaeus, 1767)	R	R			
Hydractinia echinata		D273	(Fleming, 1828)	R		O	R	R
Halecium halecium	sp.	D390	Oken, 1815					R
Kirchenpaueria pinnata		D455	Jickeli, 1883	F				
Nemertesia ramosa		D466	Lamouroux, 1816	R				
Plumularia setacea		D469	Linnaeus, 1758	O				
Sertularia argentea		D434	Linnaeus, 1758		R			
Obelia geniculata		D520	(Linnaeus, 1758)	O				O
Cerianthus lloydii		D632	Gosse, 1859				O	O
Urticina	sp.	D682	Ehrenberg, 1834					R
Adamsia carciniopados		D743	(Otto, 1823	R				
Chaetopterus variopedatus	sp.	P811	Cuvier, 1827	R				
Terebellidae	indet.	P1179		R				O
Lineus longissimus		G54	(Gunnerus, 1770)				R	O
Lanice conchilega		P1195	(Pallas, 1766)	O		R	F	O
Sabellidae	indet.	P1257					R	
Pomatoceros triqueter		P1341	(Linnaeus, 1758)	F	O	R	R	O
Polynoidae	indet.	P25				R		
Balanoidea	sp.	R59		O	R			
Pagurus bernhardus		S1457	(Linnaeus, 1758)	F	F	F	F	F
Pagurus cuanensis		S1460	Bell, 1845			R		
Pagurus prideaux		S1462	Leach, 1815	R				

Species	Species Qualifier column	MCS Code	Authority	*Horse mussel bed* sites (Species abundance SACFORN)			Maerl sites (Species abundance SACFORN)	
				BVMNCR 1	USMNCR 2	HSMNCR 3	NHM1	HM2
Galatheidae	sp.	S1469		R				
Galathea intermedia		S1472	Liljeborg, 1851		R		F	F
Ebalia tuberosa		S1508	(Pennant, 1777)		R		R	R
Hyas araneus		S1518	Leach, 1814					R
Inachus dorsettensis		S1526	(Pennant, 1777)		O			
Macropodia rostrata		S1532	(Linnaeus, 1761)	O				R
Atelecyclus rotundatus		S1555	(Olivi, 1792)	R				
Cancer pagurus		S1566	Linnaeus, 1758		R	R	R	R
Liocarcinus	sp.	S1577	Stimpson, 1870		R			
Liocarcinus depurator		S1580	(Linnaeus, 1758)			R	O	O
Carcinus maenas		S1594	(Linnaeus, 1758				O	
Liocarcinus corrugatus		S1579	(Pennant, 1777)				R	O
Pandalus	sp.	S1375	Leach, 1815					O
Polyplacophora	indet.	W46		R				O
Gibbula cineraria		W162	(Linnaeus, 1758)	F		C	O	O
Calliostoma zizyphinum		W182	(Linnaeus, 1758)	O				
Buccinum undatum		W708	Linnaeus, 1758	O	C	A	O	O
Neptunea antiqua		W727	(Linnaeus, 1758)	R	R			
Capulus ungaricus		W443	(Linnaeus, 1758)		F	C	F	O
Bivalvia	sp.						O	
Modiolus modiolus		W1702	(Linnaeus, 1758)	C	S	S		
Aequipecten opercularis		W1773	(Linnaeus, 1758)	O	R	R	O	O
Pecten maximus		W1771	(Linnaeus, 1758)	O	F			R
Dosinia	sp.	W2126	Scopoli, 1777	R				

Species	Species Qualifier column	MCS Code	Authority	*Horse mussel bed* sites (Species abundance SACFORN)			Maerl sites (Species abundance SACFORN)	
				BVMNCR 1	USMNCR 2	HSMNCR 3	NHM1	HM2
Anomia	sp.	W1806	Linnaeus, 1758	F	O	C		O
Eledone cirrhosa		W2398	(Lamarck, 1798)		R			
Tapes rhomboides		W2113	(Pennant, 1777)					O
Ensis	sp.	W1996	Schumacher, 1817				R	
Mya truncata		W2147	Linnaeus, 1758				R	
Crisiidae	indet.	Y4						R
Membranipora membranacea		Y170	(Linnaeus, 1767)				O	O
Flustra foliacea		Y187	(Linnaeus, 1758)		R			
Bugula flabellata		Y243	(Thompson in Gray, 1848)				O	
Scrupocellaria	sp.	Y274	van Beneden, 1845				F	O
Cellepora pumicosa		Y495	(Pallas, 1766)	R			O	R
Celleporella hyalina		Y337	(Linnaeus, 1767)				O	O
Disporella hispida		Y66	(Fleming, 1828)	R				R
Antedon bifida		ZB10	(Pennant, 1777)					R
Luidia ciliaris		ZB22	Forbes, 1839 (Philippi, 1837)		R			R
Porania pulvillus		ZB54	(O F Müller, 1776)	R	R			
Solaster endeca		ZB72	Forbes, 1839	R		R		
Crossaster papposus		ZB75	(Linnaeus, 1767)	R	R	O		R
Henricia	sp.	ZB82	J E Gray, 1840	R			R	
Asterias rubens		ZB100	Linnaeus, 1758	R	O	A	O	F
Marthasterias glacialis		ZB104	(Linnaeus, 1758)				R	
Ophiothrix fragilis		ZB124	(Abildgaard, 1789)	F	S	S		
Ophiocomina nigra		ZB128	(Abildgaard, 1789)	O	C	A		
Ophiopholis aculeata		ZB147	(Linnaeus, 1767)		F	S		

Species	Species Qualifier column	MCS Code	Authority	*Horse mussel bed* sites (Species abundance SACFORN)			Maerl sites (Species abundance SACFORN)	
				BVMNCR 1	USMNCR 2	HSMNCR 3	NHM1	HM2
Ophiura albida		ZB168	Forbes, 1839	R				
Echinus esculentus		ZB198	Linnaeus, 1758		C	A	O	A
Strongylocentrotus droebachiensis		ZB205	(O F Müller, 1776)			A		
Cucumaria frondosa		ZB268	(Gunnerus, 1767)		R	C		
Clavelina lepadiformis		ZD7	(O F Müller, 1776)				R	
Diplosoma	sp.	ZD58	MacDonald, 1859	R				
Ciona intestinalis		ZD71	(Linnaeus, 1767	O		A		
Corella parallelogramma		ZD81	(O F Müller, 1776)	R				
Distomus variolosus		ZD122	Gaertner in Pallas, 1774	R				
Didemnidae	indet.	ZD41					R	
Lissoclinum perforatum		ZD65	(Giard, 1872)				O	
Ciona intestinalis		ZD71	(Linnaeus, 1767				O	R
Botryllus schlosseri		ZD126	(Pallas, 1766)				R	
Scyliorhinus canicula		ZF28	de Blainville, 1816 (Linnaeus, 1758)	R	R		R	R
Diplecogaster bimaculata		ZG86	(Bonnaterre, 1788)	R				
Taurulus bubalis		ZG282	Euphrasen, 1786			R	R	R
Chirolophis ascanii		ZG425	(Walbaum, 1792)			R		
Pholis gunnellus		ZG440	(Linnaeus, 1758)	O				
Callionymus lyra		ZG452	Linnaeus, 1758	R				
Callionymus reticulatus		ZG454	Valenciennes, 1837	R			O	
Pomatoschistus	sp.	ZG476	Gill, 1864	R				
Pomatoschistus minutus		ZG479	(Pallas, 1770)					O
Pomatoschistus pictus		ZG481	(Malm, 1865)		O		O	O
Pleuronectes platessa		ZG578	Linnaeus, 1758	R				

Species	Species Qualifier column	MCS Code	Authority	*Horse mussel bed* sites (Species abundance SACFORN)			Maerl sites (Species abundance SACFORN)	
				BVMNCR 1	USMNCR 2	HSMNCR 3	NHM1	HM2
Scorpaenidae	indet.	ZG249		R				
Platichthys flesus		ZG576	(Linnaeus, 1758)	R				
Rhodophyceae	sp.	ZM2		F	O	R	O	O
Scinaia	sp.	ZM127	Bivona-Bernardi				O	R
Gelidium spinosum		ZM156	Lamouroux					O
Corallinaceae	indet.	ZM194		O	O	O		
Phymatolithon calcareum		ZM255	(Pallas) Adey et McKibbin	R	O	R	A	A
Calliblepharis ciliata		ZM319	(Hudson) Kützing					O
Plocamium cartilagineum		ZM443	(Linnaeus) Dixon				F	O
Delesseria sanguinea		ZM582						R
Drachiella spectabilis		ZM598	Ernst et J Feldmann					R
Hildenbrandia	sp.	ZM189	Nardo			O		
Dictyota dichotoma		ZR313	(Hudson) Lamouroux	O			O	F
Desmarestia ligulata		ZR336	(Lightfoot) Lamouroux					R
Saccharina latissima		ZR354	(Linnaeus) Lamouroux				R	O
Ulva	sp.	ZS174	Linnaeus					R

APPENDIX 6. FETLAR TO HAROLDSWICK SURVEY LOG

27th Aug – 5th Sept 2012

Survey Team: Heriot Watt University Lead Scientist: Dr Bill Sanderson, (WGS), SNH Project Leader: Dr Lisa Kamphausen (LK), Natalie Hirst, Heriot Watt University (NH), Robert Cook, Heriot Watt University (RC), Flora Kent, Heriot Watt University (FK), David Stirling, Heriot Watt University (DS), Prof. James Mair, Heriot Watt University (JM), Dr Joanne Porter, Heriot Watt University (JP), Sally Rouse, Heriot Watt University (SR), Piotr Kuklinsky, Natural History Museum (PK).

Overview:

Between 27th August - 5th September Heriot Watt University and SNH carried out a survey throughout the Fetlar to Haroldswick MPA potential area conducting drop down video (DDV) tows and Van Veen sampling. In total 70 DDV stations were completed, and 22 grab stations attempted (19 completed). MNCR diver surveys were also carried out on sites selected from the DDV and grab stations to further investigate maerl and horse mussel beds. In total three horse mussel bed MNCR stations were surveyed and two maerl bed stations.

Monday 27th August 2012

0900 Load *Moder Dy* at Cullivoe
0930 Depart from Cullivoe, travel to first station (NE Fetlar)
0950 First DDV commenced
1600 DDV ended (15 stations completed)
1630 End operations due to bad weather
1645 Arrive back in Cullivoe

Tuesday 28th August 2012

0900 Board *Moder Dy* at Cullivoe and travel to survey area south Colgrave Sound and Fetlar
0930 DDV commenced (5 stations completed)
1100 Switched to Van Veen grab sampling (5 stations completed, 2 stations failed)
16:30 End operations and travel to Cullivoe
1700 Arrive back in Cullivoe

Wednesday 29th August 2012

0900 Board *Moder Dy* at Cullivoe and travel to northern survey area (East side of Unst)
10:05 DDV Commenced (13 stations completed)
13:22 Switched to Van Veen grab (6 stations completed and 1 station failed)
1600 Ended operations to travel back to harbour
1700 Returned back to harbour

Thursday 30th August 2012

0900 Board *Moder Dy* at Cullivoe (delay due to boat battery failure) travel to Balta Sound
1017 DDV commenced (21 stations completed)
1700 Ended operations to travel back to harbour
1800 Returned back to harbour

Friday 31st August 2012

0900 Board *Moder Dy* at Cullivoe, travel to South Unst survey area
0950 Van Veen grabbing commenced (10 stations completed)
1045 Switch to DDV (11 stations completed)
1425 Switch to Van Veen grabbing (2 Stations completed)
1519 Switched to DDV (2 stations completed)
1550 Ended operations to travel back to harbour
1700 Returned to harbour, unloaded for end of grab and DDV survey

Saturday 1st September 2012

0900 Packed up base at Cullivoe
1200 Return travel to Mainland for loading of the *Halton* in preparation for diving activities
1600 Loading of *MV Halton* at Lerwick

Sunday 2nd September 2012

0830 Depart Lerwick on board *MV Halton*
1059 First bryozoan panel deployment and rock collection three waves of divers:-

1.) Panel deployment (JP/PK)
2.) Rock collection 12m (WGS/FK)
3.) Rock collection 6m (RC/LK/NH)

1252 Work up dive: JM/SR/DS

1557First *M. modiolus* MNCR Site (S28) three waves of divers:-

1.) Fish survey (FK/WGS)
2.) MNCR survey (JP/NH)
3.) Clump samples (LK/RC/PK)

1650 Diving operations ended for day

Monday 3rd September 2012

0800 Depart Cullivoe
0835 Second *M. modiolus* MNCR site (S80) three waves of divers:-

1.) Fish survey (FK/JM)
2.) MNCR survey (WGS/NH)
3.) Clump samples and genetic sample (DS/LK/RC)

1055 Second rock collection site, two waves of divers:-

1.) JP/SR
2.) PK/WGS

1458 Spot check for *M. modiolus* (PK/DS)
1540 Third *M. modiolus* MNCR site (K3) aborted (too deep on mix available).
1645 First Maerl MNCR site, three waves of divers:-

1.) MNCR survey (JP/NH)
2.) Core samples and genetic sample (LK/RC)

1722 Diving operations ended

Tuesday 4th September 2012

0800 Depart Cullivoe
0905 Second Maerl MNCR site (S77 Hascosay Sound), Three waves of divers:-
1.) MNCR survey (JP/SR)
2.) Core Samples (PK/LK)

1011 Third *M. modiolus* MNCR site (S77 Hascosay sound), Three waves of divers:-
1.) MNCR survey (WGS/NH)
2.) Clump samples (RC/DS)
1030 HWU fish dive cancelled due to weather

1200 Diving operations ended due to bad weather
1300 Returned to Cullivoe

Wednesday 5th September 2012

0800 Depart Cullivoe
0845 Return to West Uyea Sound for HWU Fish survey (LK/WGS)
1035 HWU Fish control site East Uyea Sound Deep (JM/FK)
1115 HWU Fish dive East Uyea Sound Shallow (JP/SR)
1300 Return to Hascosay Sound *M. modiolus* bed for HWU, three waves of divers:-
1.) Fish survey (WGS/LK)
2.) *M. modiolus* genetic sample (JP/SR)
3.) Photography dive
1400 Burra Ness HWU fish survey (FK/JM)
1530 HWU Fish survey (JP/SR)
1630 End of diving operations to travel to Burra Voe.

Thursday 6th September 2012

0800 Depart Burra Voe for Sullom Voe
0900 Calback Ness HWU *Modiolus* bed survey, three waves of divers:-
1.) *M. modiolus* fish survey (SR/FK)
2.) MNCR Survey (JP/NH)
3.) Cross point quadrat records (JM/WGS)
4.) Quadrat clearing x6 (DS/PK)
5.) Clump samples (RC/LK)
1230 Voxter Voe HWU *M. modiolus* bed survey, two waves of divers:-
1.) MNCR Survey (JP/NH)
2.) Quadrat clearing assessment (WGS/RC/LK)
1400 HWU Rock collection
1.) 6m (JP/SR)
2.) 12m (PK/DS)
1530 Calback HWU Fish control
1.) Site 1 (FK/LK)
2.) Site 2 (WGS/RC)
1630 Calback HWU Rock collection (PK/DS)
1730 Dive operations ended for day to travel to Lerwick

Friday 7th September 2012

0800 Depart Lerwick
0830 Final HWU fish survey and rock collection at "The Naab", two waves of divers:-
    1.) Fish survey (WGS/NH)
    2.) Rock collection (PK/DS)
1030 Final photography and video footage dive (SR/NH/RC/DS/WGS/LK/PK)
1300 Return to Lerwick to unload the *Halton* and sort samples for transport.
1600 Operations finished for the day

Saturday 8th September 2012

1900 Return Ferry to Aberdeen

APPENDIX 7. DDV LOG SHEET

Date	Location	Station	Start Time	Start Depth	Start coordinates	Taxa	Dominant substrate type	End Time	End Depth	End coordinates	Comments

APPENDIX 8. GRAB LOG SHEET

Date	Location	Station	Time	Infauna/PSA	Sediment Type	Sediment Colour	Depth of Sample	Texture/Presence of Surface features	Photograph

APPENDIX 9. SPECIES ABUNDANCES AT SS.SBR.SMus.ModT VIDEO STATIONS

Station	K3a	S51a	S28b	S77b	S80a	S80c
Porifera sp.		R				
Suberites sp.			R			
Hydrozoa sp.	F					F
Halecium halecium	R	F	R		R	
Polyplumaria frutescens	R	R				
Abietinaria abietina	O	O				
Sertularia cupressina		R				
Kirchenpaueria pinnata						R
Alcyonium digitatum	F	A				
Actinaria sp.	1					
Pomatoceros triqueter	R	F		R	R	
Pagurus bernhardus		4			2	
Macropodia sp.			1			
Cancer pagurus		1			2	
Liocarcinus depurator		1				
Buccinum undatum			1	3		
Modiolus modiolus	C	F	C	C	A	C
Aequipecten opercularis			3			
Scyliorhinus canicula	1					
Bryozoa sp.	R	R	O		R	
Antedon bifida			A			
Luidia ciliaris					1	2
Porania pulvillus		1		1	2	1
Solaster endeca			2			
Crossaster papposus	13	2	3	2	4	2
Asterias rubens		34		2	1	4
Ophiothrix fragilis	A		F	S	S	A
Ophiocomina nigra	R				F	O
Ophiopholis aculeata	A		C	A	S	A
Echinus esculentus	8	62		48	47	196
Strongylocentrotus droebachiensis		A		9		
Cucumaria frondosa				1		
Ciona intestinalis						R
Scyliorhinus canicula					2	
Pomatoschistus pictus			1			
Rhodophyceae sp.				R		R
Corallinaceae sp.	F	F	F	R	O	F
Phymatolithon calcareum		F				
Dictyota dichotoma				R		
Saccharina latissima				R		

APPENDIX 10. SPECIES ABUNDANCES AT SS.SMp.Mrl.Pcal AND SS.SMp.Mrl.Pcal.R VIDEO STATIONS

Station	S27a	S25	S70a	K2	S77a	S77c	S78	S49	S80b
Suberites ficus	R								
Hydrozoa	R			R			O		F
Obelia geniculata		R						R	
Cerianthus lloydii	1								
Chaetopterus sp.								R	
Arenicola marina									
Lanice conchilega				3	1		10		
Myxicola infundibulum	R								
Pomatoceros triqueter	O	R	R	O	R	O	O		
Spirorbidae					R				
Pagurus bernhardus	2				2		2		1
Inachus dorsettensis	2								
Liocarcinus depurator	2						2		
Carcinus maenas			1						
Gibbula cineraria				9					
Buccinum undatum	1								
Bivalvia					R		R		
Modiolus modiolus									R
Pecten maximus					1				
Aequipecten opercularis	4						1		
Scyliorhinus canicula	2								
Bryozoa				R		R			
Membranipora membranacea	R	O	O	O		O	R	R	
Luidia ciliaris							3		8
Porania pulvillus	5	1							2
Solaster endeca					1				
Crossaster papposus							1		3
Asterias rubens	25	1	1	2	16	3	7	3	
Ophiothrix fragilis									O
Ophiocomina nigra									R
Ophiopholis aculeata									O
Echinus esculentus	22	1		12	59	43	33	4	16
Clavelina lepadiformis							O	O	
Ciona intestinalis								R	
Pisces	1		5	12				1	
Scyliorhinus canicula							2	1	
Callionymus reticulatus	1								
Gobiusculus flavescens		2		30					
Gobius	1	1		2			3		

Station	S27a	S25	S70a	K2	S77a	S77c	S78	S49	S80b
Pomatoschistus pictus		1	11	1			1		
Pleuronectes platessa		1							
Rhodophyceae	F	F		R	O		F	C	
Scinia		R		R			R	R	
Corallinaceae	O			R	R	O			
Phymatolithon calcareum	A	A	A	C	A	A	A	A	A
Plocamium cartilagineum				R				F	
Phaeophyceae								F	O
Dictyota dichotoma	R	R	F	R	C	C	F	O	R
Desmarestia ligulata		R					R		
Halidrys siliquosa	R	R			R				
Saccharina latissima	C	A	O	F	F	F	O		
Laminaria hyperborea				R		R		R	
Ulva sp.	R	R							

APPENDIX 11. SPECIES ABUNDANCES AT SS.SMp.KSwSS VIDEO STATIONS

Station	K10	S70b	S16a	S16b	S28a	K1b	S71a	S76b	K4.5	K4b	K5
Suberites ficus			R	O			R				
Hydrozoa					O						R
Hydractinia echinata				R			O				
Obelia geniculata	R	O			R						O
Cerianthus lloydii											2
Arenicola marina										R	
Lanice conchilega											3
Myxicola infundibulum											R
Pomatoceros triqueter	O						O	O	R		R
Spirorbidae				O							
Crustacea				2							
Balanoidea	R										
Pagurus bernhardus			2	23	2		12	1			
Hyas araneus				9							
Inachus dorsettensis				1							
Cancer pagurus										1	
Liocarcinus depurator				2		1	4				
Necora puber											1
Carcinus maenas			1	7			2				
Gibbula cineraria	3	8			3						3
Calliostoma zizyphinum		2									
Buccinum undatum				1							
Modiolus modiolus				F			R				
Pecten maximus			2	5			10				5
Aequipecten opercularis			2	17			13				
Bryozoa	O						R				R
Membranipora membranacea	F	A			O			O	R	O	F
Solaster endeca				2							
Asterias rubens				3	3	2				1	4
Echinus esculentus	3	3	3	26	60		1				4
Ascidiacea						O					R
Pisces					1		2			1	2
Gobiesocidae				1							
Gadidae							1				
Labridae		1									
Gobiusculus flavescens	2	110							1		3
Gobius sp.				2			2				
Pomatoschistus sp.										1	
Pomatoschistus pictus											2
Pleuronectes platessa										1	
Rhodophyceae	F	O		A	C		C	O	F	O	C

Station	K10	S70b	S16a	S16b	S28a	K1b	S71a	S76b	K4.5	K4b	K5
Scinia sp.											F
Corallinaceae	F	R		R			R	F			R
Phymatolithon calcareum								R	F	O	O
Plocamium cartilagineum									O	O	C
Dictyota dichotoma									O	R	F
Desmarestia ligulata		R							O	R	O
Chorda filum									R		
Saccharina latissima	R	O			O			C	F	F	C
Laminaria hyperborea	A	A			O						
Ulva sp.									R		
Trailiella						A					
Diatom layer										O	
Beggiatoa sp.				R							

APPENDIX 12. SPECIES ABUNDANCES AT SS.SCS.CCS, SS.SSa.CFiSa AND SS.SCS.ICS VIDEO STATIONS

Station	S34b	S51b	S54	S56	K15	K11	S30	S6	S26	S53	S55	S45	S46b	S47	S5	S75	S3
Porifera												R				R	
Suberites ficus																R	
Hydrozoa		R	R					R									R
Hydractinia echinata																R	
Sertularia cupressina												R					
Obelia geniculata					R												
Cerianthus lloydii			1														
Urticina sp.			1														
Lineus longissimus								1									
Chaetopterus sp.	1		1							O				O			
Arenicola marina															R	O	
Lanice conchilega			3	9		2	5			4			7	4		8	3
Myxicola infundibulum			3					O									
Sabella pavonina																	O
Pomatoceros triqueter			R							R		R		R	R		
Crustacea			1								1					1	
Pagurus bernhardus				1	1			1	3	8	3	1				30	1
Cancer pagurus													1		2		
Liocarcinus depurator																	1
Carcinus maenas																9	
Gibbula cineraria					2												
Calliostoma zizyphinum																1	
Turritella communis										R							
Calyptraea chinensis	3																
Buccinum undatum			1											1			
Bivalvia			1								P			1			

Station	S34b	S51b	S54	S56	K15	K11	S30	S6	S26	S53	S55	S45	S46b	S47	S5	S75	S3
Scaphopoda				R													
Modiolus modiolus		R															
Pecten maximus			1									1		3			1
Aequipecten opercularis			1													1	
Mya truncata																	R
Bryozoa												R				R	
Alcyonidium diaphanum			R											R			
Membranipora membranacea					O			R							R		
Flustra foliacea														R			
Parasmittina trispinosa			R														
Echinodermata										1							
Luidia ciliaris														1			
Porania pulvillus			1									3					
Asterias rubens	1		4													3	2
Ophiura ophiura												1					
Echinus esculentus	1	1	5					1		1							
Strongylocentrotus droebachiensis		O															
Holothuroidea			1										1				
Ascidiacea														2		2	
Scyliorhinus canicula	2											1			1		
Aspitrigla cuculus	1																
Labridae					1												
Gobius sp.																2	
Pomatoschistus sp.			4	2	2			3		3	1			1	1		5
Pleuronectiformes sp.																1	
Rhodophyceae					O			O							O	C	O
Scinia sp.								R									R
Corallinaceae			R		R			R									

Station	S34b	S51b	S54	S56	K15	K11	S30	S6	S26	S53	S55	S45	S46b	S47	S5	S75	S3
Plocamium cartilagineum					R												
Odonthalia dentata																R	
Desmarestia ligulata								R							R		
Saccharina latissima					R			O							R		
Laminaria hyperborea					O			R									
Diatom layer							R										

APPENDIX 13. GRAB INFAUNAL SPECIES ABUNDANCES

Station	SG 1	SG 2	SG 3	SG 4	SG 5	SG 9A	SG 9B	SG 13	SG 14	SG 19	SG 20	SG 21	SG 22	SG 23	SG 27	SG 28	SG 29	SG 30	SG 31
Alcyonium digitatum	1																		
Cerianthus lloydii								1				1							
Edwardsia claparedii		1		2	1						2	6	3	1	1	6			
Platyhelminthes spp.					1														
Nemertea spp.						1								2			1		1
Tubulanus polymorphus											2			2		3			
Cerebratulus sp.	3	4		1							1			2			1		
Nematoda spp.						4	25										260		1
Phascolion strombus													1						
Pisione remota			5			1	8										4		1
Polynoidae spp. juv.		5										1		1					
Polynoidae spp. indet.														1					
Harmothoe fraserthomsoni														3					
Harmothoe glabra					1											1			
Sigalion mathildae												2							
Sthenelais limicola		1						2						1	3	1			
Eteone longa agg.					3								2		1			2	3
Hesionura elongata			2			1	2		1										
Mystides caeca	1																		
Pseudomystides limbata			1								1								
Anaitides spp. juv.					1						1			1					
Anaitides groenlandica																			1
Anaitides mucosa												7						1	
Anaitides rosea															1	1			
Eumida/Eulalia sp. juv.							1												

Station	SG 1	SG 2	SG 3	SG 4	SG 5	SG 9A	SG 9B	SG 13	SG 14	SG 19	SG 20	SG 21	SG 22	SG 23	SG 27	SG 28	SG 29	SG 30	SG 31
Eumida bahusiensis														4					
Eumida ockelmanni				1															
Eumida sanguinea	2													6					
Pterocirrus nidarosiensis														1					
Lacydonia miranda																	1		
Glycera alba		2		1				1			1			1					
Glycera gigantea							1												
Glycera lapidum	8	1	6		1	10	14			1	1						25		13
Glycera unicornis													2						
Glycinde nordmanni					1											1			
Goniada maculata		1									1		1						
Goniadella gracilis			4			1	1												3
Gyptis sp. indet.																			1
Psamathe fusca	3		1			1								1			1		
Nereimyra punctata														6					
Syllidae spp. indet.			2				2												
Trypanosyllis coeliaca																	3		
Syllis parapari			1											2					1
Syllis licheri			3			1													
Syllis pontxioi	1		14				2												12
Syllis garciai			1				1												
Syllis Type A	3																		
Syllis mauretanica			1			2													2
Odontosyllis fulgurans	3	1												5					
Odontosyllis gibba	2		1																
Opisthodonta pterochaeta			3																
Palposyllis prosostoma			1																

Station	SG 1	SG 2	SG 3	SG 4	SG 5	SG 9A	SG 9B	SG 13	SG 14	SG 19	SG 20	SG 21	SG 22	SG 23	SG 27	SG 28	SG 29	SG 30	SG 31
Syllides convolutus							1												
Exogone hebes	2	1					1		1	1									
Exogone naidina				1						1				2	3			6	
Exogone verugera		4	4								2					1			
Sphaerosyllis bulbosa			19			1											20		
Sphaerosyllis hystrix			1																
Sphaerosyllis taylori	2								1								3		
Autolytinae sp.	1													1					
Eunereis longissima			2													1			2
Aglaophamus malmgreni									1										
Nephtys spp. juv.				2	4														
Nephtys caeca		1							1										1
Nephtys cirrosa				1	2			1	5	2	1		2		4	1			
Nephtys hystricis																		2	
Nephtys longosetosa	1																		
Pareurythoe borealis																	2		
Aponuphis bilineata	1			1					2							1			
Nothria sp. juv.				1															
Nothria sp.											1								
Lumbrineris cingulata/aniara	6	11		4	3			3	2				1	15		2		1	
Ophryotrocha sp.							3												
Protodorvillea kefersteini			7			3	2												1
Orbinia (O) armandi									2							2			
Scoloplos armiger		1			1	1	1	5		1	1	40	2	1	6	2		60	
Aricidea minuta												4						2	
Aricidea catherinae		2																	
Aricidea cerrutii	16	1	2	5	6		3	3	5		1		2	1					3

Station	SG 1	SG 2	SG 3	SG 4	SG 5	SG 9A	SG 9B	SG 13	SG 14	SG 19	SG 20	SG 21	SG 22	SG 23	SG 27	SG 28	SG 29	SG 30	SG 31
Aricidea simonae		1		1															
Paradoneis lyra	2	1												4					
Poecilochaetus serpens									1					1		2			
Aonides paucibranchiata	10	13	1		3	1		6	2			5	2	2			14	11	22
Laonice sarsi			1																
Malacoceros vulgaris														1					
Polydora caeca agg	1													4					
Polydora caulleryi														3					
Polydora socialis	1																		
Prionospio fallax	1											8						2	
Prionospio banyulensis	3	1															1		
Minuspio cirrifera	6	23	3	1							7		2	12	2	2		6	
Pseudopolydora cf paucibranchiata														1					
Scolelepis (S) bonnieri				1				3			1								
Scolelepis (S) squamata									1				1		1				
Scolelepis korsuni									1									1	
Spio sp.	4	3												25		1			
Spio decorata	1	9	1	1	1			7	1		7	10	2		5			7	
Spio filicornis			3			4	4	2		3	1		1	2				19	6
Spiophanes bombyx	2	4		2	1			2	2	2	6	3	7	3	6	5		2	
Spiophanes kroyeri	15	7	1	1					1		2		6	1		1			
Magelona filiformis												2							
Magelona johnstoni												1							
Chaetopterus variopedatus				1	1						8								
Chaetozone setosa					2			7			1	53	3	1		1			
Chaetozone zetlandica	1																		

Station	SG 1	SG 2	SG 3	SG 4	SG 5	SG 9A	SG 9B	SG 13	SG 14	SG 19	SG 20	SG 21	SG 22	SG 23	SG 27	SG 28	SG 29	SG 30	SG 31
Chaetozone christiei	1	5							1				1					14	
Cirratulus cirratus	1	2												12					
Aphelochaeta sp.	1																		
Tharyx killariensis					1						2								
Diplocirrus glaucus		1																	
Capitella capitata agg.		1										13	2						
Mediomastus fragilis																		4	
Notomastus sp.	5	3	6											3			7		
Peresiella clymenoides		2			1														
Maldanidae spp. juv.				1													1		
Clymenura sp.								1											
Euclymene sp. A														1					
Euclymene lumbricoides		1																	
Praxillella sp.		1												2					
Travisia forbesii								1	1		3		1			1			
Ophelina acuminata																		1	
Scalibregma inflatum					1									1			1		
Polygordius sp.			8			7	30										30		8
Myriochele danielsseni		3		24	10						149								
Owenia fusiformis	45	9	7	2	15			5	5	3	12	48	28	26	16	16		8	2
Amphictene auricoma		1			2														
Ampharete lindstroemi agg.	4		1																
Sabellides octocirrata			1																
Sosanopsis wireni														1					
Lanice conchilega	3	1	1	2	1					1	3			4	1				1
Eupolymnia nebulosa	1		1																
Eupolymnia nesidensis														2					

Station	SG 1	SG 2	SG 3	SG 4	SG 5	SG 9A	SG 9B	SG 13	SG 14	SG 19	SG 20	SG 21	SG 22	SG 23	SG 27	SG 28	SG 29	SG 30	SG 31
Pista sp.	6			1	2			1	1		2			2					
Pista ? malmgreni														1					
Polycirrus sp.	19	11	15					1			2		1	14			1		
Parathelepus collaris			1																
Thelepus cincinnatus														21					
Sabellidae spp. juv.	3		1									1							
Branchiomma bombyx														1					
Dialychone/Chone sp.		4	17											1			20	2	
Paradialychone filicaudata	33	4	13										1	5			11		40
Euchone southerni	5	2	2																
Fabricia sabella														1					
Jasmineira caudata	4		1																
Pseudopotamilla reniformis						1													
Sabella ?discifera	1																		
Serpulidae spp. indet.														4					
Ditrupa arietina																6		1	
Hydroides elegans	1												1	12			1		
Pomatoceros lamarcki																	1		
Pomatoceros triqueter														1					
Grania spp.							2										7		2
Callipallene brevirostris														2					
Anoplodactylus petiolatus	1		1																
Verruca stroemia						1								2					
Scalpellum scalpellum														1					
Ostracoda		1	1											1					
Sarsinebalia typhlops							2												
Apherusa bispinosa																	22		

Station	SG 1	SG 2	SG 3	SG 4	SG 5	SG 9A	SG 9B	SG 13	SG 14	SG 19	SG 20	SG 21	SG 22	SG 23	SG 27	SG 28	SG 29	SG 30	SG 31
Monoculodes carinatus	1																		7
Perioculodes longimanus																1		3	
Pontocrates arenarius	1																		7
Synchelidium maculatum		1	1		1										2		1		2
Westwoodilla caecula										1									
Leucothoe lilljeborgi/incisa		1	3	1				2											
Urothoe elegans		1			1									3					
Urothoe marina	9															1			81
Metaphoxus fultoni																	2		
Acidostoma obesum				1															
Hippomedon denticulatus									1	2									1
Orchomene nanus														4					
Socarnopsis filicornis										2							96		
Tmetonyx cicada	1								1										
Tryphosites longipes											1								
Liljeborgia kinahani																	6		
Atylus falcatus																			1
Atylus vedlomensis	1		3			1					2						4		12
Ampelisca brevicornis		1		1	4			1	5				1		3			2	
Ampelisca diadema	1	1																	
Ampelisca spinipes	2		4																
Ampelisca tenuicornis	4	13		7					1				2	5					
Ampelisca typica	1	1		1	2			1	2	1	4				1	3		22	1
Bathyporeia spp.									1						8				
Ceradocus semiserratus																	42		
Maera othonis																			1
Gammaropsis maculata																	11		

Station	SG 1	SG 2	SG 3	SG 4	SG 5	SG 9A	SG 9B	SG 13	SG 14	SG 19	SG 20	SG 21	SG 22	SG 23	SG 27	SG 28	SG 29	SG 30	SG 31
Gammaropsis cornuta			2								3						8		2
Aoridae spp. indet. (female)				1					2		1						3		2
Aora gracilis																	4		
Leptocheirus pectinatus																	10		
Siphonoecetes striatus				7							5					28			
Pariambus typicus																2			
Phtisica marina																	1		
Gnathia sp. indet. (female)		1												3			1		
Gnathia oxyuraea	3	1												4					
Natatolana borealis	3																		
Eurydice pulchra	3										1								
Janira maculosa																	10		
Munna sp.							1												
Tanaopsis graciloides														1					
Bodotria arenosa											1								
Pseudocuma similis															1				
Diastylis rugosa	1																		
Caridea spp. indet.											2								
Paguridae spp. juv.			1					1											
Pagurus bernhardus																			1
Galathea sp. juv.	1		1											7					
Eurynome aspera														1					
Portunidae spp. juv.											2				2				
Polyplacophora spp. juv.	3																		
Leptochiton asellus	1													2			1		
Gastropoda spp. indet.																	1		

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Testudinalia testudinalis																	1		
Gibbula sp. indet.														1					
Onoba semicostata																	1		
Polinices pulchellus											1	1				1	4		1
Cylichna cylindracea		1										1							
Nudibranchia spp.	2					1													
Antalis entalis		2		1															
Mytilus edulis juv.	2																		
Crenella decussata	2		2								12				1	16	8	2	
Modiolus sp. juv.														3			2		
Glycymeris glycymeris juv.																			1
Limatula gwyni	2	1	1	1					4	2	1						16		
Pectinidae spp juv.	1										2			6					
Palliolum furtivum	1	1															2		
Aequipecten opercularis														3					
Anomiidae spp. juv.														16			2		
Pododesmus patelliformis	2																1		
Lucinoma borealis	1										3	3				1		9	
Semierycina nitidum														1					
Kurtiella bidentata	2	20												1					
Tellimya ferruginosa	1										1								
Goodallia triangularis	4		3													1	16		
Acanthocardia sp. juv.				1															
Acanthocardia echinata											1								
Parvicardium pinnulatum														2			1		
Spisula spp. juv.				1					2										
Spisula elliptica							1	3	19	1	3			1		8			1

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Ensis sp. juv.																		5	2
Ensis arcuatus																			1
Phaxas pellucidus		3										1	1	1	7	2			1
Fabulina fabula												8						5	
Moerella pygmaea	6		2				1		8	1	1		1	1	1	2	1	4	8
Gari sp. juv.		1															4		
Gari fervensis								2				1	2						
Gari costulata											4								
Gari tellinella	3																6		1
Abra sp. juv.		2		1	1						2	1	1						
Abra prismatica		1		1	3			6	2		4	2	2	1	1	9			1
Arctica islandica juv.												1				1			
Dosinia sp. juv.	1	3			2	1					2	5		3			1	11	
Dosinia exoleta								1									1		
Tapes spp. juv.	1													3			3		1
Tapes aurea																			1
Chamelea striatula		3	3					2			1	3	2						
Timoclea ovata	1	6						8	7		1	1	1	2		1	5	6	2
Mysia undata		1		2					1				1			1		1	
Hiatella arctica														3					
Lyonsia norwegica		1	1	1	2													1	
Thracia sp. juv.	1	1	6									2	2	5			3	2	
Thracia phaseolina																		2	
Thracia villosiuscula																	3		
Cochlodesma praetenue		10		3	6		1	7	8	3	8	6	1		1	16			
Flustridae sp.	1																		
Phoronis sp.	6	5		3				5			21	13	4	8	2	4		10	

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Asteroidea spp. juv.	1	1			1						1								
Ophiuroidea spp. juv.		2									7			1		3	43	1	
Amphiura filiformis		1																	
Amphipholis squamata	2	1	2								1			4			109	1	
Ophiocten affinis		1	2								7		1		1	8			
Echinoidea spp. juv.	1		1	2						1	3					3	7		
Echinocyamus pusillus	2	3	1	1	1						3		1	3		3			1
Echinocardium sp. juv.		1	2																
Echinocardium flavescens				1	1					1	2		1		1	9			
Leptosynapta sp. juv.								1											
Leptosynapta decaria									1					2	1				
Leptosynapta minuta																	26	1	
Labidoplax digitata		1		1															
Ascidiacea spp. juv.		8		5							7			3					
Ascidiacea sp. indet.	1																		
Dendrodoa grossularia														1					
Molgula occulta		10	1								17		2			11			
Branchiostoma lanceolatum			2																2
Chaetognathia sp.																	6		
Total number of individuals	320	263	212	102	91	44	110	92	103	30	360	254	101	346	83	193	911	240	269
Total number of species	86	77	64	45	37	20	24	31	37	19	64	32	41	92	28	46	65	38	48

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