Scottish Natural Heritage
Research Report No. 1080

2016 site condition monitoring of the rocky reefs and sea caves of Mousa SAC and survey of sedimentary habitats of the Mousa to Boddam MPA

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RESEARCH REPORT

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RESEARCH REPORT

Summary

2016 site condition monitoring of the rocky reefs and sea caves of Mousa SAC and survey of sedimentary habitats of the Mousa to Boddam MPA

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Background

Mousa Special Area of Conservation (SAC) was established in 2005 to afford protection to the harbour seals, rocky reefs and sea caves around the island of Mousa, south-east Shetland. The SAC overlaps with the northern region of the Mousa to Boddam Marine Protected Area (MPA) established in 2014 to facilitate conservation of the sandeel population and the calcium carbonate rich sediments.

One aim of the current 2016 investigation was to carry out site condition monitoring (SCM) of the Mousa SAC in order to assess the condition of the designated rocky reefs and sea caves features of the SAC. Temporal comparative data were available from previous studies, including a baseline SCM survey of the SAC in 2008. A further aim was to improve knowledge of the distribution of the designated features of the Mousa to Boddam MPA through a study of the distribution of sandeel habitat and carbonate rich sediments within the northern region of the MPA around Mousa. An additional objective was to assess the distribution and characteristics of a carbonate rich area in the form of a maerl bed reportedly present in the northern part of Mousa Sound. This was done through a dropdown video survey, together with more detailed surveying along transects through reef and maerl habitats. Sea cave monitoring methodology included a systematic search of the coastline to compile a comprehensive cave inventory and detailed biological and physical surveys of five selected cave locations.

Main findings

- While there was no evidence for temporal change in reef extent along the transects examined, a slight reduction in the frequency of dropdown video sites exhibiting reef habitats was recorded between the current survey and historical data. The level of change recorded was considered to be insufficient to imply a global change in reef extent within the SAC and was in any event consistent with natural temporal variation in hydrodynamic conditions.
- Among the sites examined in both the 2008 baseline and current surveys, four reef biotopes recorded in 2008 were not identified in 2016. There was no reason to implicate

anthropogenic factors in explaining any of the recorded physical and biological changes underlying the biotope loss at these sites.

- Change in the distribution of biotopes was recorded along all three reef transects studied in 2008 and 2016 and at 38 of the 100 dropdown video sites examined in both years. Temporal differences in camera tracking and variation in natural environmental factors such as hydrodynamism were considered most likely to be responsible for the observed changes.
- MNCR phase 2 surveys along three reef transects and quadrat quantification of the biota at two of these reef sites revealed no temporal decline in species richness between the 2008 and 2016 surveys. The quadrat and transect surveys revealed changes in the abundance of several species, but these were considered to be consistent with natural temporal variation. There was no clear evidence for the loss of any species.
- A total of 20 caves have been recorded at Mousa. The majority had a significant subtidal component and tended to be heavily influenced by scour. Most were <30 m in length but one was ~40 m and two were in excess of 80 m in length.
- There was no evidence of change in the extent or number of caves in the area since 2008 and the distribution and composition of biotopes in the surveyed caves was essentially unchanged since 2008.
- The abundance of a number of taxa had altered at a few cave locations since 2008 but there was no indication of a consistent trend apart from increased abundances of intertidal barnacles in the cave entrances. There was no indication that anthropogenic factors were implicated in any of the observed changes.
- There was no evidence of anthropogenic activities having caused any deterioration in the condition of the reefs or sea caves features since the establishment of site condition monitoring in 2008. Based on the available evidence it is recommended that the reefs and sea caves features should be assigned to the condition category "Favourable Maintained".
- Sediments of clean, medium to coarse sand, providing an apparently suitable habitat for sandeels, were recorded along 46 of the 120 dropdown video runs carried out. The distribution of the habitat was found to be largely consistent with the previous understanding of the pattern of distribution of the habitat around Mousa.
- The distribution of carbonate rich sediments, based on the presence of visually evident carbonate material along the 120 video runs, mirrored the distribution of sandeel habitat, although clean, rippled sands in the northern region of Mousa Sound did not show clear visual evidence of a carbonate origin. Carbonate material was generally manifest visually as shell gravel and larger shell material, with maerl gravel becoming a significant component in the northern part of Mousa Sound.
- The presence of a maerl bed in the northern region of Mousa Sound was confirmed. It lay beyond the MPA but straddled the northern boundary of the SAC. The patchy bed occupied an area of 13.0 ha over a depth range of 25.4 - 28.4 m. Within this area the bed formed a mosaic with reef biotopes supporting dense *Alcyonium digitatum*. Live *Phymatolithon calcareum* was abundant (>40% cover) over much of the bed and supported dense *Clavelina lepadiformis* but an otherwise sparse sessile community.

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1. INTRODUCTION

Mousa is located off the south-east coast of Mainland Shetland, 16 km south of Lerwick and separated from the Mainland by the 1 km wide Mousa Sound (Figure 1). In March 2005 Mousa was designated as a Special Area of Conservation (SAC) under the EC Habitats Directive (92/43/EEC). The area extends from MHWS to a minimum distance of 500 m from the coastline (Figure 1). The designation was primarily based on the island's role in supporting one of the largest breeding groups of harbour seals, *Phoca vitulina*, in Shetland and one of the most northerly in the UK. Furthermore, the area was recognised as supporting a significant presence of rocky reefs and submerged or partially submerged sea caves, which are Habitats Directive Annex I habitats and represent additional qualifying features for SAC designation.

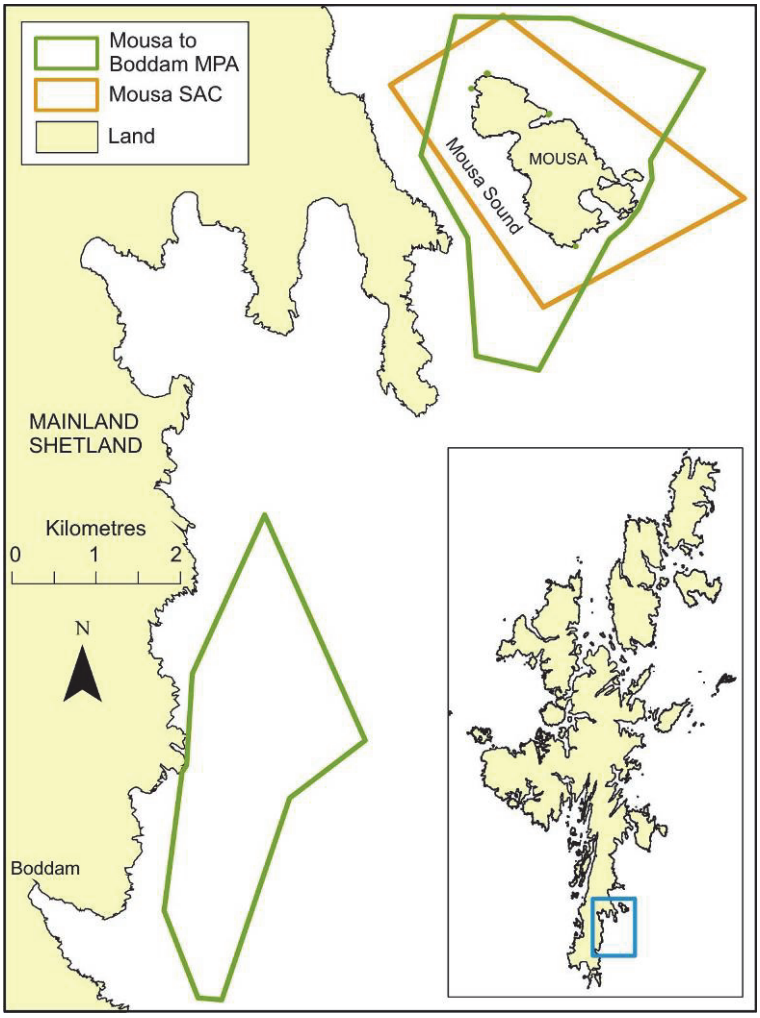

Figure 1. Location of Mousa SAC and Mousa to Boddam MPA with inset showing location of map (blue box) within Shetland Isles.

In addition to protection afforded by SAC status, the entire island is a Site of Special Scientific Interest for its maritime heath, storm petrels, Arctic terns and harbour seals. It is also a Special Protection Area for birds, as it supports internationally important breeding colonies of storm petrels, *Hydrobates pelagicus*, and Arctic terns, *Sterna paradisaea.* The island became an RSPB reserve in 2001 because of its important breeding seabird colonies.

In 2014 an area around Mousa seaward of MHWS was also designated as a Nature Conservation Marine Protected Area (MPA) by the Scottish Government under the Marine (Scotland) Act 2010. This Mousa to Boddam MPA in fact embraces two separate areas: a region off Boddam, to the south of Mousa, and the area around Mousa, overlapping with much of the Mousa SAC (Figure 1). The region off Boddam does not lie within the remit of the current study and will not be considered further in this report.

The MPA was established to afford protection to the features 'Sandeels' and 'Marine Geomorphology of the Scottish Shelf Seabed'. The MPA comprises the areas of most consistent and reliable sandeel recruitment in Shetland and the preferred locations for young of the year in the Shetland region (Marine Scotland Science, 2012). MSS surveys over the last 30 years employing demersal fishing gear, video sampling and RoxAnne acoustic mapping have identified the distribution of predicted sandeel habitat (SNH, 2012; Marine Scotland Science, 2012). This is shown in Figure 3.

The MPA region around Mousa lies completely within the Shetland carbonate production area, a key geodiversity area in Scottish waters encompassing interests from the Marine Geomorphology of the Scottish Shelf Seabed feature (Brooks *et al*., 2009, 2012). The Shetland carbonate production area is an internationally important example of a non-tropical shelf carbonate system involving the biological production of marine sediments with high calcium carbonate content (Scottish Natural Heritage, 2012).

One aim of the current investigation was to carry out site condition monitoring (SCM) of the Mousa SAC in order to assess the condition of the designated features of the SAC, rocky reefs and sea caves. A further aim was to improve knowledge of the distribution of the designated features of the Mousa to Boddam MPA through a study of the distribution of sandeel habitat and carbonate rich sediments within the northern polygon of the MPA around Mousa. An additional objective was to assess the distribution and characteristics of a carbonate rich area in the form of a maerl bed reportedly present in the northern region of Mousa Sound, just beyond the MPA boundary (see Figure 3) (Posford Haskoning Ltd, 2004).

1.1 Condition monitoring of Mousa SAC

In order to ensure a uniform approach to the monitoring of the condition of features, guidance has been drawn up on the general approach to be taken in condition monitoring (Joint Nature Conservation Committee, 2006). Thus, for the purposes of monitoring, each feature is represented by a series of attributes, which are measurable indicators of the condition of the feature at the site. For each attribute (e.g. extent of a habitat or presence of representative/notable biotopes), a target is set which is considered to correspond to the favourable condition of the feature.

In the case of the Mousa SAC the Annex I ‘reef’ and ‘sea cave’ features fall under the Common Standards Monitoring guidance produced, respectively, for littoral and inshore sublittoral rock habitats, and sea caves (Inter-Agency Marine Monitoring Group, 2004a,b). The Inter-Agency Marine Monitoring Group (*ibid*.) lists the attributes of these habitats and corresponding targets that should form the basis of the site condition monitoring (Table 1).

Table 1. Site attributes that should be utilised to define the condition of littoral and inshore sublittoral rock and sea cave features in site condition monitoring (Inter-Agency Marine Monitoring Group, 2004a,b). The use of the first three attributes is mandatory for rock features; otherwise attributes are discretionary.

Attribute	Feature	Target
Extent	Reef	No change in extent of intertidal rock or inshore sublittoral rock.
	Sea cave	No reduction in the number of caves within a site allowing for natural change. No change in dimensions of a cave, allowing for natural changes that are part of a wider coastal geomorphological management regime.
Biotope composition	Reef & Sea cave	Maintenance of the variety of biotopes identified for the site (or cave), allowing for natural succession or known cyclical changes
Distribution of biotopes. Spatial arrangement of biotopes at specified locations	Reef	Maintain the distribution/spatial arrangement of biotopes, allowing for natural succession or known cyclical changes.
Extent of sub-feature or representative/notable biotopes	Reef	No change in the extent of the biotope(s) identified for the site, allowing for natural succession or known cyclical changes.
Presence of representative/notable biotopes	Reef & Sea cave	Maintain the presence of the specified biotope, allowing for natural succession or known cyclical changes.
Species composition of representative/notable biotopes	Reef & Sea cave	No change in biotope quality due to change in species composition or loss of notable species, allowing for natural succession or known cyclical changes.
Presence and/or abundance of specified species	Reef & Sea cave	Maintain presence and/or abundance of specified species. Absence of the specified species (such as an undesirable/non-native species).

According to the definition of '*reefs*' given by the Interpretation Manual of European Union Habitats (European Commission, 2007), potential reef substrate includes bedrock, boulders and cobble fields, with 'cobbles' generally exceeding 64 mm in diameter. Furthermore, it states that within the National Marine Habitat Classification for Britain and Ireland (version 03.02), reef biotopes are listed under the following higher biotope categories: 'Littoral rock and other hard substrata (biotopes beginning with LR)'; 'Infralittoral rock and other hard substrata (IR)'; 'Circalittoral rock and other hard substrata (CR)'; 'Littoral biogenic reefs (LBR)' and 'Sublittoral biogenic reefs (SBR)'.

It is surprisingly difficult to arrive at a satisfactory biologically relevant definition of a cave. Common standards monitoring guidance refers to a working definition proposed by Bunker & Holt (2003) who state that "a cave must be large enough to get a surveyor fully into the cave, turn round and exit without damaging the attached flora and fauna". However, this definition is sufficiently broad to encompass large rock alcoves and overhangs where environmental conditions and biotic communities are likely to be indistinguishable from those of the open coast. The only biologically relevant parameter that consistently distinguishes caves from similar features is light. Surge gullies, rock arches, alcoves and rock overhangs are usually relatively well illuminated, whereas caves are typically dark. A biological definition of a cave has been proposed by Chapman (1993) as "perpetually-dark voids, more than 1 mm in diameter bounded by rock or similar inorganic materials and filled with gas and/or water". Accordingly we regard 'caves' which are fully illuminated due to large entrances to be a poor example of the feature and have concentrated efforts on sites where there is a significant reduction of light intensity within the cave.

1.2 Previous studies

Limited coverage of Mousa formed a part of a wider MNCR survey of Shetland and Fair Isle, with MNCR phase 2 surveying being carried out at five littoral and four sublittoral sites around the island in 1987 (Howson, 1988). On the very exposed east coast the shore was found to be dominated by *Semibalanus balanoides*, *Patella vulgata* and *Mytilus edulis*, with mussels attaining dominance on the lower shore, where they were covered with a mat of *Porphyra umbilicalis*. *Alaria esculenta* accompanied the mussels in a band at the bottom of the shore. A cave on the west coast had walls encrusted with coralline algae, *Semibalanus balanoides* and *Mytilus edulis*, with the surge-tolerant *Clava* sp., at the entrance. The encrusting algae, barnacles and spirorbid worms continued to the back of the cave, but in the middle section they were joined by encrusting bryozoans, *Alcyonium digitatum*, *Echinus esculentus*, *Sagartia elegans* and *Actinia equina*. Sublittoral sites on the east and west coasts supported forests of *Laminaria hyperborea* to a depth of 14 m, with the kelp continuing as a park down to 19 m on the west coast. Vertical rock faces were found to be covered in dense *Alcyonium digitatum*, accompanied by a turf of hydroids and bryozoans in the infralittoral, and encrusting algae, *Spirobranchus triqueter* and *Echinus esculentus* in the circalittoral. Two sites were examined in the centre of Mousa Sound. At the southern end of the Sound a plain of clean shelly sand was recorded at a depth of 36 m, with many large *Buccinum undatum*, *Pagurus* spp. and sandeels. The same species were also common at the northern site on coarse sand at 24 – 26 m, beyond which at 26 – 28 m the addition of cobbles and rock outcrops was accompanied by large numbers of *Ophiocomina nigra*, *Modiolus modiolus*, *Hydrallmania falcata* and *Spirobranchus* spp.

Following the designation of Mousa as a candidate SAC, a survey was carried out by Posford Haskoning Ltd in August and September 2003 designed to provide broad scale biotope maps of the littoral and sublittoral areas of the SAC (Posford Haskoning Ltd., 2004), although the survey extended beyond the limits of the SAC as finally designated. The approach taken was visual observations of the shores and five of the sea caves, combined with an AGDS survey of the sublittoral, ground truthed by dropdown video observations at 60 sites. Biotopes were allocated using the 1997 classification scheme (Connor *et al*., 1997a,b), except for the sea caves, where the 2003 system was adopted (Connor *et al.*, 2003). Forty intertidal biotopes were recorded. The intertidal zonation pattern recorded by Howson (1988) at an east coast site was found to be true for much of the north, east and south coasts, with dominance by barnacles and limpets in the eulittoral, accompanied by dense mussels in the lower eulittoral, often with a blanket of *Porphyra umbilicalis*, with *Alaria esculenta* occupying the sublittoral fringe. A similar sequence was recorded along the more sheltered western coastline, although in slightly less exposed locations mussel bands disappeared and *Alaria esculenta* was replaced by *Laminaria digitata*. Sheltered fucoid biotopes were recorded in the embayments of West Ham and East Ham, as well as around the tidal ponds and associated channels in the southeast of the island. Twelve sublittoral biotopes were recorded. A band of grazed *Laminaria hyperborea* forest and park fringed the coast on a substrate of bedrock and boulders, with the transition occurring at a depth of 15 m. Beyond the kelp zones circalittoral bedrock and boulders floored much of the seabed within the SAC and this supported dense carpets of *Alcyonium digitatum* or crusts of coralline algae and *Spirobranchus* spp., often with a hydroid turf. A patchy band of dense brittlestars was found off the southeastern coastline on bedrock and boulders at depths of 30 – 70 m. The majority of Mousa Sound and an extensive area just inside the northeastern boundary of the SAC consisted of sand and gravel with a sparse epifaunal community, but with the presence of patchy maerl at the northern entrance to the Sound. Also of conservation interest was the recording at one site off Perie Bard of the urchin *Strongylocentrotus droebachiensis*, believed to have a UK distribution restricted to Shetland (Posford Haskoning Ltd., 2004).

Posford Haskoning (2004) noted the location of nine confirmed sea caves, two possible caves and three rock arches. Of the confirmed caves, five were examined by snorkellers to produce sketches of cave shape with estimated dimensions and notes on the biota. Two of these were comparatively extensive for Mousa, being of the order of 100m in length. 'Boom cave' was located on the north coast, whilst Masti Geo cave was actually located 300 m northwest of Masti Geo. The purpose of the Posford Haskoning survey was habitat mapping so the biological data recorded in the caves was accordingly limited by the survey objectives and also by the fact that the survey was conducted by snorkelling. Posford Haskoning (2004) noted that the caves identified during their survey did not constitute a comprehensive list of the caves of Mousa.

Site condition monitoring of the rocky reefs and sea caves of the Mousa SAC was inaugurated in 2008 (Harries *et al*., 2009). This included a dropdown video survey at 120 sites selected to provide good geographical coverage within the following habitat types mapped by the Posford Haskoning study: bedrock, boulders and bedrock, cobbles, sand and bedrock. Video imagery was analysed to provide descriptions of the habitat, SACFOR abundances of the biota, biotope identities and a categorization of the site as 'reef', 'non-reef' or 'mixed' based on the presence of reef, non-reef or mixed biotopes.

In addition, intertidal and subtidal rocky reef habitats were surveyed using MNCR phase 2 methodology along six relocatable transects (Figure 2). These were selected to represent the range of environmental conditions and biotopes, although some adjustment of location was necessary to allow for adverse weather conditions. Surveys were carried out along the transects within a 4 m wide band extending from permanent markers at the top of the shore and into the subtidal, employing both shore surveyors and divers. The transect was split into different habitat zones, within which surveys of the epibiota were carried out. Video and still photographs, showing the nature of the habitats, were taken along all transects.

On the littoral sections of transects where weather conditions and topography permitted, a zone of specific interest was selected for quantitative analysis using ten square 0.25 m^2 non-overlapping quadrats. Dominant species within each quadrat were enumerated using either counts or percentage cover estimates as appropriate, and a thorough examination of the quadrat was carried out to record the presence of all species.

The video survey found reef habitats to be widely distributed throughout the sublittoral area of the SAC from the shore to a depth of 67 m. It was found that 109 of the video sites surveyed (91%) contained reef habitats. The video and transect surveys recorded a total of forty-two biotopes within the SAC, of which 35 were reef biotopes (13 littoral and 22 sublittoral). Kelp biotopes dominated the infralittoral zone on bedrock and boulders in a narrow coastal band extending to depths of 20 - 25 m. Biotopes were principally physically disturbed mixed kelp forests and parks, as well as grazed forests, but dense forests of *Laminaria hyperborea* and *Alaria esculenta* with profuse red algal turfs were also recorded, particularly along the south-eastern coastline. Beyond the coastal kelp fringe, the seabed of the surveyed area was largely of bedrock and boulders, often with sand patches, with rock surfaces supporting a species-poor community dominated by encrusting algae and *Spirobranchus* spp. At many sites these species were accompanied by dense carpets of *Alcyonium digitatum* or brittlestar beds. Four of the shores surveyed were very exposed or exposed, being typical of the island, with the eulittoral area dominated by barnacles, limpets, *Porphyra umbilicalis* and mussels. This community was replaced by a barnacle/*Fucus vesiculosus* mosaic at a moderately exposed site; whilst the only sheltered location examined supported a *Fucus serratus* dominated mosaic of fucoid algae.

Detailed biological and physical surveys were conducted at five cave sites and brief descriptions were provided at a number of other sites (Figure 2). Caves were selected for detailed survey to represent the broadest available range of cave communities and

environmental conditions, although the choice of sites was also constrained by adverse weather conditions which prevented access to the caves on the north-east coast of Mousa. Where sea conditions were suitable, the coast of the island was systematically examined at close quarters from an inflatable boat. All inlets, alcoves or other potential cave sites were investigated by a snorkeller. Where caves were present the nature of the biota was briefly noted, a sketch survey of cave extent was made, the entrance photographed and its geographic position recorded. Sites identified as caves on the Ordnance Survey maps and cave sites recorded by the 2003 mapping survey (Posford Haskoning Ltd., 2004) were checked as part of this process. The purpose of this exercise was to work towards developing a comprehensive inventory of caves around Mousa. This inventory provided a basis for selecting the most suitable sites for detailed monitoring surveys and also addressed the monitoring attribute 'number of caves in site'.

Monitoring surveys of caves were initiated by conducting a physical survey and deploying a relocatable fixed datum line for precise spatial mapping of biotopes. Methods were adapted from Ellis (1988). A point on the upper shore/supralittoral just outside the entrance was marked with a piton. Coordinates of this and photographs were obtained to facilitate relocation. This piton provided the relocation point for a fixed line (tape measure) that was set up within the cave to act as a datum line. The line was set up to run in straight line sections with additional pitons positioned as required to prevent the line being forced into a curve by obstructions or changes in the direction of the cave passage. The compass bearing and length of each section of line was recorded and the height/depth of the individual pitons were noted at the beginning and end of the section. An approximate plan view sketch was produced of the cave floor with notes on the composition of the substrate. At selected points along the line the cross-sectional shape of the passage was sketched and the cross sectional dimensions were estimated in relation to the fixed datum line. The arrangement of the datum line was typically a near-vertical descent from the relocation piton to a start piton located a short distance below the water surface. The line then continued along a single wall following the main axis of the cave. Each piton was photographed to aid the future repositioning of the datum line. While conducting the physical survey an assessment was made of changes in biological communities along the length of the cave and a series of locations were identified for subsequent collection of biological data from cross sections of the cave passage. Typically, three biological cross section surveys were conducted in each cave although this number was reduced in caves of limited length. The biological surveys were conducted within a 2 m wide band around the cross section of the passage. Boundaries of biological zones were indicated on a sketch of the cross section and a note was made of their position in relation to the datum line. Within each biological zone the abundance of each component species was estimated using the SACFOR scale and notes made on the nature and inclination of the substrate. Video footage was obtained along the length of the cave using the datum line for orientation and detailed footage was obtained of the biota at each of the biological cross sectional survey locations. Additional underwater digital still images were taken to illustrate the biota at the biological cross sectional survey locations.

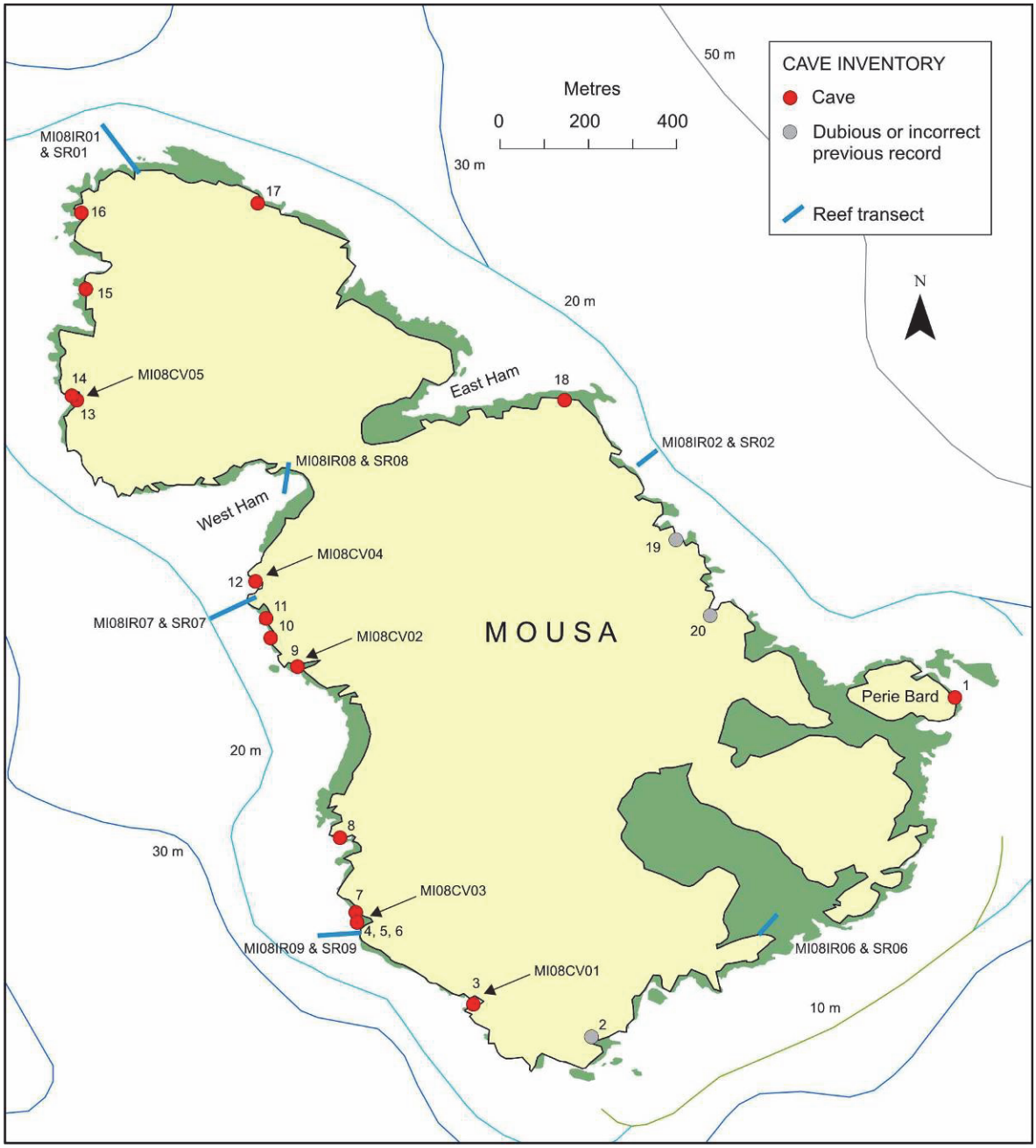

Figure 2. Cave and transect sites examined by the 2008 SCM survey (Harries et al., 2009). Cave sites surveyed in detail are arrowed with code names shown.

The cave survey revealed a total of seventeen caves around Mousa (Figure 2). Five were intertidal and <10 m in length. Twelve were partially subtidal with lengths varying from <20 m (four caves), 20 - 30 m (four caves), 40 m (one cave) and >80 m (three caves). The biota of most of the caves was impoverished due to scour and typically consisted of sparsely distributed scour-tolerant or mobile fauna on the cave floor and sublittoral walls, a narrow littoral zone consisting of various species in low abundance and a supralittoral zone with algal crusts on upper walls and ceilings. The biotope composition of different caves tended to be similar and comprised a limited number of biotopes (five in most cases).

Comparison with the results of previous surveys of the SAC revealed no temporal change in reef extent, biotope composition or distribution that could not be explained by methodological differences or natural drivers. No evidence of adverse anthropogenic impact was found during the survey and the reef and sea cave features of the SAC appeared to be in good condition.

1.3 Human usage of Mousa SAC

An extensive list of activities potentially damaging to the reef and sea cave features of Mousa SAC is provided by Shetland Islands Council (2003) and Scottish Natural Heritage (2006). Table 2 provides a digest of those activities that are known to occur in or close to the SAC. Shetland Island Council (2003) considered them to have no significant impact on the conservation features, with the possible exceptions of scallop dredging and shellfish gathering. Although it was considered that scallop dredging could have an impact, it was believed that most dredging took place beyond the boundary of the SAC. In the case of shellfish gathering, it was thought that current levels did not have a significant impact, although the possible effect of removal of key species on intertidal reef community structure was unknown.

Table 2. Sources of potential human impact on the reef and sea cave features of Mousa SAC (from Harries et al*., 2009).*

Activity	**Nature of potential damage**
dredging and trawling	direct contact with gear and effects of raised sediment
creeling	removal of key species by direct contact with gear, especially when deployed and recovered
gill and tangle nets	entanglement in lost gear
line fishing and angling	entanglement in lost gear
shore collection of shellfish and seaweed	trampling, stone turning, removal of key species
boat traffic	pumping of bilges, ballast water, grounding, spillage of oil or other chemicals
boat anchorages	scouring of seabed by ground tackle
scuba diving	physical damage to erect and fragile species
sea kayaking	physical damage

The sandeel grounds within Mousa Sound and to the north of Mousa (Figure 3) previously supported a sandeel fishery, which is no longer active (Scottish Natural Heritage, 2013). Although the island is uninhabited, the seabird and archaeological interests attract around 3000 visitors during the summer (RSPB, 2007), mostly transported by ferry to the main landing pier at West Ham, although cruise ships also land visitors at a small jetty below the Broch. The potential for this activity to disturb seals has been recognised, though impacts on reef and cave habitats have not been considered.

2. METHODS

2.1 Dropdown video survey

To facilitate assessment of the condition of the subtidal reefs feature a dropdown video survey was carried out. A subset of the 120 sites examined in the 2008 baseline survey was identified. This included a total of 100 sites, selected to achieve good geographical coverage and to include all the subtidal reef biotopes recorded during the baseline survey. To assess the distribution of sandeel habitat and calcium carbonate rich sediments within the northern sector of the Mousa to Boddam MPA, a further 31 sites were selected to provide coverage of that part of the MPA that lay outside the SAC, as well as sedimentary areas within the SAC. The location of these 131 dropdown video sites is shown in Figure 3 and further details provided in Annex 1 (Table 1.1). The video survey was carried out from 4th – 10th August 2016 from the vessel, *Onward*, working out of Aith Voe, Cunningsburgh.

The video system used consisted of a Panasonic NV-GS150 3 chip digital video camera within a Seapro housing held within a frame and illuminated by twin 100 watt lamps. A 100 m umbilical cable carried the video signal to a Sony Video Walkman for real-time observation and for recording. At each station the camera was deployed briefly from a drifting vessel, noting the times, depths and precise positions at the start and end of the drift using differential GPS (dGPS). These data, as well as brief notes on substrates and biota, were entered onto a proforma. The vessel track and time was logged every 3 seconds and displayed as a video overlay every 2 seconds. The runs averaged 3.2 minutes duration.

The video material from each station was processed in the laboratory, with notes being taken on the substrate and the biota present, where possible employing the SACFOR scale of abundance. Biotopes were allocated based on the classification scheme of Connor *et al.* (2004). To ensure consistency with the 2008 baseline survey, stations were categorised as 'reef', 'non-reef' or 'mixed' habitats based on the presence of reef biotopes or a mixture of reef and non-reef biotopes. Reef biotopes were regarded as those falling under the higher biotope categories of Infralittoral Rock and Circalittoral Rock (Connor *et al.*, 2004). Sites displaying sediments of clean, medium and coarse sands (including gravelly sands) were categorised as potential sandeel habitats, and sediments with a visible calcium carbonate component (shell and maerl material) of at least 10% as carbonate rich sediments. Depths were related to chart datum by determination of the tidal rise at the secondary port of Sumburgh using TotalTide software (Hydrographic Office, Taunton).

2.2 Maerl survey

The extent of the Mousa Sound maerl bed was surveyed by means of dropdown video drifts through the predicted area, with modification of the location of drifts based on earlier observations and current wind and tidal conditions. Eighteen drift runs (with site label prefix 'M') were carried out ranging in duration from 4 to 28 minutes. These runs were supplemented by six runs from the main dropdown video survey (section 2.1) (with site label prefix 'D'). The tracks of all 24 runs are shown in Figure 7, with further location data provided in Table 2.1 (Annex 2).

The video system employed was the same as that for the main dropdown video survey (section 2.1). Footage from each video run was split into sectors using vessel tracking data according to the percentage coverage by live maerl, assessed using the SACFOR scale.

To characterise the maerl bed an MNCR phase 2 diver survey was carried out at a representative site near the centre of the bed (site ML01, Figure 3). A 25 m tape transect line was marked out on the seabed by running out a measuring tape from the base of a shot line along a bearing of 128 °T. The depths at both ends of the tape were recorded. A band 2 m either side of the tape was surveyed by two divers, who noted the presence, and where

possible, estimates of the abundance of conspicuous biota, collecting material which needed to be identified in the laboratory. Video footage using a Canon Legria HF digital video camera was collected by means of meandering along the full distance of the transect belt referencing the transect tape at intervals, recording both wide-angle footage of the habitat and close-up footage of the species. The aim was to retain a visual record of the nature of the habitat and community and to provide material that could be used for supplementing the species inventory for the site and to aid in subsequent description of the habitat. Still photographs of the habitat and associated community were also taken for the same purpose using Nikon digital SLR still cameras with wide-angle and close-up lenses.

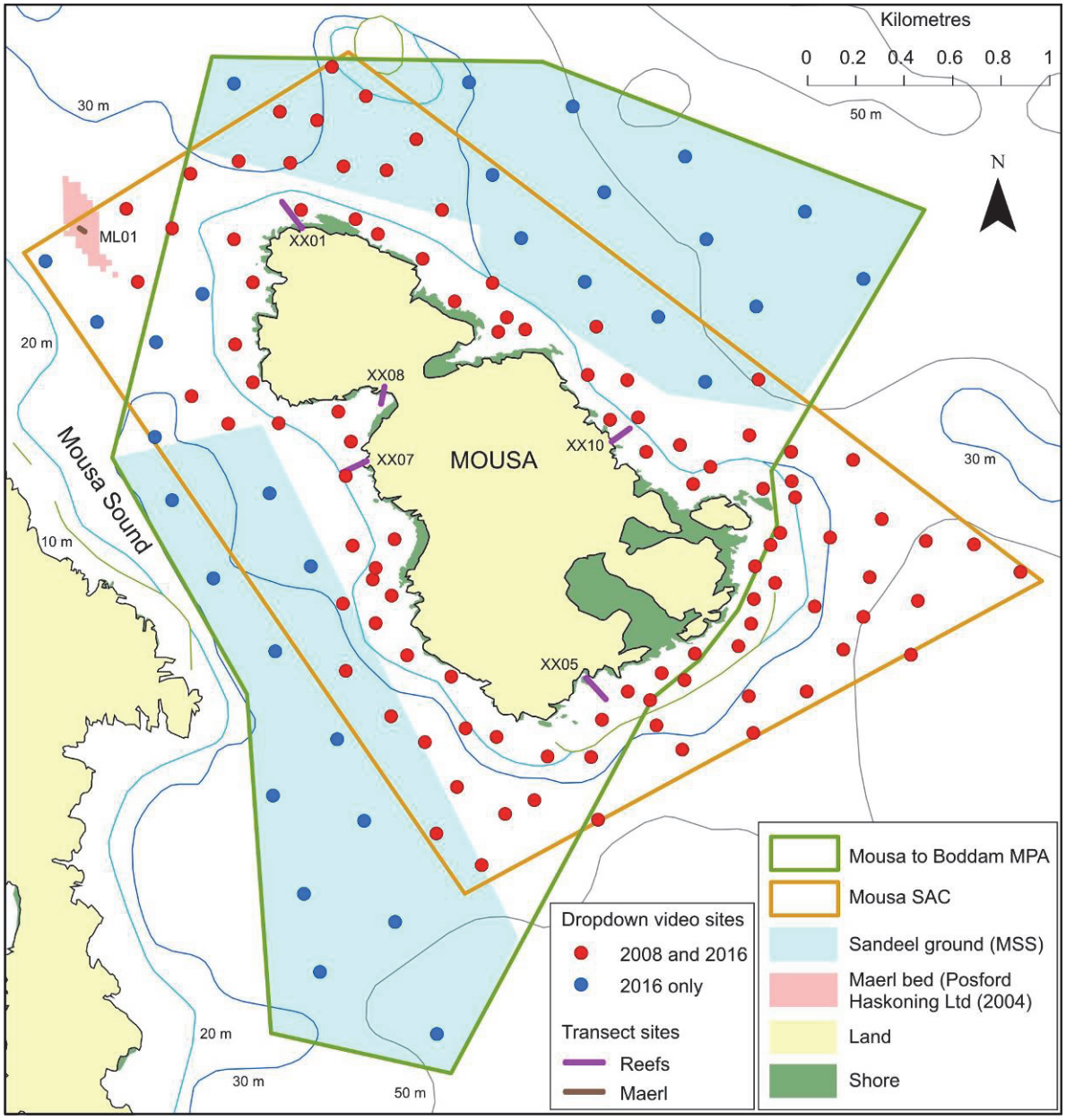

Figure 3. Distribution of dropdown video survey sample sites and rocky reef and maerl transect sites. Also shown is the sandeel ground according to Marine Scotland Science (2012) and the maerl bed based on a 2003 AGDS survey (Posford Haskoning Ltd., 2004).

Four replicate core samples were taken in areas of living maerl using a 10.3 cm diameter corer to a depth of 20 cm. The sediment was then sieved on a 1 mm mesh screen and the sievings retained in borax-buffered 5% formalin. The infauna from the sievings was sorted, identified and counted by Precision Marine Survey Ltd (East Yorkshire).

An additional 20 cm sediment core of 5 cm diameter was taken for particle size analysis. Sediment samples were dry sieved using a nest of sieves from –4 to 4 phi at 0.5 phi intervals, following separation and measurement of the silt/clay fraction by puddling the sample of known weight, which had been soaked in sodium hexametaphosphate, through a 63 µm sieve. The sediment grain size parameters, median grain size and phi quartile deviation, were obtained by interpolation of the cumulative weight percentage curves.

The diver species records and those derived from the study of the collected epibiota, video footage and still photographs were collated to produce a species list for the transect band with, where possible, SACFOR abundance estimates. Based on the physical and biological data collected, biotopes were subsequently allocated using Connor *et al.* (2004).

2.3 Reef transect survey

Relocatable transects were established at six sites during the 2008 baseline study in order to examine biotope diversity and distribution of reef habitats, as well as the species composition of representative reef biotopes. Following the recommendations from this work (Harries et al., 2009), three of these transects were selected for re-examination in 2016 (XX01, XX07, XX08). Poor weather in 2008 prevented coverage of the exposed south coast and limited coverage on the east coast to an atypical site with no access to the intertidal zone. In 2016 new south coast (XX05) and east coast (XX10) sites were selected which gave full intertidal and subtidal access to reefs more typical of the southern and eastern coastlines. Details of all five transects studied in 2016 are summarised in Table 3 and their location is shown in Figure 3. Relocation data for the three transects revisited is provided by Harries *et al.* (2009) and for the two new sites in Annex 3 of this report (Tables 3.10 and 3.11). In the 2008 baseline study the intertidal section of the transect was coded MI08IRnn and the subtidal section MI08SRnn, where nn represents the transect number. In 2016 this was simplified with transects recoded XXnn (see Table 3).

The route of the transect was marked by a 200 m graduated line attached to the transect marker (a metal piton driven into a rock crevice at the top of the shore). The line followed a constant bearing down the shore and extended into the subtidal, where it was laid along the seabed by diver, with the addition of weights at strategic points to allow conformance with major topographical features. At revisited sites accurate relaying of the transect line through the intertidal region was aided by reference to laminated copies of the relocation data and photographs.

Table 3. Summary of transects surveyed by MNCR phase 2 methodology and quadrat quantification

Site name	Site code	2008 code	Quadrats	Date
North Isle N	XX01	MI08IR01 & MI08SR01	√	25-Jul-2016
The Cellar NE	XX05	not surveyed		30-Jul-2016
Scarfi Stack N	XX07	MI08IR07 & MI08SR07	√	27-Jul-2016
West Ham	XX08	MI08IR08 & MI08SR08		28-Jul-2016
Under Lee	XX10	not surveyed		26-Jul-2016

The transect was split up into a series of zones which were defined in terms of differences in the composition of the biological community and/or by changes in substrate type. All subtidal work was carried out with the use of scuba. Zone boundaries along the transect were recorded in terms of distance along the graduated line and vertical height relative to the station marker. Intertidally, this height was determined using a laser range finder/inclinometer (Bosch GLM 80); subtidally, the depth of water was measured. Subtidally, the depth and distance was also measured at 5 metre intervals and at major topographical features, enabling a detailed profile of the transect to be subsequently drawn. Heights on the shore were related to chart datum by levelling the water's edge to the station marker and determining the tidal rise at this time using TotalTide. Depths were also converted to chart datum by subtracting the tidal rise at the time of recording.

A band 2 m either side of the tape was surveyed intertidally and subtidally using MNCR phase 2 survey methodology. Within each zone records were taken of substrate type and biota using the MNCR SACFOR scale of abundance, with collection of material for laboratory examination where *in situ* identification was not possible. Laminated data sheets were available derived from the baseline survey on the anticipated biotopes and the taxa likely to be encountered. Abundance was assessed over the zone as a whole, except where stated otherwise. Subtidally, a digital video camera (Canon Legria HF) and Nikon digital SLR still cameras with wide-angle and close-up lenses were used to make representative visual recordings of the transect zones and biota. Intertidally, a Nikon Coolpix S32 camera was mainly used for recording equivalent video and still imagery. The aim of all the imagery collection was to retain a visual record of the nature of the habitats and biota along the transect in case it might be of value in future temporal comparisons, and to aid subsequent description of the zones. Based on the physical and biological data collected, biotopes were subsequently allocated to each zone using Connor *et al.* (2004).

2.4 Quadrat survey

On the littoral sections of transects where weather conditions and topography permitted, a zone of specific interest was selected for quantitative analysis. Zone I4 was selected along transects XX01 and XX07 and these represent the same locations that were similarly examined in 2008 (Table 4). Methodology followed that employed in 2008. At site XX07 a 10 m tape was laid perpendicular to the transect line at a tape distance of 21 m. Ten square 0.25 m^2, non-overlapping quadrats were placed randomly along the tape, using a set of random numbers and both sides of the tape. At site XX01 the narrowness of the rock platform prevented this approach, and so quadrats were placed haphazardly within a 6 m wide belt running down the shore between distances of 20 and 23 m on the transect line. Before examination each quadrat was photographed using a Nikon Coolpix S32 camera. Dominant species within each quadrat were then quantified using percentage cover estimates, and a thorough examination of the quadrat was carried out to record the presence of all species. Temporal changes in percentage cover were assessed using a t test of the means of arcsin transformed values. Where a Levene's test indicated non-homogeneity of variances, a Mann-Whitney U test of the medians was employed. For taxa recorded as present/absent in quadrats, changes in frequency of occurrence were assessed using Fisher's exact test.

Table 4. Details of the sites surveyed by quadrat quantification

Site code 2016	Site code 2008	Zone	Distance along transect (m)	Quadrat placement	Biotope
XX01	MI08IR01	I4	20-23	haphazard	LR.HLR.MusB.MytB
XX07	MI08IR07	I4	21	random	LR.HLR.MusB.MytB

Positional data throughout this report employ the WGS84 reference coordinate system and all depths cited are below chart datum and intertidal heights above chart datum.

2.5 Sea cave survey

Full physical and biological surveys were conducted at three of the cave sites surveyed in 2008 (MI08CV01, MI08CV02 & MI08CV03). Following the recommendations of Harries *et al.*, 2009, a systematic search for caves was conducted on the northeastern shores of Mousa (between cave inventory site 16 in the north to site 1 in the south). All caves found were assessed for their conservation interest and potential inclusion in the monitoring programme. In accordance with the recommendations of Harries *et al.*, 2009, particular attention was paid to assessing cave inventory site 17. The two remaining 2008 sites (MI08CV04 & MI08CV05) were visited for a rapid visual assessment of possible change in extent or main biota since 2008. The search for new cave sites was conducted from an inflatable boat systematically searching along the northeast coast of the island. Cave entrances were photographed and the coordinates recorded. Where conditions allowed, the caves were entered by a snorkeler who made appropriate notes on the physical structure, extent and main biota of the site.

For the full repeat surveys of the three 2008 cave sites (MI08CV01, MI08CV02 & MI08CV03) the caves were relocated using the 2008 cave datum line relocation sheets. Cave surveyors were equipped with laminated copies of the 2008 cave datum line relocation information and the physical survey of the cave. The line was repositioned as closely as possible to the 2008 relocation data installing replacement pitons as required. With the line in place, the physical survey was repeated, directly comparing observed dimensions with those recorded in 2008. The surveyors visually examined the cave in comparison to the 2008 physical survey evaluating evidence for change in the physical structure of the cave and evaluating possible inaccuracies in the original survey.

The biological surveys were conducted at the cross section locations surveyed in 2008. Cave surveyors were equipped with laminated sheets illustrating the distribution of the 2008 recording zones and laminated checklists of the more abundant (abundances of 'frequent' or above) taxa recorded at those zones in 2008. The biological surveys were conducted within a 2 m wide band around the cross section of the passage. Surveyors compared actual zone boundaries with zone boundary records from 2008 and evaluated if adjustment of zone boundaries were appropriate. Within each biological zone the abundance of each component species was estimated using the SACFOR scale and notes made on the nature and inclination of the substrate. Voucher specimens were collected where appropriate. Video footage was obtained along the length of the cave using the datum line for orientation and detailed footage was obtained of the biota at each of the biological cross sectional survey locations. Additional underwater digital still images were taken to illustrate the biota at the biological cross sectional survey locations.

For rapid visual assessment of the two 2008 cave sites (MI08CV04 & MI08CV05) the caves were relocated as described above. Cave surveyors were equipped with laminated copies of the 2008 cave datum line relocation information and the physical survey of the cave. A datum line was laid into the cave following the approximate positioning of the 2008 line but without precise relocation of the 2008 piton placements. The surveyor assessed the physical dimensions of the cave and compared these to the 2008 records to reach a judgement on possible changes in extent. A biological survey was conducted in the same manner as described above, focussing attention on dominant / characterising species and not attempting to record the rarer taxa. Video footage was obtained throughout the cave and at the approximate locations of the 2008 biological cross sections using the datum line for orientation.

3. RESULTS

3.1 Dropdown video survey

3.1.1 Biotope and reef distribution

The results from the analysis of the 100 video survey sites are provided in Table 1.1 (Annex 1) (positional, temporal and depth data) and Table 1.2 (Annex 1) (habitat and community data). The distribution of the biotopes recorded at these sites is illustrated in Figure 4.

Within the 20 m depth contour the seabed was found to consist of kelp forests and parks on bedrock and boulders. The transition from infralittoral kelp biotopes to circalittoral faunal communities generally seemed to occur at depths of between 20-25 m. There was a general pattern of *Laminaria hyperborea* dominated forests in the shallower infralittoral and mixed kelp forests and parks in the deeper infralittoral. Along the very exposed southern coastline the *L. hyperborea* forest was often underlain by a profuse turf of foliose red algae (**IR.HIR.KFaR.LhypR.Ft**), which was lacking in the more sheltered and probably more heavily grazed forests off the west of Mousa (**IR.MIR.KR.Lhyp.GzFt**). In the deeper infralittoral, bedrock and boulders, often with cobbles or sediment patches present particularly in gullies, supported forests and parks of varying proportions of *L. hyperborea*, *Saccharina latissima*, *Saccorhiza polyschides* and *Alaria esculenta*. The biotopes recorded here (principally **IR.HIR.KSed.LsacSac**) reflect the physically disturbed nature of the habitat. It should be appreciated that distinctions between kelp forest biotopes based on dropdown video evidence can be difficult due to the often poor visibility below the canopy of kelp fronds.

Beyond the 20 m contour, sedimentary habitats generally featured more prominently within the surveyed area, except off the southern and northern coasts. Off the south of the island bedrock dominated the seabed, sometimes accompanied by boulders or coarse sand patches, and here the rock supported extensive blankets of brittlestars (**CR.MCR.EcCr.FaAlCr.Bri**) and extensive fields of dense *Alcyonium digitatum* (**CR.MCR.EcCr.FaAlCr.Adig**). The same reef biotopes were also widely distributed off the northern coast on boulders and bedrock, although here they were interspersed with megaripples of coarse sand and shell gravel (**SS.SCS.CCS**), this latter biotope also representing the dominant habitat off the east coast. In the relatively sheltered Mousa Sound clean, rippled, medium sand (**SS.SSa.IFiSa**) predominated in the centre of the sound, transitioning to coarse sand and gravel to the south (**SS.SCS.CCS**) and an area of maerl gravel and sand to the north (**SS.SMp.Mrl.Pcal.Nmix**, **SS.SCS.CCS**, **SS.SCS.ICS** and **SS.SSa.IFiSa**).

Temporal biotope changes between the 2008 and 2016 surveys were recorded at 38 of the 100 dropdown video sites. The details are provided in Table 1.3 (Annex 1) and the reasons for changed biotope ascriptions summarised in Table 5. Differences in wind and tidal current conditions (often strong) at sites resulted in differences in the trajectory of the camera and these are considered to underlie a significant proportion of the recorded changes in biotope. Marked changes in the composition of kelp communities are known to result from the incidence of storm conditions, as well as natural temporal variation in the density of grazers, such as urchins (Birkett *et al*., 1998), and such drivers are likely to represent important contributors to biotope change in the exposed conditions around Mousa. Temporal variation in hydrodynamism is also likely to be implicated in changes in shell and stone cover, as well as sediment accretion, and may contribute to localised change in the distribution of brittlestar biotopes (Table 5). Temporal variation in brittlestar abundance has been linked to a number of natural environmental factors, such as predation and temperature (Hughes,1998). None of the observed temporal changes in biotope around Mousa appear to be related to anthropogenic drivers.

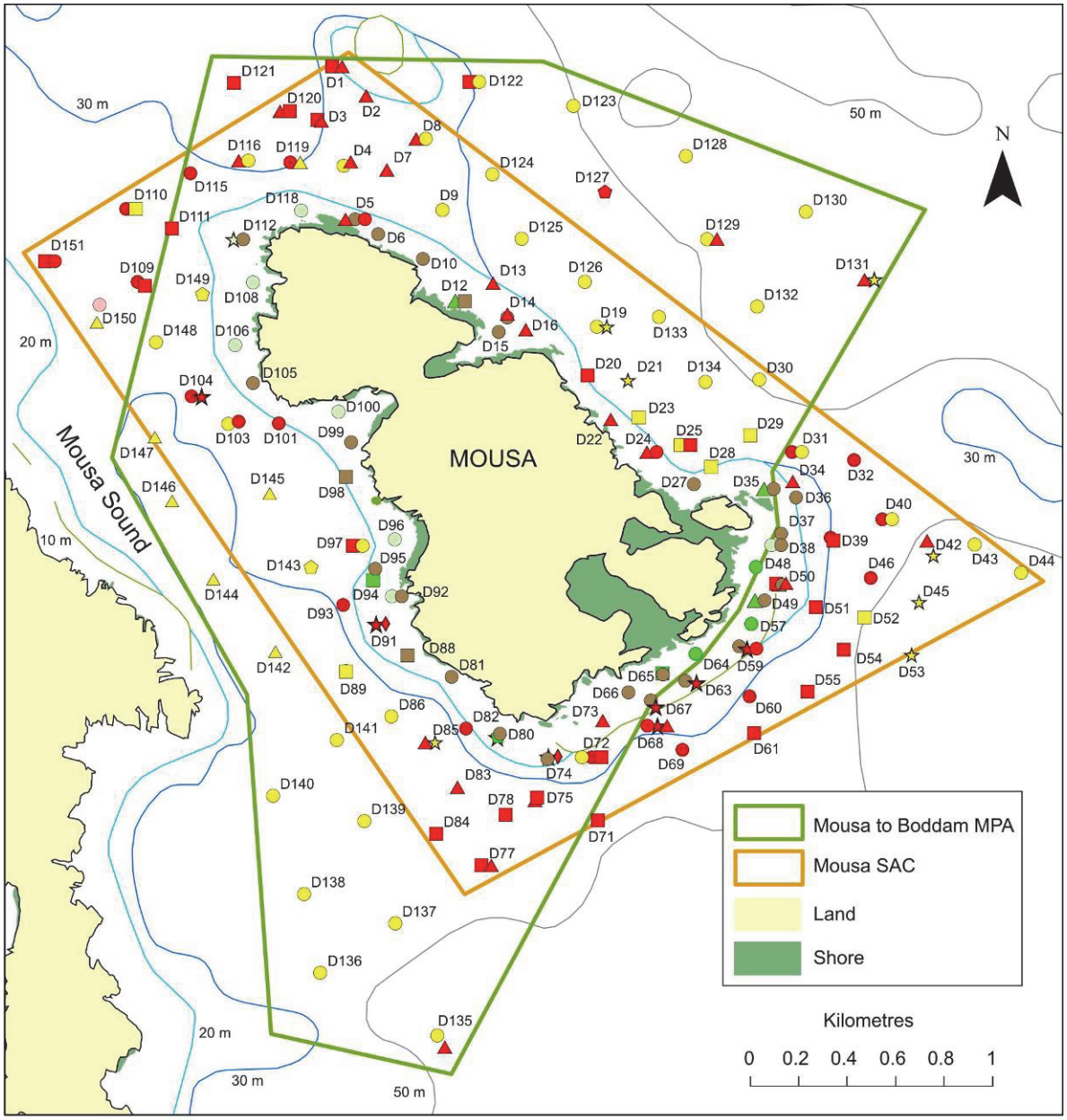

Figure 4. Distribution of biotopes recorded during the 2016 dropdown video survey.

Table 5. Summary of causes of biotope change between 2008 and 2016 at dropdown video sites.

Cause of biotope change	**Sites**
Camera tracking difference	D16, D35, D49, D50, D59, D68, D71, D80, D89, D91, D103, D115, D118
Camera tracking difference and/or sediment accretion	D21, D116
Increased shell cover in 2016	D53
Denser stone cover in 2016	D28
Ophiuroid density change (both temporal increase and decrease)	D2, D4, D52, D61, D111, D120
Increased ophiuroid and reduced *Flustra* density in 2016	D84
Reduced ophiuroid and sparser stone cover in 2016	D86
Kelp composition/density change	D12, D15, D36, D37, D38, D57, D66, D92, D95, D99, D105, D106
Dense hydroid patches absent in 2016	D7

Reef biotopes were recorded in both 2008 and 2016 at 86 of the 100 video sites and only non-reef biotopes at the same 11 sites in both years (see Table 1.2, Annex 1 for 2016 reef records). At three sites reefs were only recorded in 2008. At site D86 the stony reef present in 2008 could not be recognised in 2016 due to the reduced stone cover. At site D89 conspicuous bedrock outcrops present in 2008 were not observed in 2016 possibly resulting from temporal variation in the tracking of the camera. Tracking may also have been implicated at station D21, although the low profile bedrock outcrops visible at this site in 2008 may have been blanketed by sand in 2016.

3.1.2 Sandeel habitat

Sediments of clean, medium to coarse sand, providing an apparently suitable habitat for sandeels (Wright *et al*., 2000; Marine Scotland Science, 2012), were recorded along 46 of the 120 video runs (Figure 5, Table 1.2 in Annex 1). Sandeels were recorded at two sites, both in Mousa Sound (D142 and D143). The distribution of sandeel habitat records is largely consistent with the distribution of the habitat predicted by Marine Scotland Science (2012), with extensive coverage within polygons to the northeast of Mousa and within Mousa Sound (Figure 5). Records of apparently suitable medium and coarse sands are also located to the north of the Mousa Sound polygon, some outside the MPA, as well as scattered records elsewhere within areas dominated by rock substrates.

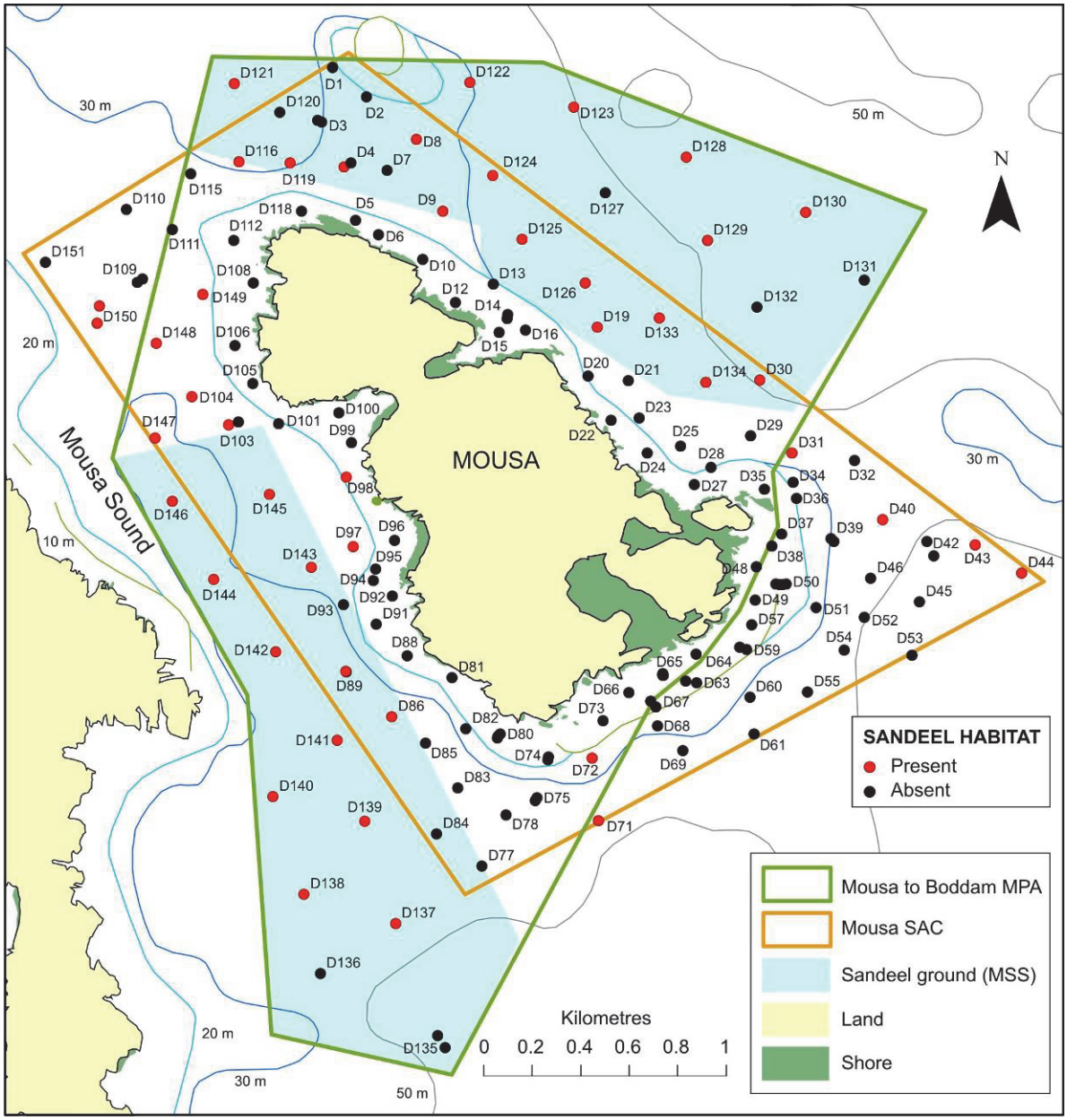

Figure 5. Distribution of sandeel habitat recorded during the 2016 dropdown video survey. Also shown is the predicted sandeel ground according to Marine Scotland Science (2012).

3.1.3 Calcium carbonate rich sediments

The distribution of carbonate rich sediments, based on the presence of visually evident carbonate material along the 120 video runs, mirrors the distribution of sandeel habitat (Figure 6, Table 1.2 in Annex 1), although the clean, rippled sands in the northern region of the Mousa Sound sandeel polygon do not show clear visual evidence of a carbonate origin. Where present, carbonate material was generally manifest visually as shell gravel and larger shell material, with maerl gravel becoming a significant component in the northern part of Mousa Sound.

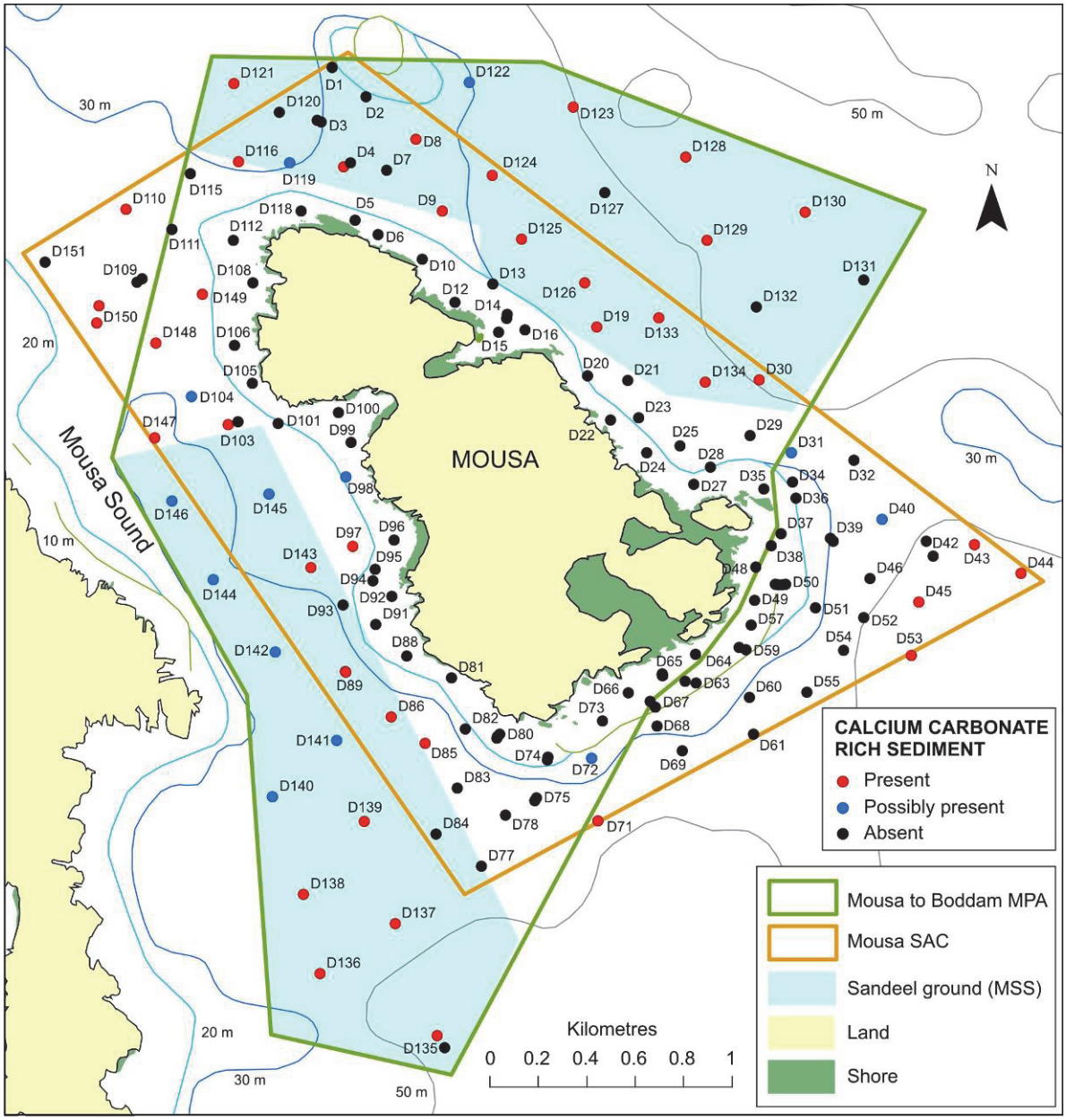

Figure 6. Distribution of carbonate rich sediments recorded during the 2016 dropdown video survey. Also shown is the predicted sandeel ground according to Marine Scotland Science (2012).

3.2 Maerl survey

The percentage coverage of the seabed by live maerl thalli along the maerl video survey runs in Mousa Sound is illustrated in Figure 7, with the SACFOR values recorded within each video sector, together with depth and positional data, provided in Table 2.1 (Annex 2).

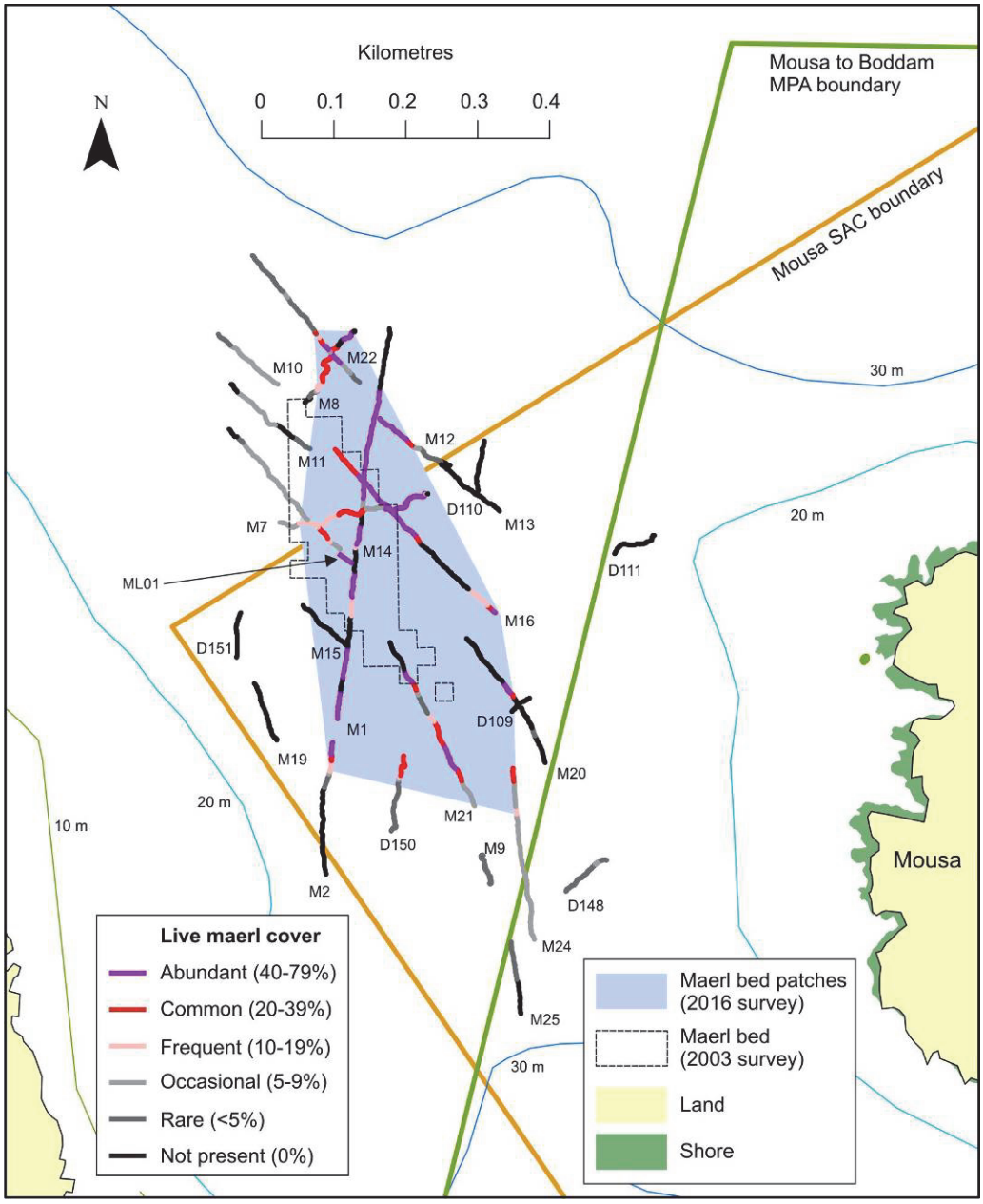

Figure 7. Percentage cover of live maerl along video runs in 2016 in the vicinity of the maerl bed reported by Posford Haskoning Ltd (2004) in 2003.

Live maerl was found over a depth range of 25.4 - 33.6 m, but maerl exceeding 10% cover and considered to represent the biotope **SS.SMp.Mrl.Pcal.Nmix** was restricted to an area of 13.0 ha within a depth range of 25.4 - 28.4 m (Figure 7). While much of this 13.0 ha area is floored by maerl on coarse sand (Figure 8), the bed was interrupted by patches of bedrock, boulders and cobbles supporting dense *Alcyonium digitatum* (**CR.MCR.EcCr.FaAlCr.Adig**), often with *Ophiocomina nigra* (**CR.MCR.EcCr.FaAlCr.Bri**) (Figure 8). The smaller (3.9 ha)

area of maerl predicted by the 2003 AGDS survey (Posford Haskoning Ltd., 2004) is largely subsumed within the 2016 bed limits (Figure 7).

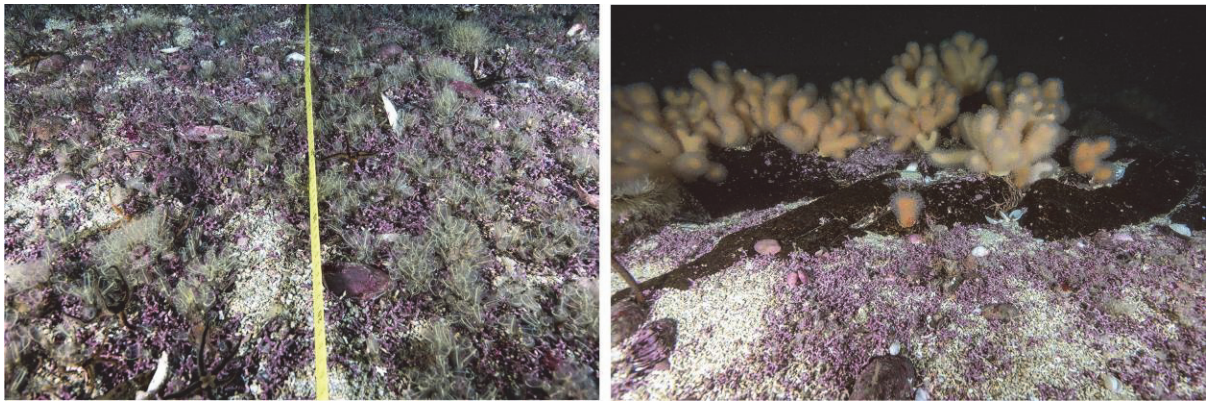

Figure 8. Left: habitat photo of maerl bed at the MNCR phase 2 survey site ML01. Right: example of dense Alcyonium digitatum *blanketed rock forming mosaic with the maerl bed.*

The MNCR phase 2 survey site (ML01) was located near the centre of the bed (Figure 7, Table 6) and appeared to be representative of much of the bed. The composition and abundance of epibiota along the 25 x 4 m belt transect is provided in Table 2.2 (Annex 2). Live *Phymatolithon calcareum* covered 40-50% of the seabed over a substrate of coarse sand with a 5-10% cover of pebbles, shells and shell fragments. The maerl supported dense *Clavelina lepadiformis* (Figure 8) but an otherwise sparse sessile community including hydroids (chiefly *Kirchenpaueria pinnata* and *Halecium halecinum*) and *Pterothamnion plumula*. The motile epifauna included abundant *Ophiocomina nigra*, frequent *Pecten maximus* and *Luidia ciliaris*, and occasional *Eledone cirrhosa*, while visible evidence of the infaunal community included *Lanice conchilega*, *Eupolymnia nebulosa*, *Neopentadactyla mixta*, *Ensis* sp. and *Glycymeris glycymeris* (**SS.SMp.Mrl.Pcal.Nmix**). A total of 49 taxa were recorded by the epibiota diver survey.

Table 6. Location and depth data for maerl transect ML01 examined by MNCR phase 2 survey.

Start position	60.008450°N 1.206210°W
End position	60.008313°N 1.205857°W
Start depth (m)	26.0
End depth (m)	25.7
Bearing (°T)	128

3.3 Reef transect survey

3.3.1 North Isle N (XX01)

This site was located at the northernmost point of North Isle and was previously selected by the 2008 SCM survey as it was considered to be representative of the north coast of Mousa (Harries *et al*., 2009).

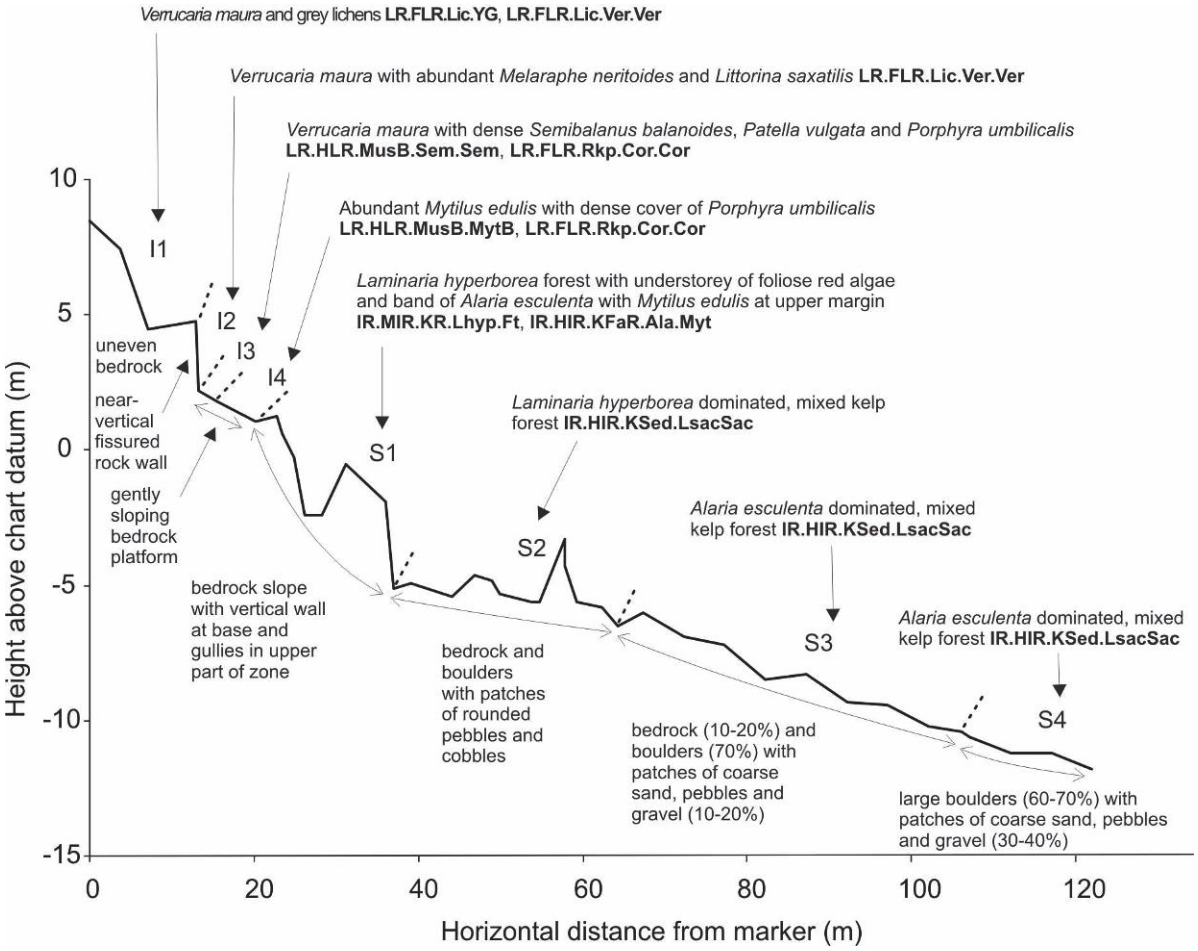

Figure 9. North Isle N (XX01) transect profile with summary of the substrates, dominant biota and biotopes recorded within the component zones.

Most of the shore consisted of highly uneven bedrock, although an extensive rock platform occupied the lower shore (Figure 9). The marker piton was positioned close to the rock/grass boundary in a rock crevice in an area of uneven bedrock, overlaid in places by laminar boulders, and dominated by *Verrucaria maura* with grey lichens (especially *Tephromela atra*) and *Ramalina siliquosa* in the upper supralittoral (**LR.FLR.Lic.YG**). Many steeply sloping and vertical faces supported a virtual monoculture of *V. maura* (**LR.FLR.Lic.Ver.Ver**). Below this zone a fissured, vertical wall extended for 2.5 m densely coated in *V. maura*, with abundant *Melaraphe neritoides* and *Littorina saxatilis* in the fissures (**LR.FLR.Lic.Ver.Ver**). Below this cliff a rock platform extended for around 7 m. The upper region of this platform, consisting of flat bedrock with small vertical faces, was coated in *V. maura* and supported dense *Semibalanus balanoides*, *Patella vulgata*, *Ceramium shuttleworthianum* and *Porphyra umbilicalis* (**LR.HLR.MusB.Sem.Sem**). Small rockpools contained *Corallina officinalis* and *Acrosiphonia arcta* (**LR.FLR.Rkp.Cor.Cor**). The lower region of the platform supported a dense bed of small *Mytilus edulis* with a rich cover of *P. umbilicalis*, together with *Ulva linza* and *Acrosiphonia arcta* (**LR.HLR.MusB.MytB**). Small

rockpools here were lined with pink encrusting algae and contained populations of *Nucella lapillus*, *Halichondria panicea*, *Actinia equina* and *C. officinalis* (**LR.FLR.Rkp.Cor.Cor**). At the base of the platform a sublittoral fringe zone consisted of uneven bedrock with dense *Alaria esculenta* and *Semibalanus balanoides*, together with *M. edulis* (**IR.HIR.KFaR.Ala.Myt**), giving way to steep bedrock with gullies and steep rock faces extending to a depth of 5.1 m. The rock supported a dense forest of *Laminaria hyperborea*, with a rich understorey of foliose red algae dominated by *Cryptopleura ramosa*, *Plocamium cartilagineum* and *Callophyllis laciniata* (**IR.MIR.KR.Lhyp.Ft**). From 5.1 m to the end of the transect at 11.8 m the biota was dominated by mixed kelps, with varying proportions of *L. hyperborea*, *Saccharina latissima*, *Saccorhiza polyschides* and *A. esculenta* and a light algal turf (**IR.HIR.KSed.LsacSac**). From 5.1 – 6.5 m the substrate of bedrock and boulders supported a mixed kelp forest dominated by *L. hyperborea* and with frequent *Desmarestia aculeata*. From 6.5 – 11.8 m the substrate was stable boulders and bedrock, with patches of pebbles, gravel and coarse sand, the rock supporting a mixed kelp forest dominated by *A. esculenta* and extensively encrusted with the *Aglaozonia* phase of *Cutleria multifida*. Although no marked changes in biota occurred over this depth range, this region of the transect was split into two zones with the substrate below 10.4 m lacking bedrock but including more extensive coverage by unstable elements (pebbles, gravel and coarse sand).

The sequence of biotopes along the transect in 2016 mirrored that recorded in 2008, except that zone S1 in 2016 was split into two zones (S1 and S2) in 2008, with the additional biotope **IR.HIR.KSed.DesFiIR** being recognised in an area of unstable cobbles and pebbles. In fact the same substrate was observed in the same location in 2016, although the biota was not considered sufficiently distinctive to warrant recognition of an additional biotope here. The abundance and relative dominance of the kelp species in the mixed kelp forest zones differed between the surveys, as might be expected in such disturbed conditions (Connor *et al*., 2004). 107 clearly separable taxa were recorded along the whole transect in 2016 compared to 80 in 2008.

3.3.2 The Cellar NE (XX05)

This transect was located on the exposed southern coastline of Mousa 160 m northeast of a creek called The Cellar. It replaced the sheltered southern transect examined in 2008 (MI08IR06 and SR06).

The shore consisted largely of stepped bedrock platforms dipping at an angle of around 30° in a south-westerly direction (Figure 10). The transect line passed through one extensive, flat platform, with the near-vertical steps of adjacent platforms encroaching within the transect belt. Pools of varying sizes were retained at the base of the steps at several locations. Rock in the upper region of the transect supported a moderate cover of *Verrucaria maura*, concentrated on near-vertical faces, with fissures containing dense *Melaraphe neritoides*. This area was split into two zones, an upper one supporting a patchy cover of *Urospora penicilliformis* (**LR.FLR.Lic.Ver.Ver**), and a lower one with a moderate cover of *Porphyra umbilicalis* and *Blidingia minima*, as well as sparse barnacles and *Patella vulgata* (**LR.FLR.Lic.Ver.PorB**). Small pools supported sparse *Ulva* sp. in the upper zone (**LR.FLR.Rkp.G**) and *Corallina officinalis* and encrusting pink coralline algae in the lower zone (**LR.FLR.Rkp.Cor.Cor**). The eulittoral section of the transect, extending from 2.5 m down to 0.8 m above chart datum was characterised by a dense cover of *P. umbilicalis* and *Semibalanus balanoides*, with *Mytilus edulis* concentrated in crevices (**LR.HLR.MusB.MytB**). A large rock pool was encrusted with pink coralline algae and contained dense *C. officinalis* (**LR.FLR.Rkp.Cor.Cor**). From 0.8 m above to 3.7 m below chart datum a forest of *Alaria esculenta* dominated the community, and represented the sole kelp species in the upper region of this zone, where the rock was densely encrusted with pink coralline algae and supported *M. edulis* and *S. balanoides* (**IR.HIR.KFaR.Ala.Myt**). A rock pool here supported profuse *C. officinalis* (**LR.FLR.Rkp.Cor.Cor**). In the lower region

of this zone mixed *Laminaria* species (including *L. digitata* and *L. hyperborea*) became common and this mixed kelp forest has been tentatively ascribed to **IR.HIR.KFaR.Ala.Ldig**. Below this biotope a substrate of irregular bedrock dissected by gullies supported a forest of *L. hyperborea* extending from 3.7 m to a maximum depth of 15.9 m (42 - 95 m on the transect line). Below the kelp canopy a rich red foliose algal turf was dominated by *Odonthalia dentata*. Most of this zone has been assigned to **IR.HIR.KFaR.LhypR.Ft**, although the fit is poor, given the presence of a relatively high density of *A. esculenta* (common). A large gulley in this zone displayed a distinctly different algal community, strongly dominated by abundant *Desmarestia aculeata* and *Saccharina latissima* (**IR.HIR.KSed.DesFilR**). From 95 m to 127 m on the transect line, over a depth range of 14.5 - 15.9 m, the substrate of uneven bedrock and gullies supporting an *Odonthalia*-dominated turf continued, but the kelp flora of the previous zone was supplemented by the presence of *Saccorhiza polyschides* (common) (**IR.HIR.KSed.LsacSac**). The transect terminated in a zone of steeply sloping bedrock extending to a depth of 20 m. The rock was extensively encrusted with the *Aglaozonia* phase of *Cutleria multifida* and supported a park of *Saccharina latissima* and a turf of *Dictyota dichotoma* and *Antedon bifida* (tentatively assigned to **IR.HIR.KSed.LsacSac**).

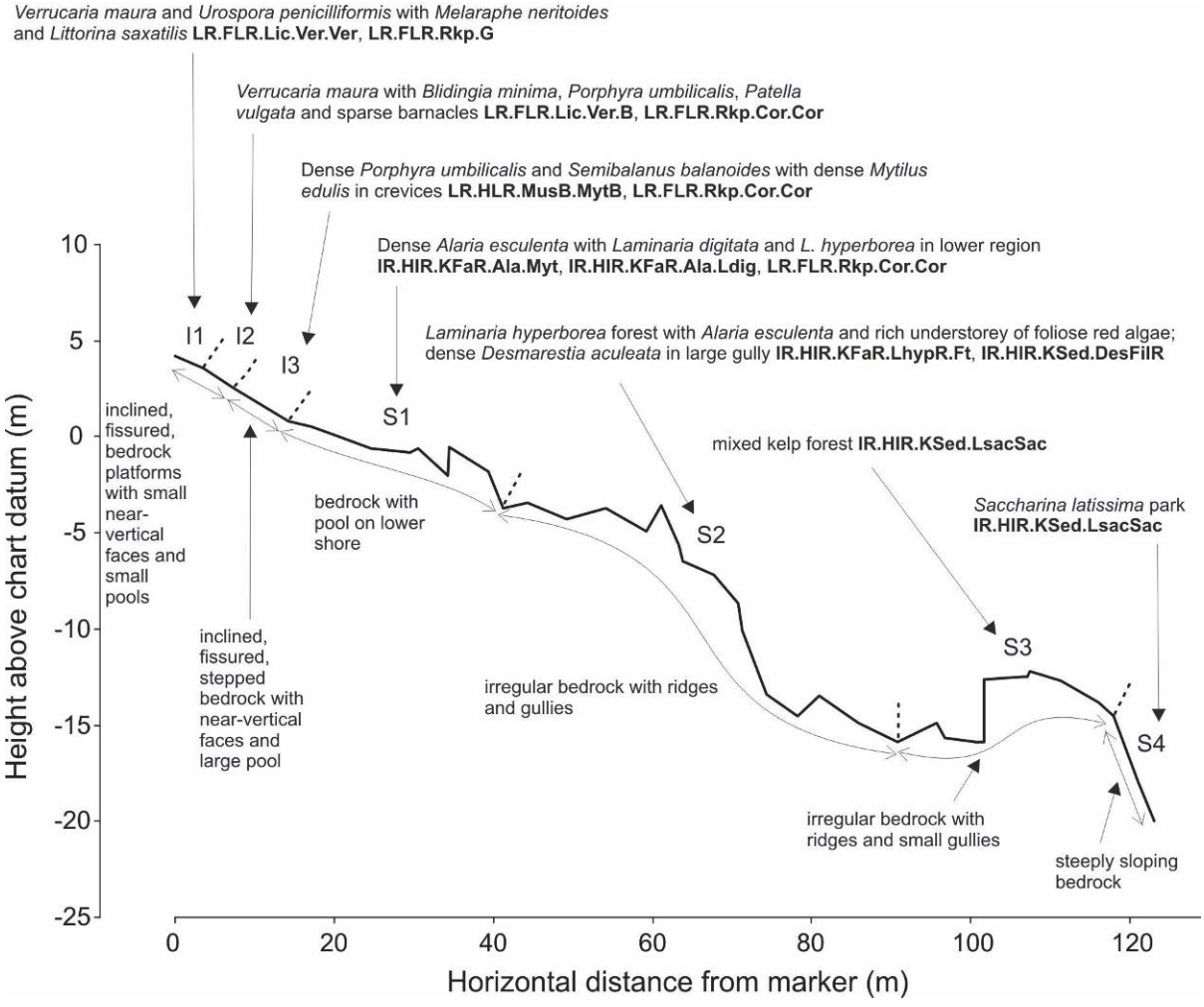

Figure 10. The Cellar N (XX05) transect profile with summary of the substrates, dominant biota and biotopes recorded within the component zones.

3.3.3 Scarfi Stack N (XX07)

Situated midway along the west coast of the island within the Sound of Mousa, this site was selected in 2008 as being representative of this relatively sheltered coastline.

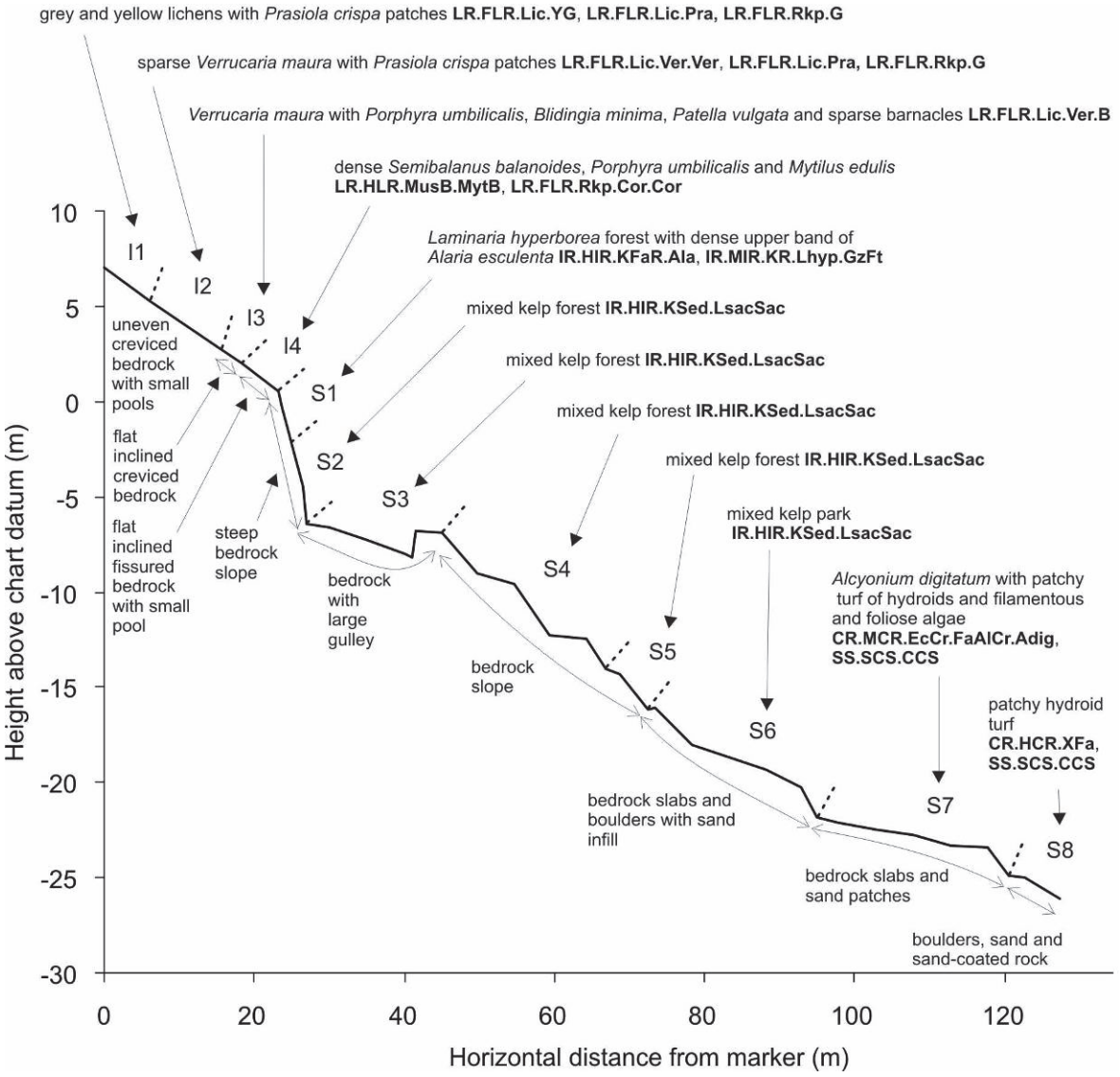

Figure 11. Scarfi Stack N (XX07) transect profile with summary of the substrates, dominant biota and biotopes recorded within the component zones.

The shore was of fissured rock beds dipping seawards (Figure 11). In the supralittoral the extensively creviced, uneven bedrock contained small pools with *Ulva intestinalis* (**LR.FLR.Rkp.G**) and patches of *Prasiola crispa* (**LR.FLR.Lic.Pra**). Grey lichens dominated the uppermost part of this region (**LR.FLR.Lic.YG**) and *Verrucaria maura* the lower part (**LR.FLR.Lic.Ver.Ver**). This area of uneven rock gave way to a narrow zone of creviced, gently-sloping, flat rock dominated by *V. maura*, *Porphyra umbilicalis* and *Patella vulgata*, with patches of *Blidingia minima* and sparse barnacles including *Semibalanus balanoides*, *Chthamalus montagui* and *C. stellatus* (**LR.FLR.Lic.Ver.B**). Below this, the mostly flat bedrock continued but was heavily fissured and included small vertical faces. This eulittoral zone supported dense *Semibalanus balanoides*, *P. umbilicalis* and *Acrosiphonia arcta*, with *Mytilus edulis* locally abundant (**LR.HLR.MusB.MytB**). A small rockpool was encrusted with pink coralline algae and *Hildenbrandia* sp. and supported abundant *Corallina officinalis*

(**LR.FLR.Rkp.Cor.Cor**). The sublittoral fringe region of the shore was not closely examined due to strong surge conditions but it appeared to consist of a narrow band of *Alaria esculenta* extending to a depth of around 0.3 m (25 m on the transect line) (**IR.HIR.KFaR.Ala**), below which steeply sloping bedrock was encrusted with pink coralline algae and *S. balanoides* and supported a narrow band of *Laminaria hyperborea* forest, together with *A. esculenta* (tentatively ascribed to **IR.MIR.KR.Lhyp.GzFt**), extending to 27 m on the transect line. The steep slope continued to a depth of 6.4 m but the kelp flora switched to a mixed forest of *Saccharina latissima* and *Saccorhiza polyschides*, with the rock densely encrusted with pink and brown algae (**IR.HIR.KSed.LsacSac**). The transect continued as mixed kelp forest (**IR.HIR.KSed.LsacSac**) on more gently sloping, algal-encrusted bedrock to a depth of 16.2 m, although the composition of the kelp flora varied. From a depth of 6.4 to 6.9 m (zone S3) *S. latissima*, *L. hyperborea* and *A. esculenta* were recorded, although *L. hyperborea* was replaced by *S. polyschides* within a gulley at around 45 m on the transect line. From 6.9 to 16.2 m depth the kelp flora was dominated by *S. latissima* and *L. hyperborea*, with *A. esculenta* absent and *S. polyschides* sparse above a depth of 14.0 m (zone S4) and both absent below 14.0 m (zone S5). The substrate changed at 16.2 m depth to one of bedrock slabs with boulders and sand infill, with the rock supporting a park of *L. hyperborea* and *S. polyschides* and a patchy algal turf dominated by *Dictyota dichotoma* (**IR.HIR.KSed.LsacSac**) (zone S6). Between 21.8 - 24.9 m depth patches of coarse sand were interspersed between the bedrock slabs, which supported dense *Alcyonium digitatum* and a patchy turf of hydroids dominated by *Halecium halecinum* and a light, patchy turf of foliose and filamentous red algae, with dense patches of *Antedon bifida*. The rocky component of this zone (S7) has been assigned to **CR.MCR.EcCr.FaAlCr.Adig** but the presence of faunal and algal turfs makes it a poor fit. The sand supported *Pomatoschistus pictus*, *Urticina felina* and sparse *Modiolus modiolus* (**SS.SCS.CCS**). Below 24.9 m depth to the end of the transect at 26.1 m the predominant substrate was coarse sand with boulders. Some of the sand areas consisted of a superficial coverage over flat rock supporting a rich hydroid turf in places including *H. halecinum*, *Kirchenpaueria pinnata* and *Nemertesia antennina*, also present on exposed boulders (tentatively assigned to **CR.HCR.XFa**). The sand supported frequent *M. modiolus* and *Luidia ciliaris* (**SS.SCS.CCS**).

There were several differences in the sequence of biotopes recorded along the transect in 2016 and 2008. In the supralittoral a narrow zone of **LR.FLR.Lic.YG** was recognised above a zone of **LR.FLR.Lic.Pra** in 2008, whereas in 2016 a broader band of **LR.FLR.Lic.YG** was recorded above **LR.FLR.Lic.Ver.Ver**, both regions containing thin patches of *Prasiola* (**LR.FLR.Lic.Pra**). Inspection of the imagery and comparison of the SACFOR records reveals the difference to be chiefly due to the much denser coverage of *Prasiola* in 2008, which extended higher up the transect and provided a relatively sharp boundary between the two upper zones. *Prasiola* density is likely to vary with the degree of eutrophication resulting from the droppings of shags, which were observed to be using the area for roosting in 2008. *Prasiola stipitata* was recorded in 2008 and *P. crispa* in 2016. These two species are quite distinctive microscopically and so there may have been a temporal change in species composition or the difference may merely reflect inadequacy in the sample sizes taken for laboratory analysis.

Although the eulittoral section of the transect was ascribed to **LR.HLR.MusB.Sem.Sem** in 2008, it was considered to be intermediate between this and **LR.HLR.MusB.MytB**, to which this section of the shore was ascribed in 2016. The change resulted from an increase in the density of *Mytilus edulis* and *Porphyra umbilicalis*, particularly evident in the results of the quadrat study (see section X.X).

In the sublittoral the same sequence of kelp forest and park zones of **IR.HIR.KFaR.Ala**, **IR.MIR.KR.Lhyp.GzFt** and **IR.HIR.KSed.LsacSac** were recorded in both years, although temporal variation in the relative dominance of the kelp taxa created differences in zonal

widths. Such changes are to be expected in such exposed, and potentially physically disturbed, conditions (Connor *et al*., 2004).

Different biotopes were ascribed to the two lowermost zones (S7 and S8) in the two surveys. A switch in biotope ascription from **IR.HIR.KFaR.FoR** to **CR.MCR.EcCr.FaAlCr.Adig** for the rock habitat in zone S7 between the years reflects a perceived decrease in the cover of the red algal turf and an increase in *Alcyonium digitatum* density; however, the biotope ascriptions in both years are uncertain, as is firm evidence for the biotope change. Patches of sand were present in both years, although these were only referred to a biotope (**SS.SCS.CCS**) in 2016. A patchy hydroid turf was recorded in both years in zone S8. This was ascribed to **SS.SMx.FluHyd** in 2008 as the turf appeared to be associated with scattered pebbles as well as some boulders. In 2016 the turf was supported by boulders and areas of sand-covered rock and so the habitat was referred to **CR.HCR.XFa**. In both years areas of apparently thicker sand strata can be referred to **SS.SCS.CCS**. There is no firm evidence for a real change in the nature of the communities in this zone. 112 clearly separable taxa were recorded along the entire transect in 2016 compared to 91 in 2008.

3.3.4 West Ham (XX08)

Located within a bay at West Ham on the west coast of the island, this moderately exposed transect lies adjacent to a jetty which serves as the main landing place for visitors. As such, this embayment is probably subject to the greatest risk from anthropogenic sources.

The shore was of creviced rock beds gently dipping seawards (Figure 12). In the supralittoral the beds were much broken producing an uneven stepped substrate, retaining water in small and medium pools, whilst the eulittoral was of smooth rock. The top of the transect was located in an area of uneven bedrock containing small pools with *Ulva intestinalis* and *U. prolifera* (**LR.FLR.Rkp.G**). The rock was encrusted with lichens, dominated by grey forms and *Xanthoria parietina*, with *Verrucaria maura* in depressed areas (**LR.FLR.Lic.YG**). Below this zone *V. maura* became dominant on a similar substrate (**LR.FLR.Lic.Ver.Ver**), with *X. parietina* and grey lichens on elevated patches of rock (**LR.FLR.Lic.YG)**. Small and medium-sized pools supported *U. intestinalis* and *Hildenbrandia* sp. (**LR.FLR.Rkp.G**). *Verrucaria maura* continued into the next zone as the dominant constituent on a similar substrate but was accompanied by frequent *Patella vulgata* and sparse *Semibalanus balanoides*, *Pelvetia canaliculata*, *Fucus spiralis* and *Porphyra umbilicalis*, with crevices also containing *Nucella lapillus* and *Littorina saxatilis* (**LR.FLR.Lic.Ver.B**). This zone gave way to the smoother bedrock surface of the eulittoral which supported a mosaic of *Fucus vesiculosus* and *S. balanoides* (**LR.MLR.BF.FvesB**). A fairly species-poor community also contained sparse populations of several red and green algae, apart from frequent *U. compressa*, while the fauna, in addition to the barnacles, included *P. vulgata*, *Nucella lapillus* and *Actinia equina*. At the bottom of the shore sloping bedrock encrusted with pink coralline algae was dominated by *Fucus serratus,* with *Himanthalia elongata*, *Laminaria digitata*, *Patella* spp. and occasional *S. balanoides* (**LR.MLR.BF.Fser**). A few erect red algal species were present, but at low density, apart from *Corallina officinalis* which was common in patches. From around chart datum to a depth of 1.6 m bedrock and boulders supported a mixed kelp forest of *L. hyperborea* (dominant), *Saccharina latissima* and *Alaria esculenta* with a fairly sparse algal and faunal understorey, although kelp fronds supported dense *Ectocarpus fasciculatus* (**IR.HIR.KSed.LsacSac**). The substrate of bedrock and boulders and mixed kelp forest continued from 1.6 to 2.1 m depth but the suite of kelps was joined by *Saccorhiza polyschides* and *S. latissima* became dominant (**IR.HIR.KSed.LsacSac**). Between 2.1 and 2.5 m depth the substrate changed to one of scattered boulders on medium sand with much of the seabed covered by a layer of dense kelp and other algae, especially *S. latissima*, *Dictyosiphon foeniculaceus* and *Ulva lactuca*, much of it unattached. *Laminaria hyperborea* was locally abundant on the boulders, which also supported a sparse red algal turf. The

biotope has been ascribed to **SS.SMP.KSwSS**, but it is a poor fit. The infaunal sand community included *Arenicola marina*, which formed a heavily-hummocked topography in the more extensive sand patches (**SS.SSA.IMuSa.ArelSa**). The transect levelled out at a depth of 2.5 m as a plain of *Arenicola*-hummocked medium sand with sparse Lanice conchilega (**SS.SSA.IMuSa.ArelSa**) supporting a patchy cover of largely unattached algae, similar in composition to that of the previous zone, the patches being tentatively assigned to **SS.SMP.KSwSS**.

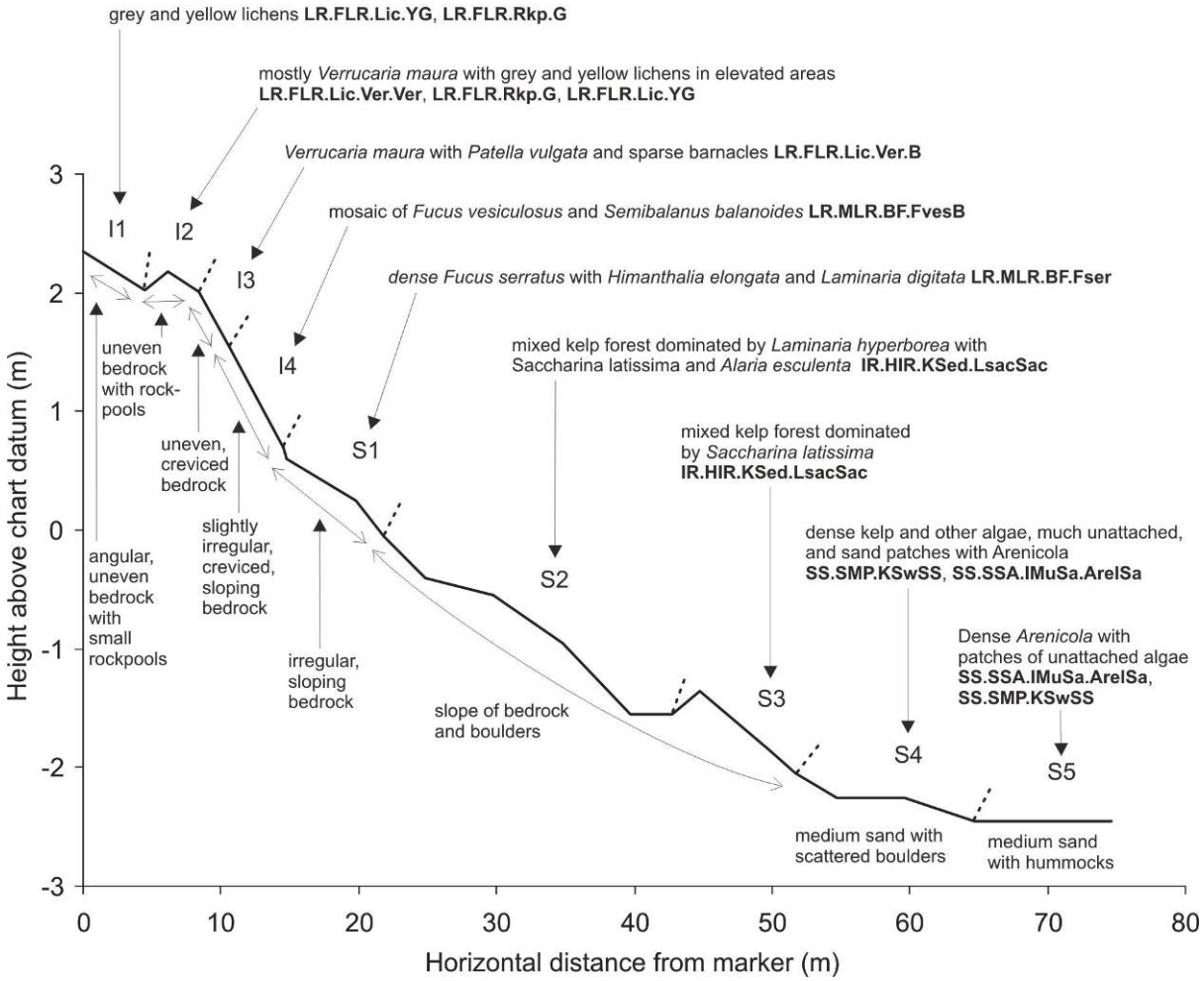

Figure 12. West Ham (XX08) transect profile with summary of the substrates, dominant biota and biotopes recorded within the component zones.

The sequence of littoral biotopes recorded in the current survey followed that observed in 2008, apart from the absence of rockpools in zone S3 in 2016. This resulted from a minor difference in interpretation of the location of the boundary between zones I2 and I3. Species composition within the littoral zones was similar in both years, although at the bottom of the shore (zone S1) the recorded abundance levels of *Himanthalia elongata* and *Laminaria digitata* were much greater in 2016 (common) than in 2008 (rare). In both years the sublittoral section of the transect largely consisted of an upper mixed kelp forest followed by *Arenicola*-hummocked sand with boulders, although there were temporal differences in detail. In 2008 the mixed kelp forest was fringed with a narrow band of dense *Alaria esculenta* along its upper margin (**IR.HIR.KFaR.Ala**). Although *A. esculenta* was common throughout the mixed kelp forest in 2016, no distinct *Alaria* biotope was discernible. Apart from this the composition of the mixed kelp forest zones (S2 and S3) and the abundance of the component kelp species was similar in both years. Although the biotopes

SS.SSA.IMuSa.AreISa and **SS.SMP.KSwSS** were recorded in both years towards the bottom of the transect, the sequence of occurrence was a little different. In 2008 there was a sharper distinction between an upper zone of dense algae (**SS.SMP.KSwSS**) (zone S4) and a lower zone of sand (zone S5) with sparse algal cover (**SS.SSA.IMuSa.AreISa**). In 2016 both these regions contained mosaics of these biotopes, the zones being distinguished on the basis of the presence of boulders in the upper zone. As much of the algal material was unattached, temporal change in its distribution would be expected. A temporal difference in the recorded estimates of stone cover in zone S5 (20% in 2008, 40-50% in 2016) may suggest some variation in the routing of the lower region of the transect. 125 clearly separable taxa were recorded along the whole transect in 2016 compared to 82 in 2008.

3.3.5 Under Lee (XX10)

The location of this east coast transect, 80 m north of the creek Under Lee, replaced that of the 2008 east coast transect, which due to the prevalent sea conditions, was situated in a location not permitting detailed examination of the shore.

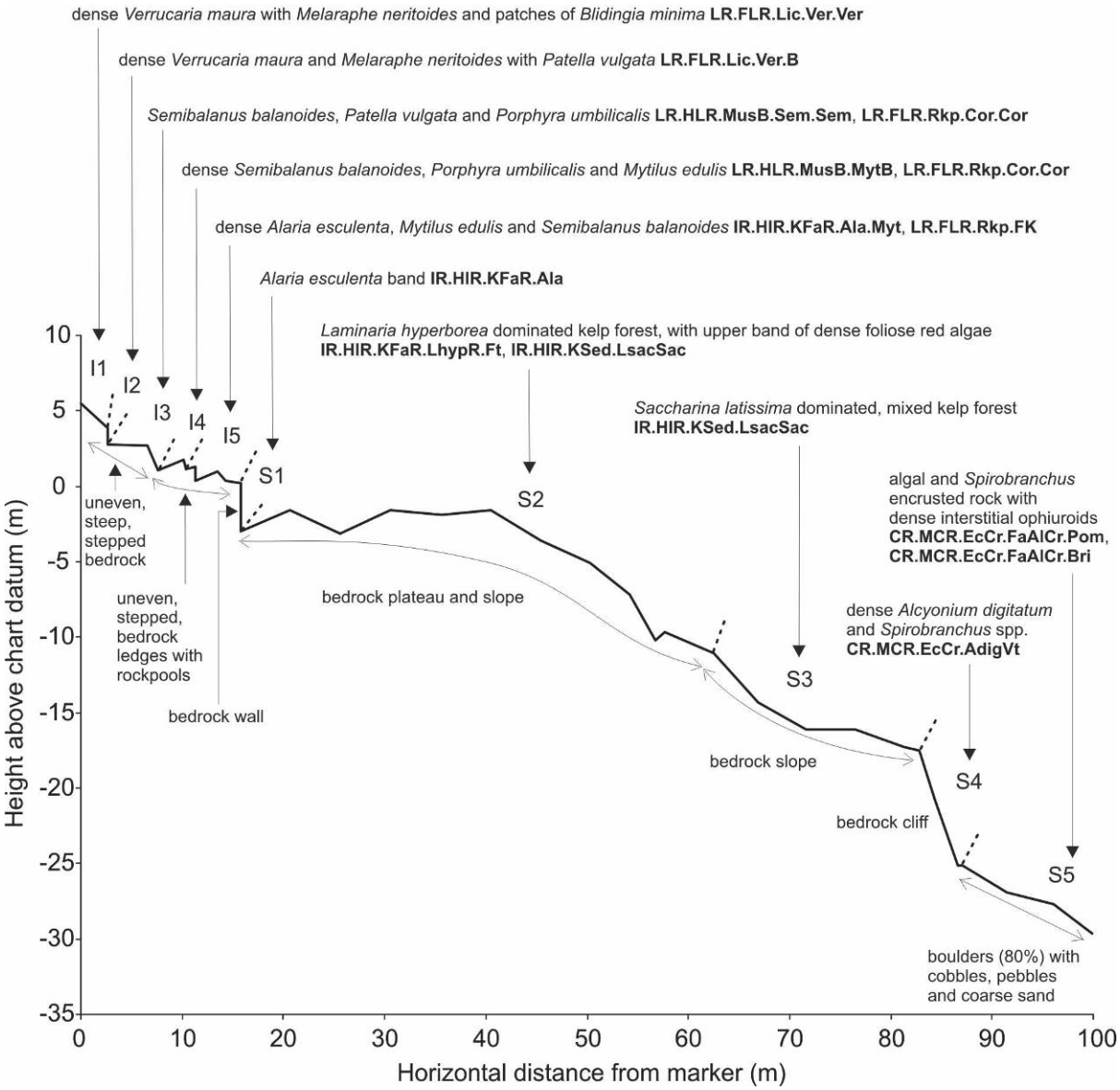

Figure 13. Under Lee (XX10) transect profile with summary of the substrates, dominant biota and biotopes recorded within the component zones.

The shore was composed of steep, stepped bedrock, with platforms and near-vertical faces (Figure 13). The marker piton at the top of the transect was located in a zone of dense *Verrucaria maura* with patches of *Blidingia minima* and *Melaraphe neritoides* in crevices (**LR.FLR.Lic.Ver.Ver**). *Verrucaria maura* and *M. neritoides* continued into the following zone, a 1 m vertical cliff, where *Patella vulgata* was also common. Although no barnacles were present, the zone has tentatively been referred to **LR.FLR.Lic.Ver.B**. Barnacles became common in the next zone which occupied the upper eulittoral, predominantly *Semibalanus balanoides*, but also sparse *Chthamalus* spp., with other dominants including *P. vulgata* and *Porphyra umbilicalis* (**LR.HLR.MusB.Sem.Sem**). Other red algae were sparse, apart from scattered clumps of *Ceramium shuttleworthianum*. A small rockpool supported a low diversity community dominated by encrusting pink coralline algae and *S. balanoides* (**LR.FLR.Rkp.Cor.Cor**). Rock in the lower eulittoral was densely coated in *Mytilus edulis*, *P. umbilicalis* and *S. balanoides* with patches of *Aglaothamnion sepositum* (**LR.HLR.MusB.MytB**). A large rockpool (4.0 x 2.5 x 0.5 m deep) was encrusted with pink coralline algae and *S. balanoides* and supported a turf of *Corallina officinalis*, as well as scattered plants of *Alaria esculenta* and small *Laminaria digitata* (**LR.FLR.Rkp.Cor.Cor**). *Alaria esculenta* became dominant in the sublittoral fringe, together with *M. edulis* and *S. balanoides* (**IR.HIR.KFaR.Ala.Myt**). Rockpools in this zone also contained dense *A. esculenta* (**LR.FLR.Rkp.FK**). At the bottom of the shore the band of *A. esculenta* continued on a vertical bedrock wall extending from around chart datum to a depth of 3 m. Rock in the upper half of this zone supported dense *S. balanoides* and *Patella* spp., with a profuse turf of *Plocamium cartilagineum* and *Odonthalia dentata* developing in the lower half (**IR.HIR.KFaR.Ala**). From the base of the wall the transect continued along a bedrock plateau followed by a rock slope. The rock of the plateau (to a distance of 50 m on the groundline) supported a *Laminaria hyperborea* forest with a profuse understorey of *O. dentata*, together with *P. cartilagineum* and *Delesseria sanguinea* (**IR.HIR.KFaR.LhypR.Ft**). Beyond 50 m the *L. hyperborea* forest continued on the bedrock slope to a depth of 11.1 m in association with lesser quantities of *A. esculenta*, *Saccorhiza polyschides* and *Saccharina latissima* (tentatively ascribed to **IR.HIR.KSed.LsacSac**). The rock was extensively encrusted with pink and brown algae but supported a generally sparse algal turf and *Desmarestia aculeata*. Small vertical faces supported locally abundant *Alcyonium digitatum*. From 11.1 to 17.5 m depth the bedrock slope continued but *S. latissima* became the dominant kelp species on algal-encrusted rock (**IR.HIR.KSed.LsacSac**). From a depth of 17.5 to 25.1 m a near-vertical bedrock cliff supported a fauna of dense *Alcyonium digitatum* and *Spirobranchus* spp. (**CR.MCR.EcCr.AdigVt**). A boulder slope with an infill of cobbles, pebbles and coarse sand extended from the base of the cliff to the end of the transect at a depth of 29.6 m. The rock was extensively encrusted with pink coralline algae, as well as *Spirobranchus* spp., which were locally abundant, and *Parasmittina trispinosa*. Between the stones *Modiolus modiolus* was common and *Ophiothrix fragilis* abundant. The zone is regarded as representing a mosaic of **CR.MCR.EcCr.FaAlCr.Pom** and **CR.MCR.EcCr.FaAlCr.Bri**.

The transect was located 263 m south-east of the nearest 2008 transect (Holes of Burro: MI08XR02), which displayed a different profile, consisting of a near-vertical bedrock cliff from the top of the shore to a depth of 18.6 m giving way to a bedrock slope, followed by a mixed substrate of coarse sediment with stones at a depth of 28 m. Despite this, there were strong similarities in the sequence of biotopes. The sequence of littoral biotopes only differed in the absence of **LR.FLR.Lic.Ver.Ver** and **LR.HLR.MusB.Sem.Sem** zones at the 2008 site, the former due to the lower penetration of the transect up the shore in 2008. The sequence of sublittoral biotopes was also very similar, apart from the replacement of **IR.HIR.KFaR.LhypR.Ft** with its vertical counterpart in 2008 (**IR.HIR.KFaR.LhypRVt**) and the absence of **IR.HIR.KSed.LsacSac** in 2008, as might be expected on a vertical cliff. Zones of **IR.HIR.KFaR.Ala.Myt**, **IR.HIR.KFaR.Ala**, **CR.MCR.EcCr.AdigVt** and **CR.MCR.EcCr.FaAlCr.Pom** with **CR.MCR.EcCr.FaAlCr.Bri** were recorded at both sites.

3.3.6 Quadrat survey

The biota recorded within the ten replicate quadrats within zone I4 along the transects at sites XX01 and XX07 are provided in Annex 3 (Tables 3.8 and 3.9). Temporal differences between the 2008 and 2016 surveys are summarised in Table 7 (XX01) and Table 8 (XX07) in terms of the number of quadrats in which the taxon was recorded and the mean percentage cover for those taxa that were quantified. The results for cryptic taxa are not included.

Table 7. Temporal change in frequency of occurrence and mean percentage cover for non-cryptic taxa in ten replicate quadrats at transect site XX01 between the 2008 and 2016 surveys. The statistical test used with significance level (p) is given.

Taxon	Data type	2008		2016		p	Test
		# quadrats	Mean % cover	# quadrats	Mean % cover		
Halichondria panicea	presence	5		1		0.141	Fisher
Actinia equina	presence	7		6		1.000	Fisher
Sagartia elegans?	presence	2		0		0.474	Fisher
Semibalanus balanoides	quantitative	10	1.0	10	10.8	**<0.001**	U test
Patella vulgata	presence	10		10		1.000	Fisher
Nucella lapillus	presence	8		0		**0.001**	Fisher
Mytilus edulis	quantitative	10	59.0	10	72.0	0.083	t test
Aglaothamnion sepositum	quantitative	10	15.5	10	9.3	**0.033**	t test
Ceramium shuttleworthianum	presence	1		7		**0.020**	Fisher
Corallina officinalis	presence	6		5		1.000	Fisher
Hildenbrandia rubra	presence	5		0		**0.033**	Fisher
Mastocarpus stellatus	presence	5		0		**0.033**	Fisher
Corallinaceae pink crust	presence	7		3		0.179	Fisher
Porphyra umbilicalis	quantitative	10	57.0	10	74.6	**0.007**	t test
Brown algal crust	presence	4		0		0.087	Fisher
Fucus vesiculosus linearis	presence	1		0		1.000	Fisher
Ectocarpus fasciculatus	presence	0		3		0.211	Fisher
Ectocarpus sp.	presence	0		1		1.000	Fisher
Punctaria sp.	presence	0		1		1.000	Fisher
Laminaria spp. juvenile	presence	1		0		1.000	Fisher
Alaria esculenta juvenile	presence	0		1		1.000	Fisher
Scytosiphon lomentaria	presence	1		7		**0.020**	Fisher
Acrosiphonia arcta	presence	4		9		0.057	Fisher
Spongonema tomentosum	presence	0		1		1.000	Fisher
Cladophora albida	presence	2		0		0.474	Fisher
Ulva flexuosa	presence	3		0		0.211	Fisher
Ulva intestinalis	presence	2		0		0.474	Fisher
Ulva linza	quantitative	10	14.5	10	14.3	0.723	t test
Ulva prolifera	presence	4		5		1.000	Fisher
mean # taxa	quantitative		14.0		12.7	0.117	t test

Significant temporal changes in cover were recorded for three of the five species recorded quantitatively at XX01 and two of the four species recorded quantitatively at XX07. For those taxa recorded as present or absent in quadrats, temporal change in frequency of occurrence was identified for five of the 24 taxa at XX01 and for four of the 16 taxa at XX07. Temporal increases at both sites were recorded for *Porphyra umbilicalis*, *Mytilus edulis* and *Semibalanus balanoides*, although they were not significant at one of the sites for the latter two species. The largest changes in cover were identified at XX07 where *Mytilus edulis*

increased from 3% to 45% and *Porphyra umbilicalis* from 28% to 84%. *Aglaothamnion sepositum* and *Nucella lapillus* displayed significant but contrary temporal trends at the two sites, with each showing an increase at one site but a decline at the other. Very little change in taxon richness was recorded (mean of 14.0 to 12.7 at XX01 and 10.5 to 11.1 at XX07). The nature and scale of temporal changes in the composition of the community fall within the range of natural variation to be expected on a rocky shore (e.g. Lewis, 1964) and do not reveal evidence of changes that are characteristic of anthropogenic drivers.

Table 8. Temporal change in frequency of occurrence and mean percentage cover for non-cryptic taxa in ten replicate quadrats at transect site XX07 between the 2008 and 2016 surveys. The statistical test used with significance level (p) is given.

		2008		2016			
	Data type	# quadrats	Mean % cover	# quadrats	Mean % cover	p	Test
Halichondria panicea	presence	1		0		1.000	Fisher
Actinia equina	presence	1		0		1.000	Fisher
Actiniaria sp.	presence	1		6		0.057	Fisher
Semibalanus balanoides	quantitative	10	34.3	10	44.0	0.333	t test
Patella vulgata	presence	10		7		0.211	Fisher
Nucella lapillus	presence	4		9		**0.020**	Fisher
Mytilus edulis	quantitative	10	3.0	10	45.3	**<0.001**	U test
Verrucaria maura	presence	6		0		**0.003**	Fisher
Aglaothamnion sepositum	presence	2		9		**0.005**	Fisher
Ceramium shuttleworthianum	presence	3		5		0.650	Fisher
Corallina officinalis	presence	2		4		0.628	Fisher
Hildenbrandia rubra	presence	10		7		0.211	Fisher
Mastocarpus stellatus	presence	5		5		1.000	Fisher
Corallinaceae pink crust	presence	3		4		1.000	Fisher
Porphyra umbilicalis	quantitative	10	28.1	10	83.6	**<0.001**	t test
Alaria esculenta	presence	1		0		1.000	Fisher
Acrosiphonia arcta	quantitative	5	4.8	9	5.0	0.292	t test
Ulva compressa	presence	0		3		0.211	Fisher
Ulva intestinalis	presence	5		0		**0.033**	Fisher
Ulva linza	presence	2		4		0.628	Fisher
mean # taxa			10.5		11.1	0.454	t test

3.4 Sea caves survey

3.4.1 Cave inventory

In 2008 (Harries *et al*, 2009), the southern and western coasts of Mousa were systematically searched for sea caves (site 1 clockwise to site 16 on Figure 14) but sea conditions did not allow a close examination of the north-eastern coast. In 2016 this remaining north-eastern coast was examined from an inflatable boat. We consider that the cave inventory is now nearly complete. All areas of the coast have been examined excepting sheltered inlets where erosional sea caves are unlikely to form. Entirely subtidal caves will not have been detected but there is no evidence of their existence in the area. Similarly, small inconspicuous caves may have been overlooked but it is unlikely that caves with small entrances will lead to cave passages of any significant extent. Two of the known sites (site 26 and 29) still require further investigation to confirm the presence and extent of cave passages. Site 26 was a narrow shallow entrance. It is probable that this will prove to be a largely intertidal cave of limited extent. Site 29 is a significant gully on the north coast of the

small island of Perie Bard. It is possible that a sea cave is present at the rear of the gully but it is more probable that a boulder slope will be found.

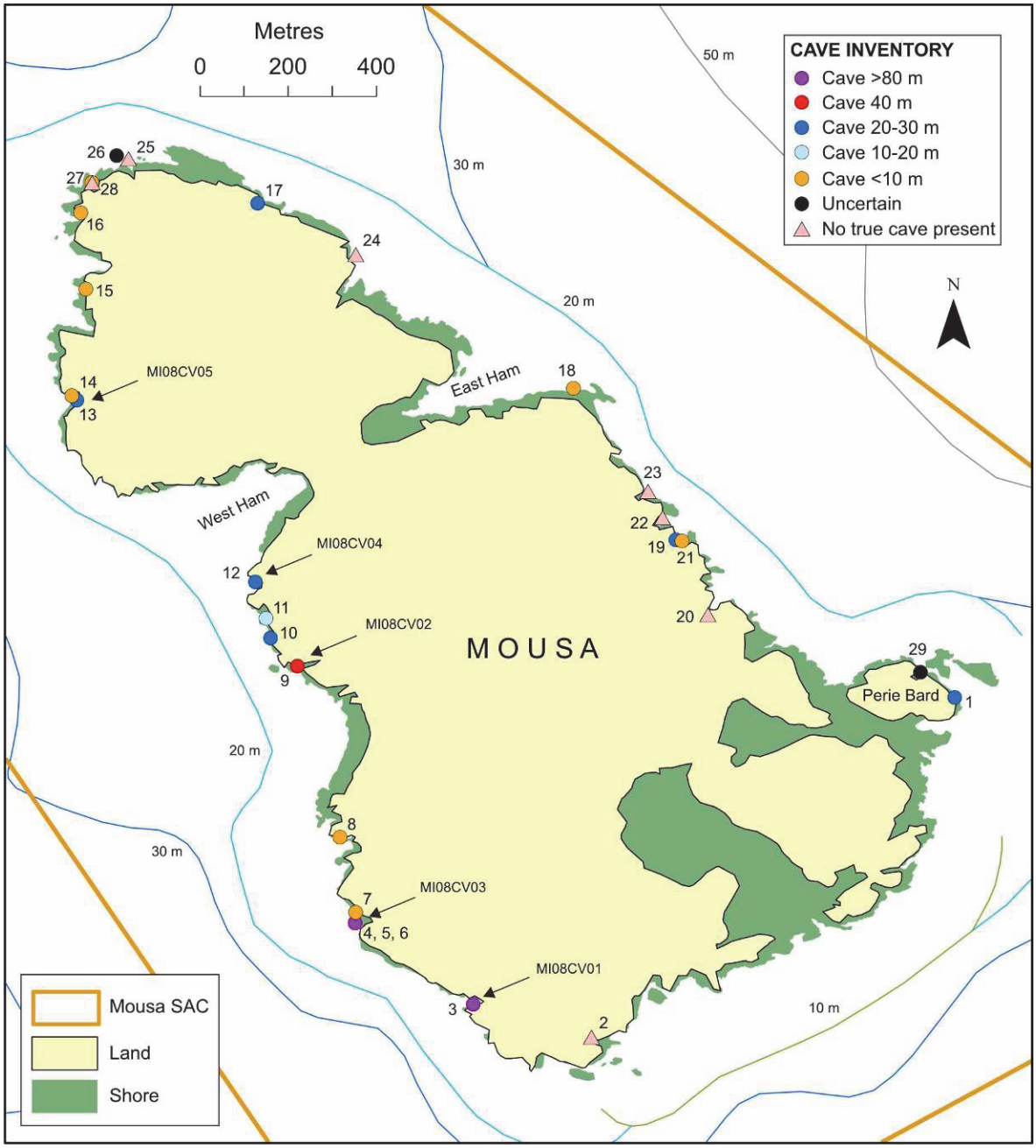

Figure 14 Distribution of sea cave records in 2016. Site codes are given for the five caves surveyed in detail

The 2008 survey noted four potential entrances on the north-eastern coast which have now been assessed. Two were confirmed as caves of relatively limited extent (sites 18 and 19) and another was found to consist of a surge gully and rock arch (site 20). It was anticipated that the fourth (site 17) would provide an extensive site for future monitoring. Unfortunately it proved to be of limited extent and was constricted and shallow towards the rear of the cave. The cave inventory includes seven locations where no caves were present. These were included to facilitate elimination from the attention of any future surveyors. They include

sites where caves were reported by earlier sources and sites where caves appeared to be present when viewed from the sea. Currently, a total of 20 sea caves are confirmed on Mousa (rock arches and unenclosed gullies are not included). Five of these caves were predominantly intertidal (sites 4, 5, 7, 8 and 15) and the remaining 15 had some subtidal component.

The intertidal caves were examined in 2008 and were found to be less than 10 m in length with moderately high levels of illumination throughout. In general most of the area of each cave was at an upper shore or supralittoral level. The most diverse communities within the intertidal caves tended to be restricted to the entrance area and were indistinguishable from the neighbouring open shore. Within the caves the composition of the biota tended to be restricted to various algal and lichen crusts similar in composition to the supralittoral parts of some of the surveyed caves.

Of the 15 caves with a subtidal component five were less than 10 m in length (sites 14, 16, 18, 21 and 27) and well illuminated throughout. Seven were between 20-30 m in length (sites 1, 10, 11, 12, 13, 17 and 19) and two of these were included in the SCM survey (sites 12 and 13). Of the three remaining caves one was ~40 m in length (site 9) and the other two were in excess of 80 m in length (sites 3 and 6). All three of these relatively extensive caves were included in the SCM survey. See Annex 4.1 for detailed information on the caves featured in the inventory.

3.4.2 Biological monitoring surveys

All five of the 2008 monitoring sites were re-examined in 2016. The three most extensive sites (CV01, CV02 and CV03) were subject to a full survey whereas the two less extensive sites (CV04 and CV05) were subject to a more rapid assessment method. The 2008 recommendations included a suggestion that additional extensive cave sites should be located and incorporated into future monitoring surveys. In particular, the site named by the 2003 Posfords survey as 'Boom Cave' (site 17 on Figure 14) was thought to represent a good potential monitoring site. The search for additional monitoring sites was conducted as described above in section 3.4.1. No additional extensive cave sites were located and Boom cave was found to be of limited extent and mostly well-illuminated. It was not regarded as a good example of the cave feature or as a useful replacement for any of the existing monitoring sites.

The relocation of the cave sites based on the 2008 relocation sheets proved to be straightforward. The pitons placed above the waterline were often still in place and their locations were easily established with the aid of the images on the relocation sheets. Subtidal pitons were not easily relocated but the 2016 data on the location of the line provides a high degree of confidence in accurate line positioning. The 2016 assessment of the physical layout of the caves confirmed adequate accuracy of the 2008 physical surveys and detected no evidence of substantial change to the physical structure of the caves.

Annex 4 contains full information on the surveyed caves. The site relocation sheets, datum line relocation sheets and physical surveys generated in 2008 are reproduced for the convenience of future surveyors and the summaries of the biological zones and full species abundance data from 2016 are presented in table format. The following sections (3.4.2.1 to 3.4.2.5) provide a description of the cave biota recorded in 2016 and an evaluation of change since 2008.

3.4.2.1 Masti Geo Cave (MI16CV01)

The repositioning of the cave datum line was achieved with a high degree of accuracy in 2016. The line was positioned following the relocation information from 2008. Piton 4 from

2008 was found to still be in position at the end of the cave. The measured tape distance of this piton was 99.2 m in 2008 and 99.9 m in 2016 so there was less than 1% difference in the repositioning of the line. Observations made by the 2016 surveyors showed close correspondence with the description and physical survey provided in the 2008 report. There was no evidence of any significant change to the physical layout of the cave and the 2008 physical survey was confirmed as accurate.

The physical description given in 2008 remains valid and was as follows. "The cave was about 115 m in length and passage width at floor level ranged from 5 to 8 m for most of the length. It was generally linear in plan view and ran almost due east into the rock. At the entrance the ceiling was about 7 m above chart datum and the floor was about 3 m below chart datum. The floor was composed of rounded boulders with some cobbles and pebbles and rose gradually, reaching chart datum some 50 m within the cave. At this point there were a number of large boulders that broke the water surface. At the rear of the cave the passage was about 4 m high and 4 m wide with a boulder beach above water level. The cave walls were inclined such that the southern (right hand) wall was predominantly upward facing whereas the northern (left hand) wall was predominantly slightly overhanging."

In 2016 the subtidal community was rather sparse with a similar assemblage of species present on the floor boulders and on the passage walls. Abundances tended to be higher on stable vertical surfaces of the passage walls and the sides of the larger floor boulders. The impoverished nature of the community was ascribed to the effects of scour with the more impoverished floor areas assigned to the biotope **IR.FIR.SG.CC.Mo** and the slightly less impoverished wall areas assigned to the biotope **IR.FIR.SG.CC.BalPom**. Characterising taxa were principally scour tolerant species such as *Spirobranchus triqueter*, *Spirorbis tridentatus*, *Verruca stroemia* and *Heteranomia squamula*. Significant cover of the sponge *Oscarella lobularis* occurred in some areas. A canopy of foliose algae was present in the entrance area (**IR.FIR.SG.FoSwCC**) and light levels were sufficient to allow coralline algal crusts to persist beyond 20 m within the cave. In some areas of the inner parts of the cave (e.g. biological section 3) there were large patches of *Clathrina coriacea* and *Dendrodoa grossularia* (**IR.FIR.SG.CC.DenCcor**).

This pattern of subtidal cave biotopes shows no distinct change from that described in 2008. However, the data shows some apparent changes in the abundances of certain taxa within some zones:

- Coralline algal crusts were recorded as abundant on the subtidal walls of cross section 1 in 2008 but only recorded as frequent in 2016. Examination of images taken in 2008 indicates the taxon was overestimated at 'abundant'. The cover of coralline crusts is variable & patchy making overall abundance estimates difficult. True abundance is likely to be frequent to common and there is no good evidence of temporal change.
- *Verruca stroemia* appears to have reduced in abundance at both cross section 1 (from C to R) and at cross section 2 (from C to R). However, this is an artefact of the SACFOR conversion. Estimates of small encrusting biota give widely differing SACFOR abundances depending on if numbers per unit area or % cover is used. Review of the raw data and imagery show no good evidence of temporal change in *Verruca stroemia*.
- *Heteranomia squamula* shows an increase (from absent to F) on the floor area of cross section 1. It is reasonable to assume these were overlooked in 2008. They are small, cryptic and often heavily encrusted with other biota. Additionally, they were recorded on the adjacent cave walls in 2008 so no significance should be attached to the absence of records from the floor.
- *Spirorbis tridentatus* appeared to form more extensive patches at cross section 2 (locally A) and cross section 3 (locally F) than was the case in 2008 but there is no

indication of an overall change in abundance and it is difficult to verify in the absence of high quality spatially defined imagery from 2008.

- *Clathrina coriacea* and *Oscarella lobularis* appeared to form more extensive patches at cross section 2 (locally C) than was the case in 2008 but there is no indication of an overall change in abundance and it is difficult to verify in the absence of high quality spatially defined imagery from 2008.

In 2016, the intertidal biota of the cave walls was dominated by *Semibalanus balanoides* and the abundance and diversity of the community progressively decreased with increasing distance into the cave. This general pattern is similar to that reported in 2008 except that *Semibalanus* abundance at cross section 1 (and to a lesser extent at cross section 2) was distinctly higher in 2016. In 2008 the intertidal community was impoverished throughout the cave and was assigned to the biotope **LR.FLR.CvOv.ScrFa**. But the 2008 report comments that this zone at cross section 1 resembled an impoverished version of **LR.HLR.MusB.Sem**. The increased *Semibalanus* abundance in 2016 would justify assigning the zone at cross section 1 to **LR.HLR.MusB.Sem**. It is probable that this change is merely a consequence of the interannual variability in *Semibalanus* recruitment and is of no major consequence. The only other component of the intertidal biota to show any indication of altered abundance was the coralline algal crusts. There is an apparent increase in coralline crust abundance at cross section 1 (from absent to C) and an apparent decrease at cross section 2 (from A to absent). No imagery is available from 2008 to verify this change and it may simply be a consequence of the patchy and localised distribution of the crusts within the cave.

In 2016, supralittoral areas of the cave passage were characterised by *Hildenbrandia* sp. (**LR.FLR.CvOv.VmucHil**) which became less abundant further within the cave. Green algal crusts were also prominent on upper areas of walls and ceiling at cross section 1 (**LR.FLR.CvOv.GCv**). This corresponds well with the records from 2008. There are some differences in the abundance estimates of the algal crusts but we cannot be confident of the accuracy of the estimates. The supralittoral zones were inaccessible and viewed from a distance under low light conditions by a diver floating at the water surface. Additionally, the reddish mineral colour of some areas of rock was very difficult to distinguish from *Hildenbrandia* when viewed under these conditions.

Overall, there is no evidence of any change to the structure and biota of the cave beyond that which can be explained in terms of interannual variability.

3.4.2.2 Cave at Scarfi Stack (MI16CV02)

The repositioning of the cave datum line was achieved with a high degree of accuracy in 2016. The line was positioned following the relocation information from 2008. Piton 3 from 2008 was found to still be in position near the end of the cave. The measured tape distance of this piton was 33.7 m in both 2008 and 2016 confirming a high degree of accuracy in the repositioning of the line. Observations made by the 2016 surveyors showed close correspondence with the description and physical survey provided in the 2008 report. There was no evidence of any significant change to the physical layout of the cave and the 2008 physical survey was confirmed as sufficiently accurate.

The physical description given in 2008 remains valid and was as follows. "The approach to the cave was via a narrow (<1 m wide at the surface) surge gully some 30 m in length and several metres deep. At the inner end the gully opened out into a broad pool at the base of the cliff where the cave entrance was located. The cave was just over 40 m in length and ran almost due east into the rock. At the entrance the passage was several metres wide narrowing down to 3 m in width within the first 10 m into the cave. It remained two to three metres in width at floor level for much of the length of the cave although areas towards the rear became considerably narrower due to the presence of elongate rock pillars in the centre of the cave passage. The passage width tended to taper from floor to ceiling so at the water surface it was generally narrower than at floor level. The ceiling was somewhat irregular and was 2 - 3 m above chart datum for much of the length of the cave although it seemed lower in some areas due to downward projections of rock. The cave floor was composed of smooth rounded boulders and cobbles with coarse sandy infill throughout the length of the cave. It was about 1 m below chart datum at the entrance and became progressively shallower reaching chart datum about 30 m into the cave and terminated in a boulder beach at the back of the cave where the ceiling lowered to around a metre above the floor."

In 2016, the rock surfaces below the waterline appeared impoverished and scoured with a very sparse community of biota. This was most pronounced on the cave floor (**IR.FIR.SG.CC.Mo**) where encrusting biota persisted only on the larger boulders and *Actinia equina* was present throughout. The submerged cave walls tended to support a slightly richer community particularly on the upper parts of the walls. This zone was assigned to the **IR.FIR.SG.CC.BalPom** although it is a distinctly impoverished version of the biotope and on the lower parts of the walls was virtually indistinguishable from the cave floor community. Characterising biota included turfs of small sabellid tubes formed by *Fabricia stellaris* (R, becoming C on some areas of upper walls) and scattered tubes of *Spirorbis tridentatus* (R). *Leucosolenia complicata* was also a prominent component of the biota on the cave walls but generally in very low abundance (R, becoming O on some areas of upper walls).

This pattern of subtidal cave biotopes shows no distinct change from that described in 2008 and the composition of the communities are very similar. However, the evidence suggests a general decrease in abundance of some taxa since 2008. This is particularly evident for the sabellid tube turf which was abundant on all cave walls and in some floor areas in 2008 but rare in most locations in 2016. *Fabricia stellaris* is known to be an opportunistic species so population fluctuations are perhaps to be expected. Sponge abundance also appeared to have declined on the cave walls since 2008 when both *Grantia compressa* and *Halichondria panicea* were prominent in cave walls in outer areas of the cave but in considerably lower abundance in 2016. Similarly, *Urticina felina* was common on the cave floor in 2008 but considerably less abundant in 2016. It is difficult to assess the significance of these changes but given the highly scoured nature of the site it is probable that this represents natural interannual variability perhaps related to differences in the levels of wave disturbance occurring over the preceding months.

In 2016 the intertidal parts of the cave walls supported a well-developed *Semibalanus balanoides* community in areas near the entrance (cross section 1). This community declined in abundance and diversity further into the cave with virtually no biota present in this zone at cross section 3. This shows some distinct differences from the 2008 records. Firstly, the intertidal area of cross section 1 contained considerably lower abundances of *Semibalanus balanoides* in 2008 and was assigned to the biotope **LR.FLR.CvOv.ScrFa**. In 2016, the increased abundance of *Semibalanus balanoides* indicates the zone has changed to the **LR.HLR.MusB.Sem** biotope. This change is consistent with the corresponding changes noted at CV01 in 2016. Secondly, in 2008 the intertidal zones of cross sections 2 and 3 were assigned to the biotope **LR.FLR.CvOv.VmucHil** on the basis of a high percentage cover of *Hildenbrandia* sp. with very little other biota present. A close examination in 2016 led to the conclusion that the 2008 records of high *Hildenbrandia* sp. abundance on these zones were erroneous and arose through confusion of the reddish mineral stain of the rock surface with thin reddish crusts of *Hildenbrandia* sp. Correspondingly, it is appropriate to reassign the intertidal biotope at cross section 2 to **LR.FLR.CvOv.ScrFa** and to reclassify the corresponding zone at cross section 3 as '**barren rock**'.

In 2016 supralittoral areas of the cave passage were dominated by *Hildenbrandia* sp. crusts and green algal stains at cross sections 1 and 2 but were largely devoid of biota at cross section 3. This represents an apparent change which is again attributable to the erroneous abundance estimates of *Hildenbrandia* sp. in 2008. Although the assigned supralittoral biotopes for cross sections 1 and 2 should remain as **LR.FLR.CvOv.VmucHil** it should be noted that the *Hildenbrandia* sp. abundance estimates made in 2008 at cross section 2 are excessively high and the classification of the supralittoral part of cross section 3 should be altered to '**barren rock**'.

Overall, there is no evidence of any change to the physical structure of the cave. The sublittoral biota appear generally less abundant than in 2008 but this is likely to be attributable to interannual variability in the level of scour. Additionally, 2016 saw more abundant intertidal *Semibalanus balanoides* at the cave entrance than in 2008 and the abundance of *Hildenbrandia* sp. within the cave is lower than was previously supposed.

3.4.2.3 Cave south of the Broch (MI16CV03)

We have a high degree of confidence in the repositioning of the cave datum line in 2016. Although none of the subtidal pitons could be located, the position of cross section 3 at 74 m on the tape could be confirmed as accurate in relation to the physical survey of the cave. This cross section was located just beyond a conspicuous jammed overhead boulder and just before a distinct constriction in the cave passage. Observations made by the 2016 surveyors showed close correspondence with the description and physical survey provided in the 2008 report. There was no evidence of any significant change to the physical layout of the cave and the 2008 physical survey was confirmed as accurate.

The physical description given in 2008 remains valid and was as follows. "The cave was about 85 m in length, generally linear in plan view and ran due east into the rock. Passage width at floor level narrowed down rapidly to about 3 m just within the entrance. After about 10 m it became significantly broader (5 - 6 m) before narrowing once more to 2 - 3 m in width. About 70 m into the cave the passage became very narrow (<1 m) finally terminating at an impassable fissure. The proportions of the cave passage were tall and narrow. Ceiling height was somewhat variable along the length of the cave typically ranging from 4 - 7 m above chart datum. The floor was mostly composed of rounded boulders and cobbles but there were also areas of bedrock and patches of gravel and pebbles in places. In the entrance area the floor was 6 - 7 m below chart datum and rose gradually within the cave but was still about 3.5 m below chart datum 70 m into the cave. Beyond this point the passage

became too narrow to investigate below the surface but the floor appeared to be bedrock and seemed to rise to just below chart datum at the end of the cave. At the end of the cave both the passage width at the water surface and the ceiling height were reduced to just a few centimetres. The cave however continued and vocalising seals could be heard through the gap. Presumably the passage was wider below the water surface. The cave walls tended to be slightly inclined such that the southern (right hand) wall was predominantly upward facing whereas the northern (left hand) wall was predominantly slightly overhanging."

The subtidal parts of this cave were considerably more extensive than any of the other surveyed caves. The general pattern was of a cave floor with mobile cobbles and boulders supporting a very sparse scoured community of sessile biota (**IR.FIR.SG.CC.Mo**). Scour effects were also apparent on the lower parts of the walls (**IR.FIR.SG.CC.BalPom**) where relatively sparse communities graded progressively into considerably richer communities on the upper parts of the wall (**IR.FIR.SG.CrSpAsAn**). These wall communities also showed a trend of reduced abundance and diversity with increasing distance into the cave accompanied by corresponding changes in species composition.

In 2016 the scoured and largely barren cave floor showed little difference from the 2008 records. At cross section 3 there were some indications of a general abundance increase with taxa that were absent in 2008 (*Grantia compressa, Spirorbis tridentatus*, polychaete tube turf and infaunal polychaete casts) now being at least locally frequent. Nevertheless these taxa remained generally sparse in 2016 and some fluctuation of species abundances in this unstable habitat is unremarkable. The data also suggests a decline in the abundance of *Spirobranchus triqueter* on the cave floor and lower walls at cross section 1. However, an examination of the raw data indicates a percentage cover of less than 1% in 2008. The relatively high SACFOR estimates are due to the use of numbers per unit area when converting to the SACFOR scale in 2008. The *Spirobranchus triqueter* were very sparse in both years and there is no real evidence of a change in abundance.

In 2016 the cave walls at cross section 1 were dominated by *Tubularia indivisa* and *Metridium dianthus* on upper parts and by bryozoan turf and sponge crusts on the lower parts of the wall. This general pattern is also apparent in the 2008 records although there is some evidence of changes in the biota. In 2008 *Corynactis viridis* and *Sagartia elegans* were common on the upper parts of the wall but not recorded in 2016 and the abundant bryozoan turf noted in 2008 was reduced to frequent in 2016. Conversely, *Halichondria panicea* and bryozoan crusts were not recorded in 2008 but were frequent and abundant respectively in the 2016 records.

In 2016 the cave walls at cross section 2 had abundant polychaete tube turf (including numerous small terebellids as well as a lower abundance of sabellids) at all levels and *Grantia compressa* ranging from common to abundant with increasing height on the wall. Abundant *Corynactis viridis* and common *Metridium dianthus* and *Sagartia elegans* characterised the upper wall while lower parts included common *Dendrodoa grossularia* and frequent *Spirorbis tridentatus, Clathrina coriacea* and *Leucosolenia complicata*. The 2008 data shows some similarities including the higher abundance of anemones on the upper wall and prominence of polychaete tube turf, *Spirorbis tridentatus*, *Clathrina coriacea* and *Dendrodoa grossularia* on the lower wall. However, in 2008 the upper wall areas were dominated by *Corynactis viridis* with lower abundances (rare) of *Metridium dianthus* and *Sagartia elegans* than seen in 2016. Polychaete tube turf was absent from the upper wall in 2008 but abundant in 2016. The superabundant bryozoan turf recorded on the lower wall in 2008 was not recorded in 2016 and *Spirorbis tridentatus* declined from abundant to frequent over the same period. *Grantia compressa* was not recorded in 2008 but was a significant component of the community in 2016.

In 2016 the cave walls at cross section 3 had common polychaete tube turf and *Spirorbis tridentatus* with abundant hydroid turf and common *Grantia compressa* in the upper areas. *Dendrodoa grossularia* and *Sagartia elegans* were also frequent. The 2008 records are similar in terms of abundance of hydroids, polychaete tube turf, *Dendrodoa grossularia* and *Sagartia elegans.* But increases of abundance have occurred for *Grantia compressa* (from absent to locally common) and for *Spirorbis tridentatus* (from occasional to common).

It is clear that a number of changes in the community composition of the cave walls have occurred between 2008 and 2016 but there is no clear and obvious pattern to these changes. For some components of the community (e.g. bryozoan turf) there appears to have been a general decline, in other cases (e.g. *Grantia compressa* and polychaete tube turf) there appears to be a trend of increased abundances. However in other cases (e.g. anemones and *Spirorbis tridentatus*) abundances show declines in one area of the cave and increases in another area. Very little is known of temporal patterns of change in sea cave community and it can only be assumed that these changes are within the normal range of variability. Overall, the general species composition and character of the cave wall community recorded in 2016 was similar to that recorded in 2008.

In 2016 the intertidal parts of the cave walls supported a well-developed *Semibalanus balanoides* community in areas near the entrance (cross section 1) which became increasingly impoverished at cross sections further into the cave. The abundance of *Semibalanus balanoides* at cross sections 1 and 2 was distinctly higher in 2016 than in 2008. In 2008 the intertidal zones at all cross sections were assigned to the biotope **LR.FLR.CvOv.ScrFa**. In view of the increased abundance of *Semibalanus balanoides* at cross section 1 in 2016 it is justified to assign this zone to **LR.HLR.MusB.Sem**. This corresponds to changes observed at CV01 and CV02. Other changes noted in the intertidal parts of the cave walls are of less significance and include a decrease of *Spirorbis tridentatus* at cross section 2 (from abundant to absent) and an increase of Actinia equina at cross section 3 (from absent to frequent).

In 2016 the supralittoral parts of the cave walls were dominated by *Hildenbrandia* sp. and green algal crusts at cross section 1 (**LR.FLR.CvOv.VmucHil and LR.FLR.CvOv.GCv**) and were essentially barren of visible biota at cross sections 2 and 3. These records are essentially identical to those recorded in 2008.

Overall, there was no evidence of any change to the physical structure of the cave. The sublittoral biota of the cave walls showed a number of changes between 2008 and 2016 but there was no clear and consistent pattern to these changes and they are assumed to be within the normal range of interannual variability. As was the case at other monitoring sites, 2016 saw more abundant intertidal *Semibalanus balanoides* at the cave entrance than 2008.

3.4.2.4 Cave near West Ham (MI16CV04)

Due to time constraints, subtidal pitons were not installed for the repositioning of the datum line at this site. However, the intertidal relocation pitons were located and a tape measure was laid along the cave floor. Given the limited extent of the cave this was sufficient to relocate the survey cross sections with confidence. Observations made by the 2016 surveyors showed close correspondence with the description and physical survey provided in the 2008 report with the exception of a slight deepening of the cave floor at about 8 m along the tape. This corresponded to a narrowing of the cave passage and was attributed to the scouring out of the floor cobbles by recent wave action. The cobbles were slightly banked up to either side of the constriction and given the obvious mobility of the cobbles it is probable that they are redistributed on a regular basis. There was no evidence of any other significant change to the physical layout of the cave and the 2008 physical survey was confirmed as accurate.

The physical description given in 2008 remains valid and was as follows. "The cave was about 25 m in length and ran north-east into the rock. The passage was about 4 m wide at the entrance, 7 m into the cave it narrowed down to 2 m and then became broader once again opening out to about 5 m in width near the back of the cave. The cave floor was composed of smooth rounded boulders and cobbles. It was ~0.5 m BCD at the entrance and deepened to ~1 m BCD where the passage became narrow. Beyond this point it became shallower once more and reached chart datum about 18 m into the cave. The ceiling was just over 4 m above chart datum over most of the length of the cave but lowered near the end of the cave to just over a metre above the floor at the back wall. Passage walls on both sides of the cave tended to be vertical or slightly overhanging."

All surfaces within this very shallow cave showed clear effects of scour. In 2016 the heavily scoured boulders of the cave floor supported only a very sparse biota of coralline algal crusts and *Spirorbis tridentatus* (**IR.FIR.SG.CC.Mo**). This community showed no significant differences from that recorded in 2008. The bases of the walls were also scoured with only sparse *Spirorbis tridentatus* and patches of *Leucosolenia complicata* and *Diplosoma listerianum* (**IR.FIR.SG.CC.BalPom**). Again, this community was similar to that recorded in 2008 with the exception of a reduction of *Spirorbis tridentatus* at cross section 2 from common in 2008 to rare in 2016.

In 2016, the upper parts of the cave walls supported a relatively profuse biota (**IR.FIR.SG.CC.BalPom**) of abundant *Spirorbis tridentatus* and polychaete tube turf (mainly composed of *Fabricia stellaris*). This community was essentially identical to that recorded in 2008 other than a slight increase in the abundance of *Grantia compressa* (from frequent to common) and *Leucosolenia complicata* (from rare to locally common) at cross section 1.

The intertidal area of cross section 1 in 2016 had significantly more *Semibalanus balanoides* (abundant) than recorded in 2008. In 2008 this zone was assigned to **LR.FLR.CvOv.VmucHil** on the basis of the predominance of *Hildenbrandia* sp. and scarcity of *Semibalanus balanoides*. It is appropriate to reassign this zone to **LR.HLR.MusB.Sem** on the basis of the increased abundance of *Semibalanus balanoides*.

In 2016 the supralittoral cave walls were characterised by high abundances of *Hildenbrandia* sp. (**LR.FLR.CvOv.VmucHil**). This pattern was essentially identical to that recorded in 2008.

Overall, there was no evidence of any significant change to the physical structure of the cave. Apart from the increase in the abundance of *Semibalanus balanoides* near the cave entrance the biota was essentially indistinguishable from that recorded in 2008.

3.4.2.5 Cave at Blow Geo (MI16CV05)

Due to time constraints, subtidal pitons were not installed for the repositioning of the datum line at this site. However, the intertidal relocation pitons were located and a tape measure was laid along the cave floor. Given the limited extent of the cave this was sufficient to relocate the survey cross section with confidence. Observations made by the 2016 surveyors showed close correspondence with the description and physical survey provided in the 2008 report. There was no evidence of any significant change to the physical layout of the cave and the 2008 physical survey was confirmed as accurate.

The physical description given in 2008 remains valid and was as follows. "The cave was about 24 m in length and ran south-east into the rock. The passage was about 2 - 3 m wide at the entrance but became broader (~6 m) further into the cave. The cave floor was composed of smooth rounded boulders and cobbles. It was ~1 m BCD at the entrance becoming shallower relatively rapidly and reaching chart datum about 10 m within the cave

with a boulder beach at the back wall. The ceiling was relatively low dropping to about 1.5 m above chart datum just within the entrance then rising to just over 3 m above chart datum in the mid-section of the cave before lowering once more to within a metre or so of the cave floor in the rear third of the cave. The general passage shape was broad and low with vertical or slightly overhanging walls."

All surfaces within this very shallow cave showed clear effects of scour. In 2016 the heavily scoured boulders of the cave floor supported only a very sparse biota of *Semibalanus balanoides* and *Spirorbis tridentatus* (**IR.FIR.SG.CC.Mo**). This community showed no significant differences from that recorded in 2008. The bases of the walls were also scoured with only sparse *Spirorbis tridentatus* and patches of polychaete tube turf (mainly composed of *Fabricia stellaris*) (**IR.FIR.SG.CC.BalPom**). Again, this community was similar to that recorded in 2008.

In 2016, the upper parts of the cave walls supported a relatively profuse biota (**IR.FIR.SG.CC.BalPom**) of frequent polychaete tube turf and *Dynamena pumila* with occasional *Spirorbis tridentatus.* This community was similar to that recorded in 2008 except for a decrease in the abundances of polychaete tube turf (from abundant to frequent) and of *Spirorbis tridentatus* (from common to occasional.

The intertidal area of the cross section in 2016 had significantly more *Semibalanus balanoides* (abundant) than recorded in 2008. In 2008 this zone was assigned to **LR.FLR.CvOv.ScrFa**. It is appropriate to reassign this zone to **LR.HLR.MusB.Sem** on the basis of the increased abundance of *Semibalanus balanoides*.

In 2016 the supralittoral cave walls were characterised by high abundances of *Hildenbrandia* sp. (**LR.FLR.CvOv.VmucHil**). This pattern was essentially identical to that recorded in 2008.

Overall, there was no evidence of any significant change to the physical structure of the cave. Apart from the increase in the abundance of *Semibalanus balanoides* in the intertidal zone the biota was essentially indistinguishable from that recorded in 2008.

4. DISCUSSION

Site condition monitoring of reef and sea cave features should consider assessment of the attributes of the feature listed in Table 1, of which three are mandatory for all monitored sites. The full suite of attributes specific to Mousa SAC are presented in the Site Attribute Tables (reproduced in Annex 5).

Following monitoring of the feature, its condition is assessed by assignment to one of seven categories (SNH, 2010):

- Favourable Maintained – the attribute targets set for the natural features have been met, and the natural feature is likely to be secure on the site under present conditions.
- Favourable Recovered – the condition of the natural feature has recovered from a previous unfavourable condition, and attribute targets are now being met.
- Unfavourable Recovering – one or more of the attribute targets have not been met on the site, but management measures are in place to improve the condition.
- Unfavourable No Change – one or more of the attribute targets have not been met, and recovery is unlikely under the present management or other activity on the site.
- Unfavourable Declining – one or more of the attribute targets have not been met, evidence suggests that condition will worsen unless remedial action is taken.
- Partially Destroyed – something has happened on the site which has removed part of the natural features, there is no prospect of restoring the destroyed area.
- Totally Destroyed – the natural feature is no longer present, there is no prospect of restoring it.

This section derives an assessment of condition following consideration of the degree to which the targets set for each of the measured attributes have been met. For each attribute, the targets, methods for assessment of adherence to the target, and the results of assessment are summarised in Annex 5 (Table X.1 for reefs, Table X.2 for sea caves).

4.1 Site condition monitoring of the reefs feature

4.1.1 Extent

No human activities have been identified, such as land reclamation and shoreline development, that are likely to have influenced the extent of the feature.

No significant change in the extent of reef biotopes along the relocatable reef transects was recorded between 2008 and 2016.

There was a slight reduction in the frequency of dropdown video sites exhibiting reef habitats between the 2008 baseline study (Harries *et al*., 2009) and the 2016 survey (86 in 2016 compared to 89 in 2008 of the total of 100 sites examined in both years). There was also a slight reduction in the frequency of reef records between the 2003 broadscale survey by Posford Haskoning Ltd. (2004) and the current study, with the same 30 sites including 29 reef records in 2003 and 27 in 2016. While locational differences cannot be ruled out in explaining such apparent change, it is possible that real change may have taken place at three sites in the form of a reduction in stone density and blanketing of low-profile bedrock. The level of change recorded is insufficient to imply a global change in reef extent within the SAC and in any event is consistent with natural temporal variation in hydrodynamic conditions.

4.1.2 Biotope composition

Excluding sites not re-examined in 2016, four reef biotopes recorded in 2008 were not recognised in 2016. Towards the bottom of transect XX07 zone S7 was ascribed to

CR.MCR.EcCr.FaAlCr.Adig in 2016 instead of its 2008 ascription of **IR.HIR.KFaR.FoR**, due to an apparent decrease in the cover of the red algal turf and an increase in *Alcyonium digitatum* density. However, the biotope ascriptions in both years are uncertain, as is firm evidence for the biotope change. A sub-biotope of **IR.HIR.KFaR.FoR** (**FoR.Dic**) was observed during the 2016 dropdown video survey but not in 2008. In 2016 **IR.HIR.KSed.LsacSac** replaced the closely related **IR.HIR.KSed.XKScrR** at video site D99. The rock was clearly sand-dusted in 2008 and supported an algal turf, which was not apparent in 2016; however, there remains uncertainty over the existence of a biotope change at this site. At video site D84 a temporal increase in ophiuroid abundance and decrease in *Flustra foliacea* density resulted in a biotope switch from **CR.MCR.EcCr.FaAlCr.Flu** to **CR.MCR.EcCr.FaAlCr.Bri**. At site D95 a decrease in the abundance of *Saccorhiza polyschides* resulted in a switch from **IR.HIR.KSed.Sac** to the closely related **HIR.KSed.LsacSac**. There is no reason to implicate anthropogenic factors in explaining any of the recorded biotope changes.

4.1.3 Distribution of biotopes

Several temporal differences were recorded in the sequences of biotopes along the three reef transects examined in 2008 and 2016.

In the upper infralittoral of transect XX01 an additional biotope **IR.HIR.KSed.DesFilR** was recognised in 2008 within an area of unstable cobbles and pebbles.

A temporal reduction in the cover of *Prasiola* spp. in the supralittoral of transect XX07, possibly related to decreased eutrophication by seabirds, resulted in the *Prasiola* biotope **LR.FLR.Lic.Pra** being partly replaced by **LR.FLR.Lic.Ver.Ver** in 2016. In the eulittoral a temporal increase in the density of *Mytilus edulis* and *Porphyra umbilicalis* led to a switch from **LR.HLR.MusB.Sem.Sem** to **LR.HLR.MusB.MytB**. As noted in section 4.1.2, temporal sequence changes towards the bottom of the transect included the apparent replacement of **IR.HIR.KFaR.FoR** by **CR.MCR.EcCr.FaAlCr.Adig** due to changes in algal turf and *Alcyonium digitatum* densities. Below this zone a switch from **SS.SMx.FluHyd** to **CR.HCR.XFa** reflected a perceived change in the habitat from a substrate of scattered pebbles and boulders supporting hydroid patches to sand coated bedrock and boulders supporting the hydroid turf, although evidence for the change is not conclusive.

Although *Alaria esculenta* was common in the upper infralittoral along transect XX08, the distinct *Alaria* zone (**IR.HIR.KFaR.Ala**) observed in 2008 was not present in 2016. At the bottom of the transect **SS.SMP.KSwSS** and **SS.SSA.IMuSa.AreISa** were recognised in both years, although they occurred sequentially in 2008 but more as a mosaic in 2016, possibly as a consequence of movement of the high proportion of unattached algae or due to slightly different routing of the transect.

Temporal changes in biotopes (and hence biotope distributions) were recorded at 38 of the 100 dropdown video sites sampled in both 2008 and 2016. The details are provided in Table 1.3 (Annex 1) and the causes for changed biotope ascriptions summarised in section 3.1.1. Temporal differences in camera tracking and variation in natural environmental factors such as hydrodynamism are considered most likely to be responsible for observed changes.

4.1.4 Species composition of representative or notable biotopes

The Site Attribute Table prescription is that the MNCR phase 2 and quadrat surveys should reveal no decline in biotope quality due to changes in species composition or loss of notable species along the relocatable reef transects. At the two sites where littoral quadrat surveys were carried out in 2008 and 2016, no significant temporal change in species richness was

recorded. At the three transect sites subject to phase 2 surveys in both years, no decline in species richness was observed. In fact, recorded richness values were slightly higher in 2016 at all three sites, although this measure is more susceptible to variation in methodology and effort than quadrat quantification.

The quadrat surveys revealed significant temporal changes in density, both increases and decreases, for eight taxa at site XX01 and six taxa at site XX07. The MNCR phase 2 surveys reflected some of these changes and identified several others. In particular, temporal variation in the abundance and relative dominance of kelp species appeared widespread. Other changes appeared more localised and included increases in densities of *Alcyonium digitatum* (XX07) and *Himanthalia elongata* (XX08) and decreases in red algal and *Prasiola* spp. turfs (XX07). All recorded changes are considered to be consistent with natural temporal variation. While there were many examples of taxa being recorded in only one year, bearing in mind variations in methodology, effort and worker expertise, there is no clear evidence for loss of any species.

4.2 Site condition monitoring of the sea caves feature

4.2.1 Extent of caves

No human activities have been identified, such as land reclamation and shoreline development, that are likely to have influenced the extent of the known caves.

No significant change in the physical extent of the known caves was recorded between 2008 and 2016. All five monitoring sites were scrutinised in some detail and none showed any sign of significant physical change since 2008.

It should be noted that any anthropogenic activity with potential to alter the extent of the caves is extremely unlikely to occur at this location and would be very obvious if it were conducted. There is potential for natural change in cave extent due to processes such as passage collapse or relocation of boulders and cobbles by storm events. However, such processes are of course beyond human control and beyond the scope of conservation management strategies.

4.2.2 Number of caves

No human activities have been identified, such as land reclamation and shoreline development, that are likely to have influenced the number of the known caves.

No significant change in the number of known caves was noted between 2008 and 2016. Many of the caves identified in the 2008 cave inventory were viewed and photographed from the sea in 2016 and none showed any obvious changes to the entrance area. All five monitoring sites were confirmed as present and unchanged.

Points made above in relation to the potential for change to cave extent also apply to the attribute ‘Number of caves’.

4.2.3 Biotope composition of caves

The target set by the site attribute table for this attribute was confirmation of the presence of six biotopes (**LR.FLR.CvOv.GCv**, **LR.FLR.CvOv.VmucHil**, **LR.FLR.CvOv.ScrFa**, **IR.FIR.SG.CrSpAsAn**, **IR.FIR.SG.CC.BalPom** & **IR.FIR.SG.CC.Mo**) on relocatable cross sections within CV03. All six were confirmed as present within the cave in 2016. Although some changes in the biota were noted at a number of locations these changes were not of sufficient magnitude to warrant reassignment of biotopes. The only exception was the intertidal area of cross section 1 near the cave entrance where elevated abundance of

Semibalanus balanoides warranted the reassignment of the previous **LR.FLR.CvOv.ScrFa** biotope to **LR.HLR.MusB.Sem**. This change was also apparent in the entrance areas of the other four surveyed caves and corresponding reassignment of intertidal zones of the outer caves to **LR.HLR.MusB.Sem** was conducted in all cases.

Apart from this change noted above, the biotope composition of all the surveyed caves remained unchanged with the exception of certain intertidal and supralittoral zones in CV02 where erroneous abundance estimates of *Hildenbrandia* sp. from 2008 necessitated a review of the biotopes.

4.2.4 Presence of representative or notable biotopes

The target set by the site attribute table for this attribute was confirmation of the presence of two biotopes (**IR.FIR.SG.CC.BalPom** & **IR.FIR.SG.CC.Mo**) within CV01, CV02 and CV03. These biotopes were confirmed present at their previous locations in each of the three caves.

4.2.5 Species composition of representative or notable biotopes

The target set by the site attribute table for this attribute was that the biotope **IR.FIR.SG.CrSpAsAn** within CV03 should include high abundance levels (at least 'frequent') of *Tubularia indivisa*, *Metridium dianthus* & *Corynactis viridis*.

At CV03 this biotope was present on the cave walls of all three surveyed cross sections. In 2008 *Tubularia indivisa* was only abundant at cross section 1. It was rare at cross section 2 and present at cross section 3. In 2016 it was not recorded at cross section 3 but abundances remained unchanged at the other two cross sections. In 2008 *Metridium dianthus* was common at cross sections 1 and 2 and absent at cross section 3. In 2016 its abundance was unchanged at cross sections 1 and 2 and it was recorded as present at cross section 3. In 2008 *Corynactis viridis* was recorded as common on cross section 1, superabundant on cross section 2 and absent from cross section 3. In 2016 it was not recorded on cross sections 1 and 3 but was abundant on cross section 2.

Hence the abundance levels of these three characterising species have remained high in at least some areas of the **IR.FIR.SG.CrSpAsAn** biotope within CV03.

The site attribute set an additional target of no decline in the overall number of taxa recorded. For the biotope **IR.FIR.SG.CrSpAsAn** within CV03 the total taxa recorded in 2008 was 39 and the total recorded in 2016 was 40. So no decline in the number of taxa recorded has occurred.

An assessment of total taxa recorded within each of the surveyed caves showed no decline in the three more extensive caves of CV01 (29 taxa in 2008 and 34 taxa in 2016), CV02 (26 taxa in both 2008 and 2016) and CV03 (54 taxa in 2008 and 56 taxa in 2016). Marginal declines in the total recorded taxa in the two less extensive caves of CV04 (26 taxa in 2008 and 15 taxa in 2016) and CV05 (18 taxa in 2008 and 15 taxa in 2016). This might be partly attributable to the heavily scoured nature of these two smaller caves but it should also be noted that they were only subject to a rapid assessment in 2016 as opposed to the more thorough survey conducted in 2008. Overall, there is no evidence of a decline in the number of taxa recorded in any of the surveyed caves.

Although changes in species abundances occurred in certain zones of each of the caves examined, the general composition and character of the biological communities remained recognisably similar between 2008 and 2016.

4.3 Overall condition assessment

Sources of potential human impact on the reef and sea cave features of Mousa SAC are summarised in Table 2 (section 1.3). During the course of the 2016 survey work human activities observed within the SAC included the operation of the tourist ferry to West Ham, yachting and small vessel line fishing, angling and creel fishing.

At the time of the survey there was no evidence of anthropogenic activities having caused any deterioration in the condition of the reefs or sea caves features since the establishment of site condition monitoring in 2008. Based on the available evidence it is recommended that the reefs and sea caves features should be assigned to the condition category "Favourable Maintained".

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ANNEX 1: DROPDOWN VIDEO SURVEY DATA

Table 1.1 Site details for the 2016 dropdown video survey.

Site	Date	Video code in	Video code out	Latitude start	Long-itude start	Latitude end	Long-itude end	Depth start CD (m)	Depth end CD (m)
D1	10/08/2016	00:00:04	00:03:19	60.014190	-1.187137	60.014285	-1.186513	31.3	28.4
D2	06/08/2016	00:00:03	00:03:43	60.013075	-1.184705	60.013135	-1.184637	31.1	30.5
D3.1	10/08/2016	00:00:03	00:02:09	60.012240	-1.188368	60.012183	-1.188077	32.4	
D3.2	10/08/2016	00:02:09	00:04:07	60.012183	-1.188077	60.012212	-1.187837		32.2
D4.1	10/08/2016	00:00:04	00:02:59	60.010500	-1.186500	60.010640	-1.185973	34.9	
D4.2	10/08/2016	00:02:59	00:05:20	60.010640	-1.185973	60.010728	-1.185698		35.1
D5	06/08/2016	00:00:01	00:03:38	60.008507	-1.185743	60.008917	-1.186480	8.1	15.8
D6	06/08/2016	00:00:03	00:04:16	60.007940	-1.184082	60.008013	-1.183580	14.9	17.6
D7	06/08/2016	00:00:03	00:05:00	60.010312	-1.183315	60.010600	-1.182898	32.9	28.6
D8	10/08/2016	00:00:03	00:05:09	60.011437	-1.181077	60.011533	-1.179922	33.5	34.9
D9	05/08/2016	00:00:02	00:02:43	60.008763	-1.179292	60.008675	-1.179178	37.7	38.1
D10	06/08/2016	00:00:01	00:03:07	60.006982	-1.180845	60.007188	-1.181467	17.0	17.2
D12	05/08/2016	00:00:03	00:02:41	60.005368	-1.178535	60.005372	-1.178415	9.9	8.6
D13	06/08/2016	00:00:02	00:03:10	60.006010	-1.175705	60.006268	-1.175962	39.7	40.7
D14.1	06/08/2016	00:00:03	00:01:02	60.004718	-1.174720	60.004847	-1.174692	15.6	
D14.2	06/08/2016	00:01:02	00:01:46	60.004847	-1.174692	60.004932	-1.174683		19.9
D15	05/08/2016	00:00:24	00:03:02	60.004202	-1.175378	60.004040	-1.175187	11.4	14.7
D16	05/08/2016	00:00:07	00:03:25	60.004263	-1.173387	60.004127	-1.172917	24.8	23.1
D19	10/08/2016	00:00:05	00:04:29	60.004292	-1.168103	60.003915	-1.166602	45.6	46.6
D20	05/08/2016	00:00:03	00:01:59	60.002498	-1.168855	60.002433	-1.168498	27.2	29.2
D21	10/08/2016	00:00:05	00:05:41	60.002283	-1.165907	60.002058	-1.164712	44.8	47.3
D22	06/08/2016	00:00:03	00:03:01	60.000832	-1.167258	60.001148	-1.167317	17.5	20.4
D23	05/08/2016	00:00:04	00:01:43	60.000888	-1.165183	60.000753	-1.164762	41.9	40.7
D24	06/08/2016	00:00:02	00:03:44	59.999595	-1.164667	59.999907	-1.165118	15.2	21.1
D25	05/08/2016	00:00:05	00:02:32	59.999817	-1.162148	59.999760	-1.161442	36.7	37.1
D27	05/08/2016	00:00:03	00:02:30	59.998362	-1.161227	59.998417	-1.160802	15.0	18.0
D28	10/08/2016	00:00:03	00:04:45	59.998987	-1.159945	59.998848	-1.158845	28.0	26.4
D29	10/08/2016	00:00:03	00:02:54	60.000117	-1.156982	60.000043	-1.156142	43.9	43.9
D30	05/08/2016	00:00:03	00:01:56	60.002163	-1.156172	60.001940	-1.155527	52.4	53.0
D31	05/08/2016	00:00:03	00:01:54	59.999442	-1.153927	59.999218	-1.153297	39.9	38.1
D32	05/08/2016	00:00:03	00:01:50	59.999088	-1.149345	59.998527	-1.148477	43.0	45.8
D34	05/08/2016	00:00:03	00:01:32	59.998353	-1.153930	59.998157	-1.153250	20.1	22.8
D35	06/08/2016	00:00:02	00:03:47	59.998123	-1.156068	59.998267	-1.156947	10.7	14.2
D36	10/08/2016	00:00:03	00:01:35	59.997758	-1.153695	59.997737	-1.153478	10.5	12.7
D37	05/08/2016	00:00:04	00:00:55	59.996452	-1.154887	59.996378	-1.154728	15.9	18.5
D38	10/08/2016	00:00:04	00:02:19	59.996022	-1.155615	59.995828	-1.155258	13.2	15.8
D39.1	05/08/2016	00:00:03	00:00:31	59.996238	-1.151218	59.996128	-1.151013	35.0	
D39.2	05/08/2016	00:00:31	00:01:30	59.996128	-1.151013	59.995938	-1.150655		34.5
D40	05/08/2016	00:00:06	00:02:00	59.996873	-1.147357	59.996187	-1.146483	47.3	49.0
D42.1	05/08/2016	00:00:07	00:01:53	59.996020	-1.144128	59.995472	-1.143662	53.4	
D42.2	05/08/2016	00:01:53	00:02:21	59.995472	-1.143662	59.995342	-1.143587		65.6
D43	10/08/2016	00:00:04	00:03:18	59.995838	-1.140575	59.995997	-1.139922	65.7	63.7
D44	05/08/2016	00:00:04	00:02:23	59.994738	-1.137190	59.994458	-1.137297	66.7	68.5
D45	05/08/2016	00:00:03	00:02:21	59.993773	-1.144817	59.992935	-1.144350	69.9	71.3

Table 1.1 continued

Site	Date	Video code in	Video code out	Latitude start	Long-itude start	Latitude end	Long-itude end	Depth start CD (m)	Depth end CD (m)
D46	10/08/2016	00:00:03	00:03:01	59.994702	-1.148368	59.994905	-1.147517	45.3	45.7
D48	05/08/2016	00:00:03	00:02:47	59.995238	-1.156812	59.995130	-1.156505	9.0	7.2
D49	10/08/2016	00:00:03	00:02:43	59.994010	-1.156980	59.993812	-1.156668	12.5	14.8
D50.1	10/08/2016	00:00:02	00:01:05	59.994587	-1.155388	59.994550	-1.155138	18.7	
D50.2	10/08/2016	00:01:05	00:01:58	59.994550	-1.155138	59.994557	-1.154890		
D50.3	10/08/2016	00:01:58	00:02:53	59.994557	-1.154890	59.994580	-1.154633		
D50.4	10/08/2016	00:02:53	00:03:33	59.994580	-1.154633	59.994573	-1.154400		27.8
D51	05/08/2016	00:00:03	00:01:36	59.993677	-1.152493	59.993587	-1.152077	42.9	45.2
D52	10/08/2016	00:00:04	00:03:50	59.993252	-1.148917	59.993377	-1.147902	56.4	58.9
D53	10/08/2016	00:00:03	00:04:31	59.991802	-1.145478	59.991832	-1.144835	71.0	72.4
D54	05/08/2016	00:00:05	00:01:50	59.992060	-1.150478	59.991900	-1.150038	46.8	48.6
D55	10/08/2016	00:00:05	00:03:03	59.990548	-1.153277	59.990648	-1.152183	37.6	45.7
D57	05/08/2016	00:00:02	00:01:13	59.993103	-1.157260	59.993093	-1.157113	10.2	10.0
D59.1	10/08/2016	00:00:04	00:01:47	59.992285	-1.158218	59.992195	-1.157688	20.5	
D59.2	10/08/2016	00:01:47	00:03:16	59.992195	-1.157688	59.992180	-1.157205		26.2
D60	05/08/2016	00:00:04	00:01:35	59.990427	-1.157552	59.990403	-1.157482	32.9	32.4
D61	05/08/2016	00:00:04	00:01:31	59.989063	-1.157312	59.989008	-1.157200	36.4	36.4
D63.1	10/08/2016	00:00:05	00:02:21	59.991083	-1.162275	59.991007	-1.161470	20.2	
D63.2	10/08/2016	00:02:21	00:02:57	59.991007	-1.161470	59.990993	-1.161262		22.4
D64	05/08/2016	00:00:04	00:02:31	59.992060	-1.161458	59.992047	-1.161547	4.8	6.0
D65.1	10/08/2016	00:00:05	00:00:49	59.991372	-1.163963	59.991322	-1.163923	7.0	
D65.2	10/08/2016	00:00:49	00:01:41	59.991322	-1.163923	59.991322	-1.163937		
D65.3	10/08/2016	00:01:41	00:02:48	59.991322	-1.163937	59.991232	-1.163848		8.9
D66	05/08/2016	00:00:04	00:03:29	59.990715	-1.166492	59.990645	-1.166367	14.3	15.9
D67.1	10/08/2016	00:00:04	00:02:07	59.990375	-1.164887	59.990150	-1.164540	19.0	
D67.2	10/08/2016	00:02:07	00:02:47	59.990150	-1.164540	59.990062	-1.164640		24.1
D68	10/08/2016	00:00:02	00:03:58	59.989440	-1.164450	59.989313	-1.163393	31.7	33.5
D69	05/08/2016	00:00:04	00:01:48	59.988517	-1.162617	59.988200	-1.162667	39.0	35.3
D71	05/08/2016	00:00:03	00:02:50	59.986000	-1.169000	59.985783	-1.168767	48.0	48.7
D72	06/08/2016	00:00:03	00:02:58	59.988332	-1.169360	59.988592	-1.168980	32.6	33.0
D73	10/08/2016	00:00:04	00:03:40	59.989697	-1.168483	59.989663	-1.167742	24.5	25.6
D74.1	05/08/2016	00:00:04	00:01:19	59.988405	-1.172593	59.988315	-1.172643	21.8	
D74.2	05/08/2016	00:01:19	00:02:34	59.988315	-1.172643	59.988243	-1.172582		22.7
D75.1	06/08/2016	00:00:02	00:01:50	59.986802	-1.173637	59.986908	-1.173490	37.3	
D75.2	06/08/2016	00:01:50	00:03:58	59.986908	-1.173490	59.986990	-1.173375		35.8
D77	05/08/2016	00:00:03	00:03:25	59.984443	-1.177713	59.984025	-1.177468	45.4	46.8
D78	04/08/2016	00:00:03	00:01:28	59.986307	-1.175848	59.986115	-1.176092	33.6	33.9
D80.1	06/08/2016	00:00:04	00:00:39	59.989173	-1.176328	59.989227	-1.176252	21.7	
D80.2	06/08/2016	00:00:39	00:01:38	59.989227	-1.176252	59.989305	-1.176092		
D80.3	06/08/2016	00:01:38	00:02:14	59.989305	-1.176092	59.989342	-1.175998		15.7
D81	05/08/2016	00:00:04	00:01:22	59.991452	-1.179550	59.991372	-1.179203	13.9	11.2
D82	06/08/2016	00:00:03	00:01:54	59.989532	-1.178612	59.989585	-1.178192	34.4	32.6
D83	05/08/2016	00:00:04	00:02:38	59.987367	-1.179348	59.986983	-1.179227	37.6	36.1
D84	06/08/2016	00:00:03	00:06:56	59.985667	-1.181005	59.985180	-1.179897	45.5	46.2
D85	05/08/2016	00:00:03	00:02:41	59.989055	-1.181632	59.988490	-1.180397	44.8	42.5
D86	06/08/2016	00:00:05	00:03:43	59.990053	-1.184090	59.989705	-1.183533	44.4	45.1
D88	05/08/2016	00:00:05	00:02:13	59.992295	-1.182798	59.992000	-1.181842	18.0	17.1

Table 1.1 continued

Site	Date	Video code in	Video code out	Latitude start	Long-itude start	Latitude end	Long-itude end	Depth start CD (m)	Depth end CD (m)
D89.1	06/08/2016	00:00:03	00:00:45	59.991782	-1.187377	59.991765	-1.187352	39.1	
D89.2	06/08/2016	00:00:45	00:08:02	59.991765	-1.187352	59.991578	-1.187113		39.4
D91	06/08/2016	00:00:04	00:04:39	59.993505	-1.185043	59.993145	-1.184667	18.2	19.1
D92	05/08/2016	00:00:03	00:03:18	59.994520	-1.183805	59.994440	-1.183508	6.4	6.0
D93	06/08/2016	00:00:08	00:03:20	59.994260	-1.187422	59.994080	-1.186873	26.7	24.4
D94	06/08/2016	00:00:08	00:03:06	59.995133	-1.185183	59.995200	-1.184950	13.9	12.8
D95	06/08/2016	00:00:03	00:02:56	59.995553	-1.184968	59.995783	-1.184763	14.2	13.7
D96	05/08/2016	00:00:03	00:02:41	59.996617	-1.183500	59.996522	-1.183460	8.2	8.0
D97	06/08/2016	00:00:05	00:01:45	59.996430	-1.186590	59.996667	-1.186435	24.6	24.6
D98	06/08/2016	00:00:03	00:02:37	59.999000	-1.186960	59.999520	-1.187475	23.3	23.9
D99	05/08/2016	00:00:03	00:02:58	60.000275	-1.186502	60.000037	-1.186557	12.1	12.4
D100	06/08/2016	00:00:02	00:01:35	60.001402	-1.187395	60.001535	-1.187315	7.7	6.7
D101	06/08/2016	00:00:03	00:03:06	60.001040	-1.191840	60.001138	-1.190942	22.4	17.1
D103.1	10/08/2016	00:00:05	00:04:02	60.001062	-1.195558	60.001147	-1.194813	29.4	
D103.2	10/08/2016	00:04:02	00:06:17	60.001147	-1.194813	60.001133	-1.194318		27.8
D104	06/08/2016	00:00:03	00:03:20	60.002128	-1.198237	60.002450	-1.198258	28.0	27.7
D105	06/08/2016	00:00:02	00:04:57	60.002567	-1.193673	60.002627	-1.193598	9.5	7.2
D106	05/08/2016	00:00:04	00:03:14	60.003988	-1.194915	60.003840	-1.194720	13.3	11.8
D108	05/08/2016	00:00:03	00:01:39	60.006283	-1.193447	60.006302	-1.193448	7.2	7.4
D109.1	10/08/2016	00:00:04	00:01:38	60.006417	-1.202003	60.006557	-1.201635	26.8	
D109.2	10/08/2016	00:01:38	00:02:09	60.006557	-1.201635	60.006583	-1.201540		28.2
D110	06/08/2016	00:00:02	00:02:01	60.009128	-1.202693	60.009822	-1.202488	25.0	26.7
D111	10/08/2016	00:00:03	00:04:24	60.008352	-1.199327	60.008568	-1.198323	23.6	23.3
D112	06/08/2016	00:00:03	00:02:38	60.007890	-1.194793	60.007848	-1.194530	16.7	15.4
D115	06/08/2016	00:00:03	00:03:04	60.010385	-1.197863	60.010617	-1.197167	29.7	29.5
D116	10/08/2016	00:00:03	00:06:59	60.010800	-1.194260	60.010477	-1.194070	34.5	32.1
D118	05/08/2016	00:00:03	00:02:45	60.008900	-1.189733	60.008833	-1.189700	7.1	5.4
D119	06/08/2016	00:00:03	00:04:34	60.010692	-1.190465	60.010852	-1.190505	35.0	35.1
D120	06/08/2016	00:00:02	00:04:50	60.012583	-1.191125	60.012690	-1.191123	36.8	36.9
D121	10/08/2016	00:00:02	00:05:00	60.013685	-1.194437	60.013883	-1.193797	40.0	41.6
D122	05/08/2016	00:00:02	00:03:28	60.013488	-1.177035	60.013232	-1.177058	42.0	38.1
D123	10/08/2016	00:00:03	00:03:33	60.012475	-1.169372	60.012423	-1.168570	51.8	52.9
D124	10/08/2016	00:00:03	00:03:14	60.010030	-1.175500	60.009810	-1.174898	41.8	41.8
D125	05/08/2016	00:00:02	00:03:08	60.007633	-1.173488	60.007368	-1.173100	42.7	42.9
D126	10/08/2016	00:00:04	00:03:37	60.005952	-1.168873	60.005653	-1.167862	45.9	46.6
D127	05/08/2016	00:00:03	00:02:32	60.009272	-1.167228	60.008960	-1.167052	49.7	47.7
D128	10/08/2016	00:00:04	00:04:34	60.010508	-1.161157	60.010465	-1.160765	59.4	59.7
D129	10/08/2016	00:00:05	00:04:26	60.007402	-1.159758	60.007295	-1.159278	56.0	57.2
D130	05/08/2016	00:00:03	00:01:56	60.008332	-1.152407	60.008145	-1.151933	66.4	67.1
D131	05/08/2016	00:00:05	00:03:53	60.005767	-1.148212	60.005575	-1.146972	66.3	67.3
D132	10/08/2016	00:00:04	00:03:49	60.004872	-1.156213	60.004962	-1.155863	57.7	57.3
D133	05/08/2016	00:00:03	00:02:12	60.004578	-1.163485	60.004382	-1.162993	48.3	49.7
D134	10/08/2016	00:00:04	00:03:22	60.002137	-1.160157	60.002072	-1.158830	48.8	49.5
D135.1	05/08/2016	00:00:03	00:01:21	59.978210	-1.181332	59.977758	-1.180820	58.7	
D135.2	05/08/2016	00:01:21	00:02:10	59.977758	-1.180820	59.977552	-1.180597		59.9
D136	05/08/2016	00:00:03	00:04:02	59.980630	-1.189865	59.980385	-1.189418	47.8	47.8
D137	05/08/2016	00:00:02	00:04:22	59.982402	-1.184205	59.981228	-1.183052	50.4	52.5

Table 1.1 continued

Site	Date	Video code in	Video code out	Latitude start	Long-itude start	Latitude end	Long-itude end	Depth start CD (m)	Depth end CD (m)
D138	06/08/2016	00:00:02	00:03:39	59.983575	-1.190925	59.983187	-1.191010	44.0	44.4
D139	05/08/2016	00:00:04	00:04:35	59.986215	-1.186303	59.985705	-1.185053	45.1	45.8
D140	05/08/2016	00:00:04	00:03:30	59.987233	-1.193023	59.987220	-1.191675	37.6	38.3
D141	05/08/2016	00:00:04	00:03:32	59.989248	-1.188157	59.989337	-1.186933	40.1	41.7
D142	06/08/2016	00:00:04	00:03:35	59.992577	-1.192553	59.992830	-1.192222	35.7	35.3
D143	06/08/2016	00:00:03	00:05:19	59.995683	-1.189740	59.995877	-1.189128	30.1	30.5
D144	06/08/2016	00:00:03	00:03:11	59.995333	-1.196973	59.994945	-1.196205	35.9	35.9
D145	06/08/2016	00:00:03	00:03:13	59.998448	-1.192665	59.998515	-1.192360	27.3	27.3
D146	06/08/2016	00:00:04	00:04:28	59.998283	-1.199875	59.998752	-1.199387	37.3	37.7
D147	10/08/2016	00:00:03	00:03:28	60.000647	-1.201030	60.000842	-1.200670	36.5	36.0
D148	10/08/2016	00:00:03	00:08:06	60.004158	-1.200755	60.004537	-1.199723	33.2	31.7
D149	06/08/2016	00:00:03	00:03:51	60.005903	-1.197212	60.006035	-1.196725	26.4	24.8
D150.1	06/08/2016	00:00:04	00:03:35	60.004962	-1.205100	60.005597	-1.204862	27.5	
D150.2	06/08/2016	00:03:35	00:05:31	60.005597	-1.204862	60.005908	-1.204715		27.3
D151	06/08/2016	00:00:04	00:02:04	60.007267	-1.208792	60.007750	-1.208670	23.9	24.2

Table 1.2 Substrates, biota, biotopes and classification of dropdown video sites according to presence of reef habitat (reef, non-reef or mixed reef and sediment), sandeel habitat and calcium carbonate rich sediment. Italicized biotopes are uncertain.

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D1	Boulders with cobbles and coarse sand and shell gravel infill	Rock encrusted with *Spirobranchus* spp. (A), pink coralline algae (C), brown algae (F), red algae (P) and *Parasmittina trispinosa* (F) and supporting hydroids (F) including *Kirchenpaueria pinnata*? and *Halecium* sp.?. Clumps of *Modiolus modiolus* (C locally), *Ophiocomina nigra* on surface of stones in some areas (locally A) and ophiuroids at base of stones (locally A) including *Ophiocomina nigra*, *Ophiothrix fragilis*? and *Ophiopholis aculeata*?. *Echinus esculentus* (C), small teleosts (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Bri CR.MCR.EcCr.FaAlCr.Pom
D2	Bedrock and boulders with coarse sand and gravel infill	Rock encrusted with *Spirobranchus* spp. (C, locally A), *Parasmittina trispinosa* (O, locally F), pink coralline algae (A) and red algae (P) and supporting sparse clumps of hydroids (R). *Urticina* sp. (R), *Cancer pagurus* (P), *Luidia ciliaris* (P), *Ophiocomina nigra* (R), *Echinus esculentus* (C).	reef	no	no	CR.MCR.EcCr.FaAlCr.Pom
D3.1	Bedrock, boulders and cobbles with coarse sand and shell gravel infill	Rock encrusted with *Spirobranchus* spp. (A), pink coralline algae (C), brown algae (P), red algae (P) and *Parasmittina trispinosa* (F) and supporting *Alcyonium digitatum* (O) and hydroids (P). Clumps of *Modiolus modiolus* (A locally), ophiuroids on surface and at base of stones (A) including *Ophiocomina nigra*, *Ophiothrix fragilis* and *Ophiopholis aculeata*. *Crossaster papposus* (P) *Luidia ciliaris* (P), *Echinus esculentus* (F), small teleosts (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Bri
D3.2	Bedrock, boulders and cobbles with coarse sand and shell gravel infill	Rock encrusted with *Spirobranchus* spp. (A), pink coralline algae (C), brown algae (P), red algae (P) and *Parasmittina trispinosa* (F) and supporting *Alcyonium digitatum* (O). Clumps of *Modiolus modiolus* (A locally), ophiuroids (F, locally C) including *Ophiocomina nigra*. *Echinus esculentus* (C).	reef	no	no	CR.MCR.EcCr.FaAlCr.Pom

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D4.1	Megaripples of shell gravel and coarse sand with scattered shells including *Ensis*	*Echinus esculentus* (P).	non-reef	yes	yes	SS.SCS.CCS
D4.2	Boulders, cobbles and some pebbles with infill of coarse sand and shell gravel	Rock encrusted with *Spirobranchus* spp. (A), pink coralline algae (C), brown algae (P) and *Parasmittina trispinosa* (O) and supporting hydroids (F). *Modiolus modiolus* (C locally), ophiuroids at base of stones (locally C) including *Ophiocomina nigra* and *Ophiothrix fragilis*?. *Asterias rubens* (P), *Echinus esculentus* (C), small teleosts (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Pom
D5	Steep, stepped, bedrock slope	Rock encrusted with brown algae (A), pink coralline algae (P) and *Spirobranchus* spp. (locally A), with mixed kelp forest and park in shallower waters dominated by *Saccharina latissima* (F-A), with small *Laminaria hyperborea?* (R-F) and *Alaria esculenta* (P); foliose red algae (R). Dense patches of *Alcyonium digitatum* (locally S) on more vertical faces in shallower waters and both on upward-facing and vertical faces in deeper water mosaicked with patches of encrusting biota. *Echinus esculentus* (C), teleost spp. (P).	reef	no	no	*IR.HIR.KSed.LsacSac* *CR.MCR.EcCr.FaAlCr.Adig* *CR.MCR.EcCr.FaAlCr.Pom*
D6	Boulders and cobbles and possibly bedrock outcrops, with small pockets of coarse sediment	*Saccharina latissima* forest (A) with fronds supporting *Membranipora membranacea* (P) and stipes *Gibbula cineraria*? (P); rock encrusted with serpulid worms (P) and pink (P) and brown algae (P). *Echinus esculentus* (P), *Alaria esculenta* (P), small teleosts including Gadidae sp. (P).	reef	no	no	*IR.HIR.KSed.LsacSac*

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D7	Bedrock and boulders	Rock encrusted with *Spirobranchus* spp. (A), *Parasmittina trispinosa* (F, locally C) and pink coralline (A), brown (O) and red (R) algae and supporting sparse hydroid patches (R) including *Nemertesia antennina*, and *Caryophyllia smithii* (R). *Asterias rubens* (P), *Echinus esculentus* (C), small teleosts (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Pom
D8	Sloping bedrock steps and boulders and areas of coarse sand with shell gravel	Rock encrusted with *Spirobranchus* spp. (A), pink coralline algae (A), brown algae (P), *Balanus* sp. (P) and *Parasmittina trispinosa* (F) and supporting sparse *Alcyonium digitatum* (O) and hydroids (O) including a short, thin turf (P) and *Nemertesia antennina*? (P), and *Alcyonidium diaphanum* (P); *Echinus esculentus* (C), small teleosts (P). No biota observed on sediment.	mixed	yes	yes	CR.MCR.EcCr.FaAlCr.Pom SS.SCS.CCS
D9	Megaripples of shell gravel, coarse sand and shells including *Ensis*	Pectiniidae sp. (P), *Asterias rubens* (P).	non-reef	yes	yes	SS.SCS.CCS
D10	Boulders with some cobbles and pebbles and small pockets of coarse sand/shell gravel	Rock encrusted with brown (A), pink (C) and red (P) algal crusts and *Spirobranchus* spp. (locally A). Scattered plants of *Saccharina latissima* (F), *Saccorhiza polyschides* (R), *Alaria esculenta* (O), *Desmarestia aculeata* (R) and foliose red algae (R). *Echinus esculentus* (C), Ophiuroidea sp. (R), small teleosts (P).	reef	no	no	IR.HIR.KSed.LsacSac
D12	Bedrock and boulders with areas of cobbles and pebbles	Dense *Laminaria hyperborea* forest (A) with stipes supporting red algae and fronds *Membranipora membranacea* (O). Understorey of foliose red algae (A) including *Callophyllis laciniata* (P), as well as *Dictyota dichotoma* (P). Patches of *Saccharina latissima* (C) with *Desmarestia aculeata* (P) and *Alaria esculenta* (P), possibly in more disturbed areas. Cottidae sp. (P), *Echinus esculentus* (O), filamentous red algae (P).	reef	no	no	*IR.MIR.KR.Lhyp.Ft* *IR.HIR.KSed*

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D13	Mostly boulders with some cobbles and pebbles and small pockets of coarse sediment	Rock encrusted with pink (C) and red (P) algal crusts, *Spirobranchus* spp. (A) and *Parasmittina trispinosa* (F). *Caryophyllia smithii* (P), *Echinus esculentus* (F), *Ophiocomina nigra* (small patches where A), *Ophiopholis aculeata*? (A locally in crevices), small teleosts (P).	reef	no	no	*CR.MCR.EcCr.FaAlCr.Pom*
D14.1	Bedrock	Mixed kelp forest of *Saccharina latissima* (C-A) and *Saccorhiza polyschides* (F-C), with *Desmarestia aculeata* (F); kelp fronds with *Membranipora membranacea* and *Obelia geniculata*. Rock encrusted with pink, red and brown algae and supporting an apparently fairly sparse understorey of foliose red algae (P). *Echinus esculentus* (P)	reef	no	no	IR.HIR.KSed.LsacSac
D14.2	Near-vertical bedrock slope with platforms	Rock encrusted with pink (A) and brown (F) algal crusts and *Spirobranchus* spp. (C-A) and supporting scattered *Alcyonium digitatum* (R, locally A) and hydroids (P). *Echinus esculentus* (C).	reef	no	no	CR.MCR.EcCr.FaAlCr.Pom
D15	Bedrock and boulders	Mixed kelp forest of *Laminaria hyperborea* (C, locally A) and *Saccharina latissima* (C, locally A). Apparently sparse understorey of foliose reds including *Cryptopleura ramosa* (R, but C locally), *Dictyota dichotoma* (P) and *Desmarestia aculeata* (P). Rock encrusted with brown and pink coralline algae (P). *Membranipora membranacea* (O), *Echinus esculentus* (P).	reef	no	no	*IR.HIR.KSed.LsacSac*
D16	Boulders and cobbles with coarse sand infill	Stones encrusted with pink coralline (C), red (P) and brown (F) algae, as well as *Spirobranchus* spp. (A) and *Parasmittina trispinosa* (O). *Luidia ciliaris*? (P), *Echinus esculentus* (C), solitary Ascidiacea spp. (R), shoal of juvenile teleosts (P). *Ophiothrix fragilis*? initially A in a small patch but R overall.	reef	no	no	CR.MCR.EcCr.FaAlCr.Pom

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D19	Megaripples of coarse sand and shell gravel with stone gravel and pebbles in troughs and areas of around 50% cover of stone gravel, pebbles and occasional cobbles on coarse sediment	Stones sparsely encrusted with serpulid worms (P). *Luidia ciliaris*? (P), *Ophiocomina nigra* (O), *Scyliorhinus* sp.? (P)	non-reef	yes	yes	SS.SCS.CCS *SS.SCS.CCS.PomB*
D20	Boulder field with shell gravel and coarse sand infill	Stones encrusted with pink coralline algae (A) red algae (R) and *Spirobranchus* spp. (C) and supporting sparse *Alcyonium digitatum* (R). *Echinus esculentus* (C), shoal of juvenile teleosts (P). *Ophiocomina nigra* (A-S) on stone upper surfaces and *Ophiothrix fragilis* (A) predominantly in interstices.	reef	no	no	CR.MCR.EcCr.FaAlCr.Bri
D21	Around 80% cover of pebbles, cobbles and shells, including *Modiolus*, on coarse sand	Stones encrusted with serpulid worms (A) and pink algae (O) and supporting *Alcyonidium diaphanum* (C locally), *Clavelina lepadiformis* (O) and sparse hydroids (R) and *Alcyonium digitatum* (R). *Ophiocomina nigra* (locally A), *Luidia ciliaris* (P), *Echinus esculentus* (O).	non-reef	no	no	*SS.SCS.CCS.PomB*
D22	Boulders	Rock encrusted with pink (F), red (P) and brown (A) algal crusts and *Spirobranchus* spp. (A locally) and supporting very sparse *Saccharina latissima* (R) and *Desmarestia aculeata* (R). Caridea sp. (P), *Asterias rubens*? (P), *Ophiocomina nigra* (R), *Ophiothrix fragilis*? (P in crevices), *Echinus esculentus* (C), small teleosts (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Pom

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D23	Pebbles, cobbles and occasional boulders on coarse sand	Stones encrusted with pink coralline algae (F) red algae (R) and *Spirobranchus* spp. (C). *Echinus esculentus* (C), juvenile teleosts (P). *Ophiocomina nigra* (A), *Ophiothrix fragilis* (A, locally S).	non-reef	no	no	SS.SMX.CMx.OphMx
D24	Bedrock and boulders and cobbles with coarse sand infill	Rock encrusted with pink (C), red (P) and brown (A) algal crusts and *Spirobranchus* spp. (C, A locally) and supporting patches of dense *Alcyonium digitatum* (locally A). *Gibbula* sp. (P), *Asterias rubens* (R), *Marthasterias glacialis* (P), *Luidia ciliaris* (P), *Ophiura* sp. (P), *Echinus esculentus* (C, locally A), small teleosts (P), shoal of gadoids.	reef	no	no	CR.MCR.EcCr.FaAlCr.Pom CR.MCR.EcCr.FaAlCr.Adig
D25	Pebbles and cobbles on coarse sand with areas of bedrock and boulders	Rock encrusted with pink coralline algae (O, locally C) red algae (O, locally C), *Parasmittina trispinosa* (R) and *Spirobranchus* spp. (C) and supporting *Alcyonium digitatum* (R, locally F). *Echinus esculentus* (C), *Ophiocomina nigra* (A), *Ophiothrix fragilis* (A, locally S), *Ophiopholis aculeata* (P), *Luidia ciliaris* (O), Pleuronectiformes sp. (P).	reef	no	no	SS.SMX.CMx.OphMx CR.MCR.EcCr.FaAlCr.Bri
D27	Bedrock with patches of boulders and cobbles	Rock encrusted with pink coralline algae (O) red algae (P) and *Aglaozonia* (*Cutleria multifida*) and supporting forest and park of mixed kelps dominated by *Saccharina latissima* (C, locally A) and including *Saccorhiza polyschides* (P), *Alaria esculenta* (P) and *Laminaria hyperborea*? (P). Sparse algal understorey including *Dictyota dichotoma* (P) and *Desmarestia aculeata* (P). *Gibbula* sp. (P), *Echinus esculentus* (C), apparently small patches of dense *Ophiocomina nigra* (locally A), *Ophiothrix fragilis* (R).	reef	no	no	IR.HIR.KSed.LsacSac

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D28	Around 70% cover of pebbles, cobbles and occasional boulders on coarse sand	Stones encrusted with serpulid worms (C) and brown (F) and pink (F) algae and supporting scattered *Alcyonium digitatum* (O, locally F). *Ophiothrix fragilis* (S, locally C), *Ophiocomina nigra* (locally A), *Asterias rubens* (P), *Luidia ciliaris* (O), *Echinus esculentus* (F, locally C)	non-reef	no	no	SS.SMx.CMx.OphMx
D29	Around 80% cover of pebbles, cobbles and occasional boulders on coarse sand	Stones encrusted with serpulid worms (A), *Balanus* sp. (P) and pink algae (O) and supporting scattered *Alcyonium digitatum* (F) and hydroids (R). Ophiuroids (A) including *Ophiothrix fragilis* (P), *Ophiocomina nigra* (locally A), *Ophiura* sp. (P) and *Ophiopholis aculeata*? (P), mostly at base of stones. *Lanice conchilega* (R), *Asterias rubens?* (P), *Luidia ciliaris* (P), *Echinus esculentus* (F).	non-reef	no	no	SS.SMx.CMx.OphMx
D30	Megaripples of shell gravel and coarse sand with scattered pebbles and shells, especially in troughs	*Chaetopterus variopedatus*? (P).	non-reef	yes	yes	SS.SCS.CCS
D31	Bedrock, boulders and cobbles with patches of coarse sand	Rock densely encrusted with *Spirobranchus* spp. (S) and pink coralline algae (C) and supporting *Alcyonium digitatum* (A) and hydroid patches (F). *Echinus esculentus* (C).	mixed	yes	unknown	CR.MCR.EcCr.FaAlCr.Adig SS.SCS.CCS
D32	Bedrock with some boulders and small pockets of coarse sand/shell gravel	Rock encrusted with pink encrusting algae (O) and *Spirobranchus* spp. (A) and supporting dense *Alcyonium digitatum* (S). *Echinus esculentus* (C).	reef	no	no	CR.MCR.EcCr.FaAlCr.Adig
D34	Bedrock and boulders	Rock densely encrusted with brown algae (S) and *Spirobranchus* spp. (A) and with pink coralline algae (R) and supporting patches of *Alcyonium digitatum* (R, locally C). *Echinus esculentus* (A), juvenile gadoids (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Pom

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D35	Bedrock with patches of boulders and pebbles, possibly in gullies	Rock encrusted with pink coralline (C) and red algae (P) and supporting dense forest of *Laminaria hyperborea* (A) with some *Saccorhiza polyschides* (P). Stipes heavily epiphytised with red algae and fronds with *Membranipora membranacea* and *Obelia geniculata*. Algal understorey apparently very patchy, varying from sparse to moderately well-developed. Small patches of *Alaria esculenta* (locally C), *Saccharina latissima* (locally A) and *Desmarestia aculeata* (P) possibly related to vicinity of stony patches. *Alcyonium digitatum* (P), *Echinus esculentus* (C locally), *Asterias rubens* (P).	reef	no	no	*IR.MIR.KR.Lhyp.Ft* *IR.HIR.KSed.LsacSac*
D36	Bedrock	Mixed kelp forest of *Laminaria hyperborea* (A), *Saccharina latissima* (locally A) and *Alaria esculenta* (P). Rock encrusted with pink coralline, brown and red algae and supporting patchy foliose red algal turf (F), *Desmarestia aculeata*, Balanidae spp. (P) and patches of *Alcyonium digitatum* on verticals (overall O). *Membranipora membranacea* (P), small *Asterias rubens* (locally C), *Echinus esculentus* (P).	reef	no	no	*IR.HIR.KSed.LsacSac*
D37	Bedrock	Forest of small *Saccharina latissima*, with *Saccorhiza polyschides*? (O) and sparse understorey of foliose red algae (R) and *Desmarestia aculeata* (R); encrusting brown algae (A) and pink coralline algae (O). *Gibbula* sp. (P), *Echinus esculentus* (P).	reef	no	no	*IR.HIR.KSed.LsacSac*
D38	Bedrock with gullies of boulders and cobbles	*Laminaria hyperborea* forest (A) supporting *Membranipora membranacea* (P), with rock encrusted with pink and brown algae and apparently with sparse algal understorey. Patches of hydroids or possibly crinoids (O). Areas, probably more disturbed, where kelp cover reduced and includes *Saccharina latissima*, as well as *Desmarestia aculeata*. *Echinus esculentus* (C).	reef	no	no	*IR.MIR.KR.Lhyp.GzFt* *IR.HIR.KSed.LsacSac*

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D39.1	Bedrock	Rock encrusted with *Spirobranchus* spp. (A) and supporting dense *Alcyonium digitatum* (S). *Crossaster papposus* (P), *Ophiocomina nigra* (C locally).	reef	no	no	CR.MCR.EcCr.FaAlCr.Adig
D39.2	Bedrock	Rock encrusted with pink encrusting algae (P), brown algae (P) and *Spirobranchus* spp. (A) and supporting dense *Alcyonium digitatum* (S). *Echinus esculentus* (F).	reef	no	no	CR.MCR.EcCr.FaAlCr.Bri
D40	Bedrock with channels of coarse sand	Rock encrusted with *Spirobranchus* spp. (A) and supporting dense *Alcyonium digitatum* (S). *Echinus esculentus* (P), hydroid clumps adjacent to sand patches (P).	mixed	yes	unknown	CR.MCR.EcCr.FaAlCr.Adig SS.SCS.CCS
D42.1	Uneven bedrock	Rock encrusted with dense *Spirobranchus* spp. (A) and *Parasmittina trispinosa* (O) and with patchy turf of hydroids (F) including *Abietinaria abietina* (P). *Asterias rubens?* (P), *Crossaster papposus* (O), *Echinus esculentus* (C), teleost sp. (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Pom
D42.2	Dense pebbles on coarse sand	Stones supporting little life apart from serpulid worms (C).		no	no	SS.SCS.CCS.PomB
D43	Megaripples of coarse sand and shell gravel	Paguridae sp. (R).	non-reef	yes	yes	SS.SCS.CCS
D44	Coarse sand and shell gravel with scattered shells and isolated boulders	Shells support sparse hydroids (R) and serpulid worms (P). *Urticina* sp. (R), *Porania pulvillus* (O).	non-reef	yes	yes	SS.SCS.CCS
D45	Dense shells with some gravel and pebbles on coarse sand and shell gravel	Shells supporting serpulid worms (C) and scattered hydroids (O). *Luidia ciliaris* (P).	non-reef	no	yes	*SS.SCS.CCS.PomB*

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D46	Low-relief bedrock with small pockets of coarse sand	Rock encrusted with *Spirobranchus* spp. (S), *Parasmittina trispinosa*? (R) and pink coralline algae (R) and supporting dense *Alcyonium digitatum* (S) and clumps of hydroids (F) including *Halecium halecinum* (P) and *Abietinaria abietina*? (P). *Ophiocomina nigra* (O), *Echinus esculentus* (C), small teleosts (P), Labridae sp. (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Adig
D48	Bedrock	Forest of *Laminaria hyperborea* (A) with fronds supporting *Membranipora membranacea* (P) and stipes dense red algae locally. Understorey of red foliose algae (A locally) including *Delesseria sanguinea* and *Odonthalia dentata*, as well as *Dictyota dichotoma* (P) and *Alaria esculenta* (P). *Macropodia* sp.? (P).	reef		no	*IR.HIR.KFaR.LhypR.Ft*
D49	Bedrock with gullies of boulders and cobbles	*Laminaria hyperborea* forest (A) supporting *Membranipora membranacea* (P) and *Obelia geniculata* (P), with rock encrusted with pink, red and brown algae and with turf of foliose red algae (C, locally A) and *Desmarestia aculeata* (P). Lower areas, probably more disturbed, with *Saccharina latissima (locally A).*	reef	no	no	*IR.MIR.KR.Lhyp.Ft* *IR.HIR.KSed.LsacSac*
D50.1	Bedrock, boulders and cobbles	Rock encrusted with *Spirobranchus* spp. (C) and pink (O) and brown (A) algal crusts with *Ophiothrix fragilis* (S) and *Ophiocomina nigra* (P). *Urticina felina* (P), *Asterias rubens* (O), *Echinus esculentus* (C), small teleosts (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Bri
D50.2	Bedrock, boulders and cobbles	Rock encrusted with *Spirobranchus* spp. (C) and pink (C) and brown (A) algal crusts. *Echinus esculentus* (C), small teleosts (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Pom
D50.3	Bedrock	Rock encrusted with pink (F) and brown (A) algal crusts and supporting mixed kelp forest of *Saccharina latissima* (A), *Laminaria hyperborea* (P) and possibly *Saccorhiza polyschides* (P); *Desmarestia aculeata* (O). *Membranipora membranacea* (P), *Echinus esculentus* (C).	reef	no	no	IR.HIR.KSed.LsacSac

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D50.4	Vertical cliff with boulders at base	Rock encrusted with *Spirobranchus* spp. (A, at least locally) and pink (A) and brown (A) algal crusts. *Alcyonium digitatum* (R), *Echinus esculentus* (C), Labridae sp. (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Pom
D51	Field of boulders on coarse sand and/or shell gravel	Rock encrusted with pink coralline algae (F) and *Spirobranchus* spp. (P). *Asterias rubens* (P), *Echinus esculentus* (C), *Ophiothrix fragilis* (S), *Ophiocomina nigra* (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Bri
D52	Dense pebbles and some cobbles and shells on coarse sand and shell gravel	Stones encrusted with serpulid worms (A) and supporting hydroids (R) including *Halecium* sp., *Alcyonium digitatum* (F) and *Alcyonidium digitatum* (R). Paguridae spp. (O), ophiuroids (A) including *Ophiopholis aculeata*, *Ophiocomina nigra* and *Ophiothrix fragilis*, *Luidia ciliaris* (P), *Echinus esculentus* (F).	non-reef	no	no	SS.SMx.CMx.OphMx
D53	Coarse sand and shell gravel with dense cover of shells, especially *Modiolus*	Shells encrusted with serpulid worms (A) and supporting scattered tufts of hydroids (O), *Alcyonium digitatum* (R) and *Alcyonidium diaphanum* (R). *Porania pulvillus* (P), *Stichastrella rosea* (P).	non-reef	no	yes	*SS.SCS.CCS.PomB*
D54	Uneven bedrock with patches of coarsesand and/or shell gravel	Rock encrusted with pink coralline algae (F), *Spirobranchus* spp. (A) and *Parasmittina trispinosa* (R). *Asterias rubens* (P), *Crossaster papposus* (P), *Luidia ciliaris* (P), *Echinus esculentus* (C), *Ophiothrix fragilis* (S), *Ophiocomina nigra* (C locally).	reef	no	no	CR.MCR.EcCr.FaAlCr.Bri
D55	Bedrock with small channels of coarse sand	Rock encrusted with *Spirobranchus* spp. (C) and pink (A) and brown (C) algal crusts and supporting dense *Alcyonium digitatum* (C, locally A) and *Ophiothrix fragilis* (S) with *Ophiocomina nigra* (P). *Urticina* sp. (O), *Echinus esculentus* (F), small teleosts (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Bri

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D57	Bedrock	Forest of *Laminaria hyperborea* (A) with fronds supporting *Membranipora membranacea* (P) and *Obelia geniculata* (P). Understorey of dense red foliose algae including *Delesseria sanguinea* (S) and *Odonthalia dentata* (P), as well as *Alaria esculenta* (P), *Saccharina latissima* (P) and *Desmarestia aculeata* (P).	reef		no	IR.HIR.KFaR.LhypR.Ft
D59.1	Bedrock	Rock densely encrusted with brown algae (S) and pink coralline crust (R) and supporting park of mixed kelps including *Saccharina latissima* (F) and *Saccorhiza polyschides* (F), and patchy turf of apparently brown algae, possibly *Dictyota dichotoma* (F). *P*atches of *Alcyonium digitatum* (O, locally C), hydroids (F) including *Kirchenpaueria pinnata*? (P) and *Nemertesia antennina* (P), *Asterias rubens* (P), *Echinus esculentus* (C).	reef	no	no	IR.HIR.KSed.LsacSac
D59.2	Bedrock and boulders	Rock encrusted with pink (O), red (P) and brown (S) algal crusts and supporting areas of dense *Alcyonium digitatum* (where A). Hydroid patches (P), *Crossaster papposus* (O), juvenile crinoids? (P), *Asterias rubens*? (P), *Echinus esculentus* (C), shoal of small teleosts (P).	reef	no	no	CR.MCR.EcCr.FaAlCr CR.MCR.EcCr.FaAlCr.Adig
D60	Bedrock ridges with small pockets of shell gravel and coarse sand	Rock encrusted with pink coralline algae (A) and brown algae (P) and *Spirobranchus* (A), with dense *Alcyonium digitatum* (C, locally A). *Luidia ciliaris* (P), *Echinus esculentus* (C), *Ophiocomina nigra* (C locally), small teleosts (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Adig
D61	Bedrock with small pockets of shell gravel and coarse sand	Rock encrusted with pink coralline algae (C) and brown algae (A) and *Spirobranchus* (A), with dense *Alcyonium digitatum* (A, locally S). *Echinus esculentus* (C), *Ophiothrix fragilis* (S), *Ophiocomina nigra* (C).	reef	no	no	CR.MCR.EcCr.FaAlCr.Bri

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D63.1	Uneven bedrock with steep slopes	Rock encrusted with pink (P), red (P) and brown (locally A) algae. Shallower areas with forest of *Saccharina latissima* (A) with possibly *Saccorhiza polyschides* and/or *Laminaria hyperborea* (O). Fronds with *Obelia geniculata* and *Membranipora membranacea*. Turf of foliose red algae (locally A), *Urticina* sp.? (P). Patchy *Antedon* spp. (locally S) or possibly hydroids, and *Alcyonium digitatum* (O, locally C). Deeper areas with *S. latissima* park (F) and more extensive brown algal crust. *Echinus esculentus* (F).	reef	no	no	*IR.HIR.KSed.LsacSac*
D63.2	Bedrock and boulders	Rock densely encrusted with brown algae (S); pink coralline crust (O). *Spirobranchus* spp. (P, possibly C), patches of *Alcyonium digitatum* (F), *Echinus esculentus* (C).	reef	no	no	CR.MCR.EcCr.FaAlCr
D64	Bedrock	Dense forest of short *Laminaria hyperborea* (A-S) supporting *Membranipora membranacea* (P), with *Alaria esculenta* (C) and dense turf of foliose red algae (S) including *Odonthalia dentata* (S, at least locally) supporting *Electra pilosa*? (P).	reef	no	no	IR.HIR.KFaR.LhypR.Ft
D65.1	Bedrock	Mixed forest of *Alaria esculenta* (A) and *Laminaria* spp. (A), with *Laminaria* stipes supporting dense red algal epiphytes and understorey of dense red algae (S) dominated by *Odonthalia dentata* (locally S)	reef	no	no	*IR.HIR.KFaR.Ala*
D65.2	Bedrock	Forest of *Laminaria hyperborea* with fronds supporting dense *Membranipora membranacea* (F) and *Obelia geniculata* (P, and understorey of foliose red algae (A-S). *Alcyonium digitatum* (locally A on verticals).	reef	no	no	*IR.HIR.KFaR.LhypR.Ft*
D65.3	Boulders and possibly bedrock	Mixed kelp forest of *Saccharina latissima* (A) and *Laminaria hyperborea* possibly with *Saccorhiza polyschides* (F combined) with foliose red algal turf (S). *Membranipora membranacea* (P).	reef	no	no	*IR.HIR.KSed.LsacSac*

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D66	Bedrock	Dense forest of small *Saccharina latissima* (A) with *Laminaria hyperborea* (F) supporting *Membranipora membranacea*. Rock extensively encrusted with brown, red and some pink algae and with fairly sparse turf (F) of foliose red algae including *Delesseria sanguinea* (P); *Desmarestia aculeata* (P), *Alaria esculenta* (P). *Asterias rubens* (F), *Echinus esculentus* (F)	reef	no	no	IR.HIR.KSed.LsacSac
D67.1	Bedrock	Mixed kelp forest of *Saccharina latissima* (A), *Saccorhiza polyschides* (P) and possibly *Laminaria hyperborea* (P), with *Desmarestia aculeata* (P); kelp fronds with *Membranipora membranacea* (P). Rock encrusted with pink, red and brown algae and supporting a patchy understorey of foliose red algae (localy C). *Asterias rubens (P), Echinus esculentus* (C)	reef	no	no	IR.HIR.KSed.LsacSac
D67.2	Bedrock	Rock encrusted with pink (O), red (P) and brown (S) algal crusts and *Spirobranchus* spp. (P) and supporting patchy *Alcyonium digitatum* (O). *Asterias rubens* (P), *Echinus esculentus* (C).	reef	no	no	CR.MCR.EcCr.FaAlCr
D68	Mostly bedrock with some boulders and small patches of coarse sand	Rock encrusted with pink (P), red (P) and brown (locally S) algal crusts, *Balanus* spp. (P), *Parasmittina trispinosa* (R) and *Spirobranchus* spp. (locally A but sparse on flat rock where dense brown crusts) and supporting areas of dense *Alcyonium digitatum* (where A). *Gibbula* sp. (P), *Crossaster papposus* (P), *Asterias rubens* (P), *Echinus esculentus* (C).	reef	no	no	CR.MCR.EcCr.FaAlCr CR.MCR.EcCr.FaAlCr.Pom CR.MCR.EcCr.FaAlCr.Adig
D69	Bedrock ridges with small pockets of shell gravel and coarse sand	Rock encrusted with pink coralline algae (C) and brown algae (C) and *Spirobranchus* (A), with patchy cover of *Alcyonium digitatum* (C). *Echinus esculentus* (F), *Ophiocomina nigra* (locally C).	reef	no	no	CR.MCR.EcCr.FaAlCr.Adig

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D71	Bedrock ridges with intervening patches of megarippled shell gravel	Rock encrusted with pink coralline algae (C) and *Spirobranchus* (A) with cover of *Ophiothrix fragilis* (S). *Echinus esculentus* (F), *Solaster endeca* (P), *Ciona intestinalis* (P). Sediment with some patches of *O. fragilis* (P) and *Ophiocomina nigra* (R), as well as *Luidia ciliaris* (P)	mixed	yes	yes	CR.MCR.EcCr.FaAlCr.BriSS.SCS.CCS
D72	Uneven bedrock and gulley with coarse sand and patchy cover by boulders, cobbles, pebbles and gravel	Rock encrusted with *Spirobranchus* spp. (locally A on verticals), pink coralline algae (O) and brown algae (A) and supporting dense *Alcyonium digitatum* (A). *Solaster endeca* (P), patchy cover of *Ophiothrix fragilis* (locally S), *Ophiocomina nigra* (P), *Echinus esculentus* (C), teleosts (P).	mixed	yes	unknown	CR.MCR.EcCr.FaAlCr.Adig *CR.MCR.EcCr.FaAlCr.BriSS.SCS.CCS*
D73	Bedrock and boulders with small pockets of coarse sand	Rock encrusted with pink (F, locally C), red (P) and brown (A) algal crusts and *Spirobranchus* spp. (C, A locally) and supporting patchy *Alcyonium digitatum* (R). Hydroid clumps (O), *Gibbula cineraria* (P), *Calliostoma zizyphinum*? (P), *Asterias rubens* (R), *Echinus esculentus* (C), *Clavelina lepadiformis* (P), small teleosts (P), foliose red algae (R). Camera tracks briefly over lower edge of kelp park where small *Saccharina latissima* (F), *Desmarestia aculeata* (P) and turf of filamentous red algae (A).	reef	no	no	*CR.MCR.EcCr.FaAlCr.Pom*
D74.1	Stepped bedrock slope	Rock extensively encrusted by *Aglaozonia* (A), pink coralline algae (F) and *Spirobranchus* spp. (locally A). Possible patchy turf in some flatter areas. *Alcyonium digitatum* overall R but locally C on vertical faces.	reef	no	no	CR.MCR.EcCr.FaAlCr CR.MCR.EcCr.FaAlCr.AdigVt
D74.2	Bedrock	Rock extensively encrusted by *Aglaozonia* (S), with pink coralline algae (O). Sparse park of *Saccorhiza polyschides* (F) with *Alcyonium digitatum* (R) *Kirchenpaueria pinnata* (R) and *Echinus esculentus* (C).	reef	no	no	IR.HIR.KSed.LsacSac

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D75.1	Inclined bedrock platforms and small pockets of coarse sand	Rock encrusted with *Spirobranchus* spp. (A), *Parasmittina trispinosa* (R), pink coralline algae (A) and brown algae (F) and supporting patchy *Alcyonium digitatum* (R overall), *Caryophyllia smithii* (R) and hydroids (O). *Urticina felina* (O), *Asterias rubens* (P), *Ophiocomina nigra* (O), *Echinus esculentus* (C), small teleosts (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Pom
D75.2	Bedrock with small pockets of coarse sand	Rock encrusted with pink coralline algae (A) and brown algae (F-C) and supporting sparse *Alcyonium digitatum* (O. *Urticina felina* (P), *Ophiothrix fragilis* (S), *Ophiocomina nigra* (P), *Echinus esculentus* (F), small teleosts (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Bri
D77	Bedrock ridges with small pockets of coarse sand	Rock encrusted with dense *Spirobranchus* spp. (A), *Parasmittina trispinosa* (O), pink coralline algae (O) and brown algae (P) and supporting *Alcyonidium diaphanum* (locally C) and *Alcyonium digitatum* (R). Patchy cover of ophiuroids including *Ophiothrix fragilis* (locally S) and *Ophiocomina nigra* (locally A). *Asterias rubens* (O), *Crossaster papposus* (P), *Echinus esculentus* (C), many small teleosts (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Bri CR.MCR.EcCr.FaAlCr.Pom
D78	Bedrock	Rock encrusted with pink coralline algae (A) and brown algae (A) and supporting dense *Ophiothrix fragilis* (S) and sparse *Alcyonium digitatum* (O). *Crossaster papposus* (P), *Luidia ciliaris* (P), *Echinus esculentus* (C).	reef	no	no	CR.MCR.EcCr.FaAlCr.Bri
D80.1	Flat, smooth bedrock	Rock densely encrusted with *Aglaozonia* (S), as well as pink coralline algae (R). *Gibbula cineraria* (P).	reef	no	no	CR.MCR.EcCr.FaAlCr
D80.2	Flat, smooth bedrock	Rock encrusted with *Aglaozonia* (A), as well as pink coralline algae (R) and supporting a dense turf of *Dictyota dichotoma* (S), foliose red algae (R) and sparse hydroids (O). *Echinus esculentus* (O).	reef	no	no	IR.HIR.KFaR.FoR.Dic

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D80.3	Bedrock	Forest of small *Saccharina latissima* (A) with sparse understorey of foliose red algae (R) and *Dictyota dichotoma* (R); rock encrusted with pink coralline algae (P) and *Aglaozonia* (P). *Echinus esculentus* (C).	reef	no	no	IR.HIR.KSed.LsacSac
D81	Bedrock and boulders	Rock encrusted with pink coralline algae (C), red algae (P) and brown algae (P) and supporting forest of *Saccharina latissima* (A) and other large kelps (F) including *Saccorhiza polyschides* (P). *Echinus esculentus* (P).	reef	no	no	IR.HIR.KSed.LsacSac
D82	Bedrock and boulders with coarse sand and shell gravel infill	Rock encrusted with *Spirobranchus* spp. (A) and pink coralline algae (A) and with dense *Ophiocomina nigra* (A, locally S). *Echinus esculentus* (C), small teleosts (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Adig
D83	Bedrock and boulders	Rock encrusted with dense *Spirobranchus* spp. (A), *Parasmittina trispinosa* (F, locally C), pink coralline algae (F) and brown algae (F) and with patchy hydroids (O) including *Abietinaria abietina* (P). *Porania pulvillus* (P), *Luidia ciliaris* (P), *Echinus esculentus* (C), *Ophiothrix fragilis* (P in crevices), *Ascidia mentula* (P), many small teleosts (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Pom
D84	Bedrock ridges with small pockets of coarse sand and shell gravel	Rock encrusted with dense *Spirobranchus* spp. (A, locally S), pink coralline algae (P) and brown algae (P) and with dense *Ophiocomina nigra* (A); hydroid patches (F, but thin turf A where sparse ophiuroids). *Urticina* sp. (P), *Caryophyllia smithii* (locally C), *Alcyonidium diaphanum* (R), *Solaster endeca* (P), *Crossaster papposus* (O), *Ophiothrix fragilis* (P), *Echinus esculentus* (C), *Ciona intestinalis*? (P), *Ascidia virginea* (P), Gadidae sp. (P), small teleosts (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Bri

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D85	Boulders and bedrock outcrops with patches of coarse sand and shell gravel with surface scatter of pebbles and cobbles	Rock encrusted with dense *Spirobranchus* spp. (A), *Parasmittina trispinosa* (F) and pink coralline algae (O) and supporting hydroid patches (O) including *Abietinaria abietina* (P). *Asterias rubens* (P), *Luidia ciliaris* (O), *Echinus esculentus* (F), Pleuronectiformes sp. (P).	mixed	no	yes	CR.MCR.EcCr.FaAlCr.Pom *SS.SCS.CCS.PomB*
D86	Megaripples of coarse sand and shell gravel with concentrations of stone gravel, pebbles, shells and occasional cobbles and small boulders in troughs	Stones encrusted with serpulid worms (P) and supporting occasional hydroid tufts. *Lanice conchilega* (O), *Ophiocomina nigra* (R), *Echinus esculentus* (F).	non-reef	yes	yes	SS.SCS.CCS
D88	Boulders, cobbles and bedrock outcrops	Rock densely encrusted with brown algae (A) and pink algae (P) and supporting sparse kelp park with *Alaria esculenta* (O-F) and other kelps (O) including *Saccharina latissima* (P). *Asterias rubens* (F), *Echinus esculentus* (C), small teleosts (P).	reef	no	no	IR.HIR.KSed
D89.1	Coarse sand and shell gravel with scattered shells and sparsely scattered cobbles and pebbles	Stones encrusted with serpulid worms (P) and pink coralline and brown algae and supporting sparse hydroids (R). Small teleost sp. (P).	non-reef	yes	yes	*SS.SCS.CCS*

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D89.2	Coarse sand and shell gravel with around 50% cover by cobbles and pebbles with shells	Stones encrusted with serpulid worms (A), *Parasmittina trispinosa* (R) and pink coralline and brown algae and supporting *Alcyonium digitatum* (O), *Urticina* sp. (P) and sparse, small hydroids (R). *Ophiocomina nigra* (A, locally S), *Luidia ciliaris* (O), *Echinus esculentus* (F), small teleost sp. (P).	non-reef	no	yes	*SS.SMx.CMx.OphMx*
D91	Stepped, bedrock platforms with small pockets of coarse sand and shell gravel	Rock encrusted with *Aglaozonia* (A), pink coralline algae (O) and red algae (P) and supporting patches of *Alcyonium digitatum* (overall O) and sparse erect algae including foliose reds (R), *Alaria esculenta* (O) and other small kelps (R). *Urticina* sp. (P), *Crossaster papposus* (O), *Echinus esculentus* (C, locally A), large gadoids (O). Vertical faces support dense *Spirobranchus* spp. (A) and *A. digitatum* (S).	reef	no	no	CR.MCR.EcCr.FaAlCr CR.MCR.EcCr.AdigVt
D92	Bedrock and boulders	*Laminaria hyperborea* forest (A) with fronds supporting fairly dense *Membranipora membranacea* and *Obelia geniculata*, and sparse understorey of red algae including *Callophyllis laciniata* (P); rock encrusted with pink and brown algae; *Echinus esculentus* (P), *Asterias rubens* (P), small teleost (P). Patches of *Saccharina latissima* (locally A) with *Alaria esculenta* (P) and *Desmarestia aculeata* (P), possibly in lower areas with boulders and cobbles	reef	no	no	*IR.MIR.KR.Lhyp.GzFt* *IR.HIR.KSed.LsacSac*
D93	Predominantly boulders and bedrock outcrops with some cobbles and pebbles and infill of coarse sand and shell gravel	Rock encrusted with *Spirobranchus* spp. (C, locally A), *Parasmittina trispinosa* (R), pink coralline algae (A) red algae (P) and brown algae (P) and supporting dense *Alcyonium digitatum* (A). *Crossaster papposus* (P), *Echinus esculentus* (C), small teleosts (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Adig

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D94	Bedrock, boulders and occasional cobbles with small pockets of coarse sand	Rock densely encrusted with *Aglaozonia* (A), as well as pink coralline algae (O), heavily grazed by *Echinus esculentus* (A) and *Gibbula* sp. (P). *Alaria esculenta* (C, locally A), *Saccharina latissima* (O), erect red algae (R), *Asterias rubens* (P), small teleosts (P).	reef	no	no	*IR.HIR.KFaR.Ala*
D95	Boulders	Rock densely encrusted with *Aglaozonia* (A), as well as pink coralline algae (F) and red algae (P) and *Spirobranchus* spp. (locally A), heavily grazed by *Echinus esculentus* (A) and *Gibbula* sp. (P). *Alaria esculenta* (C, locally A), small *Laminaria hyperborea* (F), *Saccharina latissima* (P), foliose red algae (O), *Asterias rubens* (P), *Crossaster papposus* (P), small teleosts (P).	reef	no	no	*IR.HIR.KSed.LsacSac*
D96	Boulders	Patchy *Laminaria hyperborea* forest (A); rock encrusted with pink (P) and brown algae (P) but apparently often bare on the upper surfaces of boulders. *Echinus esculentus* (C), small teleosts (P), *Alaria esculenta* (P), *Desmarestia aculeata* (P).	reef	no	no	*IR.MIR.KR.Lhyp.GzFt*
D97	Coarse sand and shell gravel (c.50%) with bedrock outcrops, boulders and some cobbles and pebbles	Rock encrusted with *Aglaozonia* (C), pink coralline algae (C) and *Spirobranchus* spp. (locally A), and supporting small *Laminaria hyperborea*? (O), *Alcyonium digitatum* (O) and sparse hydroids (O). *Cancer pagurus* (P), *Ophiocomina nigra* (C, locally A), *Echinus esculentus* (C), small teleosts (P).	mixed	yes	yes	*CR.MCR.EcCr.FaAlCr.Bri SS.SCS.CCS*

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D98	Coarse sand, possibly with shell gravel, locally with scattered gravel, pebbles and cobbles (60%). Also scattered bedrock outcrops and boulders	Rock encrusted with brown (C) and pink coralline algae (C) and *Spirobranchus* spp. (locally A) and supporting sparse kelp park (F) of *Saccharina latissima* and possibly small *Laminaria hyperborea* with foliose reds (R). Patches of *Alcyonium digitatum* (F) and hydroids (F, locally S) including *Halecium halecinum* (P). *Luidia ciliaris*? (O), *Echinus esculentus* (F).	mixed	yes	unknown	*IR.HIR.KSed* SS.SCS.CCS
D99	Bedrock with small coarse sand/shell gravel patches	Mixed kelp forest dominated by *Saccharina latissima* (C-A), with *Laminaria hyperborea* and/or *Saccorhiza polyschides* (F-C). Rock encrusted with *Spirobranchus* spp. (P) and pink (P), red (P) and brown (P) algae. Apparently no, or sparse, algal turf, although *S. latissima* sporelings present. *Echinus esculentus* (C), *Asterias rubens* (P), small teleosts (P).	reef	no	no	*IR.HIR.KSed.LsacSac*
D100	Bedrock, possibly with boulders locally	Rock encrusted with brown (C) and pink coralline algae (C) and supporting kelp forest strongly dominated by *Laminaria hyperborea* (A) with *Saccharina latissima* (P). Kelp fronds with *Membranipora membranacea* (F) and *Obelia geniculata* (P). *Echinus esculentus* (P).	reef	no	no	IR.MIR.KR.Lhyp.GzFt
D101	Mostly bedrock with some boulders and cobbles and small pockets of coarse sand and shell gravel	Rock encrusted with *Spirobranchus* spp. (F-C, locally A), pink coralline algae (C) and brown algae (A, locally S) and supporting dense but patchy *Alcyonium digitatum* (C). *Echinus esculentus* (C), *Molva molva* (P), small teleosts (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Adig
D103.1	Dense shells and shell gravel on coarse sand	Shells support hydroid clumps (O). *Luidia ciliaris* (P), *Echinus esculentus* (P), Gobiidae sp. (P).	non-reef	yes	yes	SS.SCS.CCS

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D103.2	Low relief bedrock (70%) with patches of possibly superficial coarse sand and pebbles	Rock encrusted with *Spirobranchus* spp. (C, locally A), pink coralline algae (C), red algae (P) and brown algae (P) and with patchy cover of *Alcyonium digitatum* (C) and sparse hydroids (P). *Crossaster papposus* (P), *Echinus esculentus* (F).	reef	no	no	*CR.MCR.EcCr.FaAlCr.Adig*
D104	Around 50% cover of clean, rippled, medium sand with scattered, mostly flat, boulders and bedrock outcrops with cobbles and pebbles	Rock initially with dense *Alcyonium digitatum* (S) but later supporting very sparse erect biota and becoming sand-dusted with encrusting pink coralline algae (A), brown algae (P) and red algae (P) and sparse, short, thin hydroid turf (O). *Spirobranchus* spp. locally A on short vertical faces. *Ophiocomina nigra* (O), *Ophiura* sp. (P), *Echinus esculentus* (C), *Molva molva* (P).	mixed	yes	unknown	CR.MCR.EcCr.FaAlCr.Adig CR.MCR.EcCr.FaAlCr
D105	Bedrock	Rock encrusted with red algae (P), brown algae (P) and pink coralline algae (P) with sparse algal understorey. Mixed kelp forest dominated by *Saccharina latissima* (A), with *Saccorhiza polyschides* (F, locally C) and *Alaria esculenta* (P); fronds with *Membranipora membranacea* (F) and *Obelia geniculata* (P). *Gibbula* sp. (P).	reef	no	no	IR.HIR.KSed.LsacSac
D106	Bedrock and boulders	Patchy *Laminaria hyperborea* forest (A) supporting *Membranipora membranacea* (P); rock encrusted with pink (P), red (P) and brown algae (P) but with bare patches. *Echinus esculentus* (C), *Alaria esculenta* (F), *Desmarestia aculeata* (R), *Callophyllis laciniata* (R).	reef	no	no	*IR.MIR.KR.Lhyp.GzFt*
D108	Bedrock	*Laminaria hyperborea* forest (A) supporting *Membranipora membranacea* (P); rock encrusted with pink (P), red (P) and brown algae (P) and apparently with sparse foliose red algae. *Echinus esculentus* (P), *Alaria esculenta* (P), *Saccharina latissima* (P).	reef	no	no	*IR.MIR.KR.Lhyp.GzFt*

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D109.1	Dense boulders on coarse sand	Rock encrusted with *Spirobranchus* spp. (C, locally A), *Parasmittina trispinosa* (R), pink coralline algae (C) and brown algae (C) and with dense cover of *Alcyonium digitatum* (A). *Ophiocomina nigra* (O); *Ophiothrix fragilis?* (O). *Echinus esculentus* (C).	reef	no	no	CR.MCR.EcCr.FaAlCr.Adig
D109.2	Dense boulders on coarse sand	Rock encrusted with *Spirobranchus* spp. (C, locally A), *Parasmittina trispinosa* (R), pink coralline algae (C) and brown algae (C) and with dense cover of *Alcyonium digitatum* (A). *Ophiocomina nigra* (A). *Echinus esculentus* (C).	reef	no	no	CR.MCR.EcCr.FaAlCr.Bri
D110	Bedrock with boulders, cobbles and locally pebbles on coarse sand and shell gravel	Rock encrusted with *Spirobranchus* spp. (A), *Parasmittina trispinosa* (O), pink coralline algae (C), red algae (P) and brown algae (P) and supporting dense *Alcyonium digitatum* (A, locally S). *Crossaster papposus* (P), *Echinus esculentus* (F), patches of *Ophiocomina nigra* (locally A, particularly in more mixed areas of sand and stones). Small teleosts (P).	mixed	no	yes	CR.MCR.EcCr.FaAlCr.Adig SS.SMX.CMx.OphMx
D111	Dense cobbles and small boulders (75%) on coarse sand	Rock encrusted with sparse *Spirobranchus* spp. (O, locally A on stone sides), pink coralline algae (A), red algae (R) and brown algae (P) and with dense cover of *Alcyonium digitatum* (A) and *Ophiocomina nigra* (S); *Ophiothrix fragilis* (P). *Modiolus modiolus* (F), *Echinus esculentus* (F), small teleost sp. (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Bri
D112	Bedrock, boulders and patches of pebbles with coarse sand and gravel	Park/thin forest of *Laminaria hyperborea* (C, locally A) with fronds supporting *Membranipora membranacea* and *Gibbula cineraria. Saccorhiza polyschides* (P) and *Alaria esculenta* (F). Rock encrusted with *Spirobranchus* spp. (C) and pink (C), brown (C) and red algae. *Echinus esculentus* (C). Locally, in apparently more unstable stony areas, *Saccharina latissima* (locally A).	mixed	no	no	*IR.MIR.KR.Lhyp.GzPk* *IR.HIR.KSed.LsacSac*

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D115	Mostly bedrock with some boulders and small patches of coarse sand and shell gravel with cobbles. Megaripples of coarse sediment in the distance at the start of the run but not traversed	Rock encrusted with *Spirobranchus* spp. (A), *Parasmittina trispinosa* (F), pink coralline algae (A), red algae (O) and brown algae (P) and supporting sparse clumps of hydroids (R) and dense *Alcyonium digitatum* (A, locally S). *Modiolus modiolus* (P), *Crossaster papposus* (P), *Echinus esculentus* (C), patches of *Ophiocomina nigra* (locally A). Shoal of small teleosts (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Adig
D116	Mostly megaripples of coarse sand with shell gravel and with pebbles in troughs (75%). Patches of outcropping bedrock, boulders and pebbles.	Rock encrusted with *Spirobranchus* spp. (A), pink coralline algae (C) and with patchy cover of hydroids (F) including *Kirchenpaueria pinnata*? (P) and *Abietinaria abietina*? (P), and *Alcyonium digitatum* (O, locally C). *Ophiocomina nigra* (O, locally C), *Echinus esculentus* (C), teleost spp. (P). Sediment with sparse *A. digitatum* and pink coralline algae on stones.	mixed	yes	yes	CR.MCR.EcCr.FaAlCr.Pom SS.SCS.CCS
D118	Bedrock	*Laminaria hyperborea* forest (A) with fronds supporting *Membranipora membranacea* (F) and some stipes dense foliose red algae; rock encrusted with pink (P), red (P) and brown algae (P) and with sparse foliose red algae. *Hyas* sp.? (P), *Echinus esculentus* (C), *Alaria esculenta* (P), *Saccharina latissima* (P).	reef	no	no	*IR.MIR.KR.Lhyp.GzFt*
D119	Predominantly lightly rippled, clean medium sand with small patches of outcropping bedrock	Rock encrusted with *Spirobranchus* spp. (P) and pink coralline algae (A) and supporting dense *Alcyonium digitatum* (A). *Lanice conchilega* (O).	mixed	yes	unknown	CR.MCR.EcCr.FaAlCr.Adig SS.SSa.IFiSa

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D120	Mostly bedrock but areas of boulders and cobbles with coarse sand and gravel infill	Rock encrusted with *Spirobranchus* spp. (A), *Parasmittina trispinosa* (C), pink coralline algae (C) and brown algae (O) and supporting sparse clumps of hydroids (R) and *Alcyonium digitatum* (R). *Crossaster papposus* (P), *Echinus esculentus* (C), patches of dense ophiuroids (locally A) including *Ophiocomina nigra* (locally A) and possibly *Ophiopholis aculeata* (P), especially in crevices. Small teleosts (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Pom CR.MCR.EcCr.FaAlCr.Bri
D121	Megaripples of coarse sand and shell gravel (70%) with patches of outcropping bedrock	Rock encrusted with *Spirobranchus* spp. (A), pink coralline algae (C) and *Parasmittina trispinosa* (P) and with cover of ophiuroids (S) dominated by *Ophiopholis aculeata* (S), with *Ophiocomina nigra* (C) and possibly *Ophiothrix fragilis* (P). *Echinus esculentus* (C). Sediment with *E. esculentus* (F), *Crossaster papposus* (P), *O. nigra* (P), *Eledone cirrhosa* (P) and Paguridae sp. (R).	mixed	yes	yes	CR.MCR.EcCr.FaAlCr.Bri SS.SCS.CCS
D122	Low-lying bedrock with small sand patches and extensive area of medium sand	Rock encrusted with *Spirobranchus* spp. (A), pink coralline algae (A) and brown algae (C, locally A) and supporting variable density of ophiuroids (overall A) including *Ophiocomina nigra* (locally A) and *Ophiothrix fragilis* (locally S), and patchy *Alcyonium digitatum* (O, locally A). *Caryophyllia smithii* (P), *Nemertesia antennina* (P), *Asterias rubens* (O).*Echinus esculentus* (C).	mixed	yes	unknown	CR.MCR.EcCr.FaAlCr.Bri SS.SCS.CCS
D123	Coarse sand and shell gravel with shells in troughs	*Cancer pagurus* (P), *Pecten maximus* (R), Paguridae spp. (F), *Asterias rubens* (P), *Neopentadactyla mixta*? (P).	non-reef	yes	yes	SS.SCS.CCS
D124	Shell gravel with coarse sand	Actiniaria sp. (R), *Asterias rubens* (P).	non-reef	yes	yes	SS.SCS.CCS
D125	Megaripples of shell gravel with scattered shells including *Ensis*	*Lanice conchilega* (P), small Brachyura sp.? (P).	non-reef	yes	yes	SS.SCS.CCS

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D126	Megaripples of coarse sand and shell gravel with scattered shells	Hydroids (R), Triglidae sp.? (P).	non-reef	yes	yes	SS.SCS.CCS
D127	Predominantly bedrock but with areas of boulders and cobbles	Rock encrusted with pink coralline (C) and red algae (O), as well as *Spirobranchus* spp. (A) and *Parasmittina trispinosa* (O). *Caryophyllia smithii* (C), *Stichastrella rosea* (P), *Echinus esculentus* (C), shoal of juvenile gadoids (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Car
D128	Coarse sand and shell gravel with shells in troughs	Paguridae spp. (F).	non-reef	yes	yes	SS.SCS.CCS
D129	Coarse sand and shell gravel with shells in troughs and patches of outcropping bedrock	Rock encrusted with *Spirobranchus* spp. (A) and pink coralline algae (O) and with *Ophiocomina nigra* (locally C) and *Echinus esculentus* (C). Sediment with *O. nigra* (P where adjacent to rock) and *Ophiura albida*? (P).	mixed	yes	yes	SS.SCS.CCS CR.MCR.EcCr.FaAlCr.Pom
D130	Megaripples of coarse sand and shell gravel with dense shells in troughs	*Scyliorhinus* sp. (P).	non-reef	yes	yes	SS.SCS.CCS
D131	Boulders on coarse sand with areas of mainly pebbles and cobbles on coarse sand	Stones encrusted with *Spirobranchus* spp. (A) and *Parasmittina trispinosa* (O). *Luidia ciliaris* (O), *Echinus esculentus* (C), *Scyliorhinus* sp. (O). Ophiuroids locally A but largely confined to stones undersurfaces and interstices, including *Ophiocomina nigra*, *Ophiothrix fragilis* and *Ophiura* sp..	mixed	no	no	CR.MCR.EcCr.FaAlCr.Pom SS.SCS.CCS.PomB

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D132	Megaripples of stone gravel and pebbles, with shells in troughs including *Modiolus*	*Alcyonidium diaphanum* (P), *Echinus esculentus* (P).	non-reef	no	no	SS.SCS.CCS
D133	Megaripples of shell gravel and coarse sand with shells in troughs	*Lanice conchilega*? (P)	non-reef	yes	yes	SS.SCS.CCS
D134	Megaripples of shell gravel and coarse sand with scattered shells	*Asterias rubens* (P).	non-reef	yes	yes	SS.SCS.CCS
D135.1	Megaripples of stone gravel and pebbles, with dense shells in troughs	Pebbles encrusted with serpulid worms (C).	non-reef	no	yes	SS.SCS.CCS
D135.2	Bedrock	Rock encrusted with dense *Spirobranchus* spp. (A) and *Parasmittina trispinosa* (O) and supporting hydroid patches (O) including *Abietinaria abietina* (P). Patches of *Ophiocomina nigra* (locally C), *Porania pulvillus* (P), *Echinus esculentus* (C), small teleosts (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Pom
D136	Megaripples of stone gravel with some coarse sand; troughs with pebbles and shells	Pebbles encrusted with serpulid worms (P). *Echinus esculentus* (O), *Ophiocomina nigra* (R), small teleost sp. (P), *Aspitrigla cuculus* (P)	non-reef	no	yes	SS.SCS.CCS

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D137	Clean coarse sand with some shell gravel, slightly rippled in places	No biota clearly evident. Fast drift.	non-reef	yes	yes	SS.SCS.CCS
D138	Coarse sand with shell gravel and scattered *Ensis* shells	Paguridae sp.? (R), *Asterias rubens* (P).	non-reef	yes	yes	*SS.SCS.CCS*
D139	Clean, coarse sand with shell gravel and scattered shells	*Cancer pagurus* (P).	non-reef	yes	yes	SS.SCS.CCS
D140	Clean, faintly rippled, coarse sand with sparse *Ensis* shells	No biota observed.	non-reef	yes	unknown	SS.SCS.CCS
D141	Clean, faintly rippled, coarse sand with sparse *Ensis* shells	No biota observed.	non-reef	yes	unknown	SS.SCS.CCS
D142	Clean, rippled, medium sand with sparsely scattered shells including *Ensis*	*Ammodytes* sp. (P - 1 seen).	non-reef	yes	unknown	*SS.SSa.IFiSa*
D143	Megaripples of coarse sand and shell gravel with scattered shells including *Ensis*	*Lanice conchilega* (R), *Pecten maximus* (R), *Crossaster papposus* (P), *Echinus esculentus* (O), *Ammodytes* sp. (P - 1 seen), small teleost sp. (P), Pleuronectiformes sp. (P).	non-reef	yes	yes	SS.SCS.ICS

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D144	Clean, rippled, medium sand with scattered *Ensis* shells	*Echinus esculentus* (P), Pleuronectiformes sp. (P).	non-reef	yes	unknown	*SS.SSa.IFiSa*
D145	Clean, rippled, medium sand with very sparse *Ensis* shells	No biota seen.	non-reef	yes	unknown	*SS.SSa.IFiSa*
D146	Clean, rippled, medium sand with scattered shells including *Ensis*	*Lanice conchilega* (O), *Pecten maximus* (O), *Eledone cirrhosa* (P).	non-reef	yes	unknown	*SS.SSa.IFiSa*
D147	Medium sand with dense *Ensis* shells	Shells encrusted with pink coralline algae and support hydroid clumps (O). *Echinus esculentus* (P).	non-reef	yes	yes	*SS.SSa.IFiSa*
D148	Maerl gravel and coarse sand with scattered pebbles, shells and occasional boulders at end of run	Stones and shells encrusted with pink coralline algae (O) and *Spirobranchus* spp. (C) and supporting hydroids (O-F) including *Halecium halecinum*? (P), *Alcyonium digitatum* (R) and *Clavelina lepadiformis* (P). Live *Phymatolithon calcareum* (c.3% - R), locally 8% - O). *Urticina felina* (R), *Chaetopterus variopedatus*? (R), *Neopentadactyla mixta*? (P).	non-reef	yes	yes	SS.SCS.CCS
D149	Rippled medium-coarse sand with shell gravel and scattered boulders, cobbles, pebbles and shells, especially *Ensis*	Rock encrusted with *Spirobranchus* spp. (F), pink coralline algae (A) and brown algae (O) and supporting sparse hydroid turf (R). Rock with *Urticina* sp. (P) and *Echinus esculentus* (C). *Ophiocomina nigra* (C locally), *Dictyota dichotoma* (R).	mixed	yes	yes	*SS.SCS.ICS*

Table 1.2 continued

Site	Substrate	Biota	Reef	Sand-eel habitat	Carbon-ate sediment	Biotope
D150.1	Clean, current-rippled medium sand with patchy cover of dead maerl gravel, pebbles and shells including *Ensis*	Pebbles, gravel and shell support hydroid clumps (O overall but C in patches where coarser material concentrated). Pebbles and shells encrusted with pink coralline and red algae. *Phymatolithon calcareum* (R), foliose red algae (R).	non-reef	yes	yes	*SS.SSa.IFiSa*
D150.2	Coarse sand and maerl gravel with scattered pebbles and shells including *Ensis*	Live *Phymatolithon calcareum* (C) supporting patchy turf of hydroids (F) and *Clavelina lepadiformis* (P).	non-reef	yes	yes	SS.SMp.Mrl.Pcal.Nmix
D151	Largely bedrock and boulders with some cobbles, pebbles and small coarse sand pockets	Rock encrusted with *Spirobranchus* spp. (A), *Parasmittina trispinosa* (F), pink coralline algae (C), red algae (P) and brown algae (A, locally S) and supporting dense *Alcyonium digitatum* (A) and sparse hydroids (R). *Modiolus modiolus* (P), *Crossaster papposus* (P), *Echinus esculentus* (C), *Ophiocomina nigra* (A, locally S, but sparse in some areas), *Ophiothrix fragilis*? (P), *Ophiopholis aculeata*? (P). Small teleosts (P).	reef	no	no	CR.MCR.EcCr.FaAlCr.Bri CR.MCR.EcCr.FaAlCr.Adig

Table 1.3 Biotope differences recorded during the 2008 baseline (Harries et al*., 2009) and 2016 dropdown video surveys, with comments on the change.*

Site	Biotope 2016	Biotope 2008	Comment
D2	CR.MCR.EcCr.FaAlCr.Pom	CR.MCR.EcCr.FaAlCr.Pom CR.MCR.EcCr.FaAlCr.Bri	Partial match. Dense ophiuroids absent in 2016
D4	SS.SCS.CCS CR.MCR.EcCr.FaAlCr.Pom	SS.SCS.CCS CR.MCR.EcCr.FaAlCr.Bri	Ophiuroids much denser in 2008
D7	CR.MCR.EcCr.FaAlCr.Pom	CR.MCR.EcCr.FaAlCr.Pom CR.HCR.XFa	Partial match but dense hydroid turf absent in 2016
D12	IR.MIR.KR.Lhyp.Ft IR.HIR.KSed	IR.HIR.KSed.LsacSac	Poor visibility of characterising species. Same biotope(s) possibly present in both years.
D15	IR.HIR.KSed.LsacSac	IR.MIR.KR.Lhyp.GzFt	Marked temporal difference in the abundance of *S. latissima* locally, although patches where *L. hyperborea* strongly dominant, and Lhyp.GzFt possibly present in 2016
D16	CR.MCR.EcCr.FaAlCr.Pom	CR.MCR.EcCr.FaAlCr.Bri CR.MCR.EcCr.FaAlCr.Pom	Partial agreement, although ophiuroid density in 2016 insufficient to recognise FaAlCr.Bri. Depth difference indicates locational difference
D21	SS.SCS.CCS.PomB	CR.MCR.EcCr.FaAlCr.Pom	Bedrock absent in 2016, possibly due to different camera track, although 2008 bedrock low relief and could be covered by sediment
D28	SS.SMx.CMx.OphMx	SS.SMX.CMx.OphMx SS.SCS.CCS	CCS not recognised in 2016 as stone cover much denser
D35	IR.MIR.KR.Lhyp.Ft IR.HIR.KSed.LsacSac	IR.HIR.KFaR.LhypR.Ft IR.MIR.KR.Lhyp.Ft	Absence of LhypR probably due to deeper run in 2016 (conditions prevented shallower coverage)
D36	IR.HIR.KSed.LsacSac	IR.HIR.KFaR.Ala	Differs markedly in red turf abundance, as well as apparently in *Alaria* and *Laminaria* abundance
D37	IR.HIR.KSed.LsacSac	IR.MIR.KR.Lhyp.GzFt	Band of *S. latissima* present in deeper water in 2008, so apparent temporal change possibly consequence of location difference
D38	IR.MIR.KR.Lhyp.GzFt IR.HIR.KSed.LsacSac	IR.MIR.KR.Lhyp.GzFt	Apparent absence of LsacSac in 2008 possibly due to difference in tracking or change in kelp dominance locally
D49	IR.MIR.KR.Lhyp.Ft IR.HIR.KSed.LsacSac	IR.HIR.KFaR.Ala IR.HIR.KSed.LsacSac	Ala possibly absent in 2016 as conditions prevented access to shallow water
D50	CR.MCR.EcCr.FaAlCr.Bri CR.MCR.EcCr.FaAlCr.Pom IR.HIR.KSed.LsacSac	CR.MCR.EcCr.FaAlCr.Pom IR.HIR.KSed.LsacSac	Bri not observed in 2008, although camera apparently did not traverse this area
D52	SS.SMx.CMx.OphMx	SS.SMX.CMx.FluHyd	Greater ophiuroid density in 2016

Table 1.3 continued

Site	Biotope 2016	Biotope 2008	Comment
D53	SS.SCS.CCS.PomB	SS.SCS.CCS	Shell cover absent in 2008
D57	IR.HIR.KFaR.LhypR.Ft	IR.HIR.KFaR.LhypR.Ft IR.HIR.KFaR.Ala	Only difference is that *Alaria* is apparently denser in patches in 2008 (possibly in slightly shallower areas)
D59	IR.HIR.KSed.LsacSacCR.MCR.EcCr.FaAlCrCR.MCR.EcCr.FaAlCr.Adig	CR.MCR.EcCr.FaAlCr.Pom	Absence of KSed in 2008 will be due to deeper camera track. FaAlCr biotopes probably the same in both years, interpretations differing slightly due to route of camera
D61	CR.MCR.EcCr.FaAlCr.Bri	CR.MCR.EcCr.FaAlCr.Adig	Habitat gained dense ophiuroids in 2016, otherwise similar
D66	IR.HIR.KSed.LsacSac	IR.MIR.KR.Lhyp.Ft	Switch from *Laminaria hyperborea* to *Saccharina latissima* dominated forest
D68	CR.MCR.EcCr.FaAlCr CR.MCR.EcCr.FaAlCr.Pom CR.MCR.EcCr.FaAlCr.Adig	CR.MCR.EcCr.FaAlCr.Pom CR.MCR.EcCr.FaAlCr.Adig SS.SCS.CCS	Coarse sediment patches far more extensive in 2008. *Spirobranchus* impoverished areas not obvious in 2008 but possibly present. Brown crust appears better developed in 2016. Differences possibly due to tracking
D71	CR.MCR.EcCr.FaAlCr.Bri SS.SCS.CCS	CR.MCR.EcCr.FaAlCr.Bri	Main habitat the same but sediment patches not traversed in 2008
D80	CR.MCR.EcCr.FaAlCr IR.HIR.KFaR.FoR.Dic	IR.HIR.KSed.LsacSac	2016 run deeper than 2008
D84	CR.MCR.EcCr.FaAlCr.Bri	CR.MCR.EcCr.FaAlCr.Flu	Dense ophiuroids in 2016 but no *Flustra* apparent
D86	SS.SCS.CCS	CR.MCR.EcCr.FaAlCr.Bri	Temporal change in stone density and size, as well as *Ophiocomina* density. Habitat change suggests either storm-mediated or locational difference
D89	SS.SCS.CCS SS.SMx.CMx.OphMx	CR.MCR.EcCr.FaAlCr.Adig SS.SMX.CMx.FluHyd	Different substrate initially indicates locational difference
D91	CR.MCR.EcCr.FaAlCr CR.MCR.EcCr.AdigVt	CR.MCR.EcCr.FaAlCr.Adig SS.SCS.CCS	Coarse sand waves and hydroid turf absent in 2016. Differences probably due to tracking
D92	IR.MIR.KR.Lhyp.GzFt IR.HIR.KSed.LsacSac	IR.MIR.KR.Lhyp.GzFt	*Laminaria hyperborea* biotope present in both years. KSed possibly present in 2008
D95	IR.HIR.KSed.LsacSac	IR.HIR.KSed.Sac	*Saccorhiza* replaced by *Laminaria* in 2016
D99	IR.HIR.KSed.LsacSac	IR.HIR.KSed.XKScrR	2008 biotope could be interpreted as LsacSac, although rock clearly sediment dusted in 2008 and supporting algal turf
D103	SS.SCS.CCS CR.MCR.EcCr.FaAlCr.Adig	CR.MCR.EcCr.FaAlCr.Adig	Tracking difference

Table 1.3 continued

Site	Biotope 2016	Biotope 2008	Comment
D105	IR.HIR.KSed.LsacSac	IR.MIR.KR.Lhyp.GzFt	Quite different kelp community
D106	IR.MIR.KR.Lhyp.GzFt	IR.HIR.KFaR.Ala	Switched from strong *Alaria* dominance to *Laminaria* dominance in 2016
D111	CR.MCR.EcCr.FaAlCr.Bri	CR.MCR.EcCr.FaAlCr.Adig	Only clear difference is that there were patches in 2008 where *Ophiocomina* was sparse
D115	CR.MCR.EcCr.FaAlCr.Adig	CR.MCR.EcCr.FaAlCr.Adig SS.SMX.CMx.OphMx	Partial match. OphMx not recorded initially in 2016 but possibly in distance but not traversed. Very small patches of OphMx could be recognised later on
D116	CR.MCR.EcCr.FaAlCr.Pom SS.SCS.CCS	CR.MCR.EcCr.FaAlCr.Adig	Habitat so different that locational difference or area inundated with sand in 2016
D118	IR.MIR.KR.Lhyp.GzFt	IR.MIR.KR.Lhyp.GzFt IR.HIR.KSed.LsacSac	No change in main biotope but LsacSac not present in 2016 as gulley not traversed
D120	CR.MCR.EcCr.FaAlCr.Pom CR.MCR.EcCr.FaAlCr.Bri	CR.MCR.EcCr.FaAlCr.Bri SS.SMX.CMx.OphMx	Partial match. Ophiuroids less dense in 2016 and physical habitat difference (scattered stones on coarse sand in 2008) suggest difference in video tracking towards end

ANNEX 2: MAERL SURVEY DATA

Table 2.1 Maerl distribution video survey data. SACFOR abundance of live maerl along sectors of video runs, with positional and depth data.

Site sector	Date	Start latitude	Start longitude	End latitude	End longitude	Depth start CD (m)	Depth end CD (m)	SACFOR
M1_1	06/08/2016	60.006385	-1.206331	60.006726	-1.206250	27.5		A
M1_2	06/08/2016	60.006741	-1.206247	60.006891	-1.206183			N
M1_3	06/08/2016	60.006905	-1.206178	60.007306	-1.206029			A
M1_4	06/08/2016	60.007313	-1.206033	60.007656	-1.205934			N
M1_5	06/08/2016	60.007670	-1.205924	60.007891	-1.205891			F
M1_6	06/08/2016	60.007901	-1.205896	60.008210	-1.205814			A
M1_7	06/08/2016	60.008222	-1.205818	60.008491	-1.205778			N
M1_8	06/08/2016	60.008509	-1.205776	60.008540	-1.205758			F
M1_9	06/08/2016	60.008556	-1.205748	60.008798	-1.205625			A
M1_10	06/08/2016	60.008810	-1.205619	60.009000	-1.205574			N
M1_11	06/08/2016	60.009013	-1.205569	60.009127	-1.205544			O
M1_12	06/08/2016	60.009140	-1.205542	60.010486	-1.205073			A
M1_13	06/08/2016	60.010501	-1.205070	60.011244	-1.204778		27.8	N
M2_1	06/08/2016	60.004453	-1.206727	60.005531	-1.206721	26.3		N
M2_2	06/08/2016	60.005536	-1.206712	60.005692	-1.206588			R
M2_3	06/08/2016	60.005702	-1.206586	60.005738	-1.206571			O
M2_4	06/08/2016	60.005741	-1.206568	60.005854	-1.206513			F
M2_5	06/08/2016	60.005863	-1.206514	60.005945	-1.206513			C
M2_6	06/08/2016	60.005950	-1.206516	60.006095	-1.206478		27.7	A
M7_1	10/08/2016	60.008854	-1.207649	60.008833	-1.207170	25.9		O
M7_2	10/08/2016	60.008835	-1.207160	60.008927	-1.206169			F
M7_3	10/08/2016	60.008930	-1.206167	60.008991	-1.205487			C
M7_4	10/08/2016	60.008992	-1.205478	60.008988	-1.204998			O
M7_5	10/08/2016	60.008987	-1.204994	60.009173	-1.203982			A
M7_6	10/08/2016	60.009172	-1.203980	60.009169	-1.203941			F
M7_7	10/08/2016	60.009169	-1.203941	60.009171	-1.203933		25.7	N
M8_1	10/08/2016	60.010348	-1.206939	60.010418	-1.206821	27.9		N
M8_2	10/08/2016	60.010418	-1.206820	60.010473	-1.206652			R
M8_3	10/08/2016	60.010476	-1.206648	60.010500	-1.206621			O
M8_4	10/08/2016	60.010502	-1.206616	60.010604	-1.206470			F
M8_5	10/08/2016	60.010607	-1.206470	60.011050	-1.206082			C
M8_6	10/08/2016	60.011047	-1.206072	60.011123	-1.205938			N
M8_7	10/08/2016	60.011124	-1.205932	60.011222	-1.205649			A
M8_8	10/08/2016	60.011217	-1.205664	60.011220	-1.205653		27.7	N
M9	10/08/2016	60.004643	-1.202809	60.004280	-1.202657	29.7	31	R
M10_1	11/08/2016	60.010587	-1.207591	60.011081	-1.208755	27.7		O
M10_2	11/08/2016	60.011087	-1.208759	60.011228	-1.209054		28.1	R
M11_1	11/08/2016	60.009774	-1.206838	60.009920	-1.207245	26.1		R
M11_2	11/08/2016	60.009925	-1.207263	60.010082	-1.207665			N
M11_3	11/08/2016	60.010083	-1.207684	60.010496	-1.208602			O
M11_4	11/08/2016	60.010505	-1.208614	60.010606	-1.208766		27	N
M12_1	11/08/2016	60.009517	-1.203352	60.009565	-1.203563	27.1		N

Table 2.1 continued

Site sector	Date	Start latitude	Start longitude	End latitude	End longitude	Depth start CD (m)	Depth end CD (m)	SACFOR
M12_2	11/08/2016	60.009567	-1.203578	60.009732	-1.204089			R
M12_3	11/08/2016	60.009733	-1.204113	60.009765	-1.204280			O
M12_4	11/08/2016	60.009772	-1.204301	60.009842	-1.204416			C
M12_5	11/08/2016	60.009853	-1.204421	60.010124	-1.205082		27.2	A
M13	11/08/2016	60.008922	-1.202156	60.009526	-1.203580	25.4	27.3	N
M14_1	11/08/2016	60.008503	-1.206154	60.008583	-1.206381	26.2		O
M14_2	11/08/2016	60.008597	-1.206404	60.008629	-1.206452			F
M14_3	11/08/2016	60.008642	-1.206456	60.008769	-1.206663			C
M14_4	11/08/2016	60.008783	-1.206692	60.008877	-1.206932			F
M14_5	11/08/2016	60.008882	-1.206948	60.009873	-1.208506			O
M14_6	11/08/2016	60.009872	-1.208510	60.009945	-1.208647			R
M14_7	11/08/2016	60.009951	-1.208660	60.010043	-1.208845		24.3	N
M15	11/08/2016	60.007292	-1.206027	60.007817	-1.207131	25.6	23.4	N
M16_1	11/08/2016	60.007658	-1.202335	60.007710	-1.202454	25.4		A
M16_2	11/08/2016	60.007722	-1.202464	60.007744	-1.202518			C
M16_3	11/08/2016	60.007750	-1.202523	60.007955	-1.202970			F
M16_4	11/08/2016	60.007966	-1.202992	60.008561	-1.204176			N
M16_5	11/08/2016	60.008571	-1.204189	60.008649	-1.204281			C
M16_6	11/08/2016	60.008660	-1.204291	60.009445	-1.205702			A
M16_7	11/08/2016	60.009453	-1.205714	60.009754	-1.206212		26.3	C
M19	11/08/2016	60.006144	-1.207861	60.006856	-1.208387	26.7	23.5	N
M20_1	11/08/2016	60.005769	-1.201196	60.006101	-1.201429	30.1		N
M20_2	11/08/2016	60.006110	-1.201437	60.006200	-1.201492			R
M20_3	11/08/2016	60.006206	-1.201496	60.006595	-1.201929			N
M20_4	11/08/2016	60.006600	-1.201939	60.006649	-1.202008			C
M20_5	11/08/2016	60.006657	-1.202021	60.006787	-1.202188			A
M20_6	11/08/2016	60.006795	-1.202194	60.007344	-1.203063		25.2	N
M21_1	11/08/2016	60.005258	-1.202983	60.005555	-1.203285	28.7		O
M21_10	11/08/2016	60.006976	-1.204641	60.007317	-1.204975		25.8	N
M21_2	11/08/2016	60.005569	-1.203287	60.005716	-1.203400			C
M21_3	11/08/2016	60.005725	-1.203421	60.006035	-1.203720			A
M21_4	11/08/2016	60.006039	-1.203728	60.006313	-1.203927			C
M21_5	11/08/2016	60.006318	-1.203943	60.006419	-1.204081			F
M21_6	11/08/2016	60.006427	-1.204091	60.006646	-1.204305			R
M21_7	11/08/2016	60.006654	-1.204313	60.006706	-1.204347			O
M21_8	11/08/2016	60.006717	-1.204353	60.006816	-1.204445			C
M21_9	11/08/2016	60.006826	-1.204454	60.006965	-1.204640			A
M22_1	11/08/2016	60.010586	-1.205562	60.010691	-1.205770	27.1		R
M22_10	11/08/2016	60.011251	-1.206666	60.011658	-1.207290			R
M22_11	11/08/2016	60.011665	-1.207299	60.011733	-1.207410			O
M22_12	11/08/2016	60.011740	-1.207420	60.012202	-1.208140		28	R
M22_2	11/08/2016	60.010701	-1.205785	60.010830	-1.206025			O
M22_3	11/08/2016	60.010836	-1.206039	60.010959	-1.206255			A
M22_4	11/08/2016	60.010965	-1.206263	60.010991	-1.206304			O
M22_5	11/08/2016	60.011000	-1.206307	60.011074	-1.206454			A
M22_6	11/08/2016	60.011086	-1.206462	60.011137	-1.206525			C
M22_7	11/08/2016	60.011150	-1.206529	60.011196	-1.206584			F

Table 2.1 continued

Site sector	Date	Start latitude	Start longitude	End latitude	End longitude	Depth start CD (m)	Depth end CD (m)	SACFOR
M22_8	11/08/2016	60.011201	-1.206600	60.011214	-1.206620			R
M22_9	11/08/2016	60.011216	-1.206631	60.011241	-1.206655			C
M24_1	11/08/2016	60.003569	-1.201584	60.005134	-1.201942	33.6		O
M24_2	11/08/2016	60.005145	-1.201945	60.005218	-1.201956			F
M24_3	11/08/2016	60.005231	-1.201959	60.005538	-1.201977			O
M24_4	11/08/2016	60.005547	-1.201991	60.005713	-1.202005		28.4	C
M25_1	11/08/2016	60.002650	-1.201965	60.003063	-1.202043	33.1		N
M25_2	11/08/2016	60.003075	-1.202051	60.003551	-1.202156		33.1	R
D109	10/08/2016	60.006418	-1.201988	60.006583	-1.201543	26.8	28.2	N
D110	06/08/2016	60.009134	-1.202697	60.009813	-1.202493	25.0	26.7	N
D111	10/08/2016	60.008352	-1.199326	60.008567	-1.198326	23.6	23.3	N
D148_1	10/08/2016	60.004161	-1.200756	60.004484	-1.200027	33.2		R
D148_2	10/08/2016	60.004492	-1.200017	60.004530	-1.199865			O
D148_3	10/08/2016	60.004533	-1.199866	60.004537	-1.199724		31.7	R
D150_1	06/08/2016	60.004969	-1.205082	60.005591	-1.204864	27.5		R
D150_2	06/08/2016	60.005605	-1.204858	60.005631	-1.204848			O
D150_3	06/08/2016	60.005636	-1.204841	60.005652	-1.204813			F
D150_4	06/08/2016	60.005662	-1.204804	60.005905	-1.204714		27.3	C
D151	06/08/2016	60.007189	-1.208810	60.007747	-1.208674	23.9	24.2	N

Table 2.2 SACFOR abundance of taxa recorded during the MNCR phase 2 survey along maerl transect ML01. Bracketed values signify localised abundance.

Taxa	SACFOR
Leucosolenia sp.	P
Sycon ciliatum	R
Anthoathecata sp.	P
Clytia sp.?	P
Kirchenpaueria pinnata	O
Halecium halecinum	R
Hydrallmania falcata	R
Alcyonium digitatum	R
Caryophyllia (Caryophyllia) smithii	R
Lineus longissimus	R
Eupolymnia nebulosa	P
Lanice conchilega	R
Spirobranchus triqueter	R
Balanus balanus	P
Tectura spp.	P
Gibbula sp.	R
Buccinum undatum	P
Polinices egg rings	P
Pecten maximus	F
Ensis sp. siphons	P
Glycymeris glycymeris	P
Philine sp	P
Nudibranchia indet.	P
Sepiola atlantica	R
Eledone cirrhosa	O

Taxa	SACFOR
Aetea sica	P
Amathia gracilis	P
Scrupocellaria scruposa	P
Asterias rubens juv.?	P
Solaster endeca	P
Luidia ciliaris	F
Ophiocomina nigra	A(C)
Ophiopholis aculeata	P
Amphipholis squamata	P
Echinus esculentus	F(C)
Neopentadactyla mixta	P
Clavelina lepadiformis	A
Ascidia virginea	R
Callionymus sp.	R
Pomatoschistus pictus	R
Gadus morhua juv.	P
Cruoria sp.?	R
Phymatolithon calcareum	A(S)
Corallinaceae pink crust	(A)
Plocamium cartilagineum	P
Pterothamnion plumula	R
Pseudolithoderma extensum	R
Dictyota dichotoma	R
Chlorophyta spp. shell borers	R

ANNEX 3: REEF TRANSECT DATA

Table 3.1 Zone boundaries, substrates, dominant biota and biotopes recorded along reef transects at five sites. Italicized biotopes signify uncertainty.

Zone	Tape distance (m)		Height above chart datum (m)		Substrate	Biogenic features of zone	Biotopes
	start	end	start	end			
TRANSECT: North Isle N (XX01)							
I1	0.00	14.20	8.46	4.78	uneven bedrock	*Verrucaria maura* and grey lichens	LR.FLR.Lic.YG
I2	14.20	16.80	4.78	2.20	near-vertical creviced rock wall	*Verrucaria maura* with abundant *Melaraphe neritoides* and *Littorina saxatilis*	LR.FLR.Lic.Ver.Ver
I3	16.80	19.13	2.20	1.80	gently sloping bedrock platform	*Verrucaria maura* with dense *Semibalanus balanoides*, *Patella vulgata* and *Porphyra umbilicalis*	LR.HLR.MusB.Sem.Sem, LR.FLR.Rkp.Cor.Cor
I4	19.13	23.84	1.80	1.04	gently sloping bedrock platform	Abundant *Mytilus edulis* with dense cover of *Porphyra umbilicalis*	LR.HLR.MusB.MytB, LR.FLR.Rkp.Cor.Cor
S1	23.84	43.00	1.04	-5.10	bedrock slope with vertical wall at base and gullies in upper part of zone.	*Laminaria hyperborea* forest with understorey of foliose red algae and band of *Alaria esculenta* with *Mytilus edulis* at upper margin	IR.MIR.KR.Lhyp.Ft, IR.HIR.KFaR.Ala.Myt
S2	43.00	72.00	-5.10	-6.50	bedrock and boulders with patches of rounded pebbles and cobbles	mixed kelp forest	IR.HIR.KSed.LsacSac
S3	72.00	114.00	-6.50	-10.40	bedrock (10-20%) and boulders (70%) with patches of coarse sand, pebbles and gravel (10-20%)	mixed kelp forest	IR.HIR.KSed.LsacSac
S4	114.00	130.00	-10.40	-11.80	large boulders (60-70% with patches of coarse sand, pebbles and gravel (30-40%)	mixed kelp forest	IR.HIR.KSed.LsacSac

Table 3.1 continued

Zone	Tape distance (m)		Height above chart datum (m)		Substrate	Biogenic features of zone	Biotopes
	start	end	start	end			
TRANSECT: The Cellar NE (XX05)							
I1	0.00	3.65	4.20	3.55	inclined, creviced, bedrock platforms with small near-vertical faces and small pools	*Verrucaria maura* and *Urospora penicilliformis* with *Melaraphe neritoides* and *Littorina saxatilis*	LR.FLR.Lic.Ver.Ver, LR.FLR.Rkp.G
I2	3.65	7.65	3.55	2.48	inclined, creviced, bedrock platforms with small near-vertical faces and small pools	*Verrucaria maura* with *Blidingia minima*, *Porphyra umbilicalis*, *Patella vulgata* and sparse barnacles	LR.FLR.Lic.Ver.B, LR.FLR.Rkp.Cor.Cor
I3	7.65	14.70	2.48	0.81	inclined, creviced, stepped bedrock with near-vertical faces and large pool (3 m x 0.75 m x 0.2 m deep) on west side	Dense *Porphyra umbilicalis* and *Semibalanus balanoides* with dense *Mytilus edulis* in crevices	LR.HLR.MusB.MytB, LR.FLR.Rkp.Cor.Cor
S1	14.70	42.00	0.81	-3.70	bedrock with pool on lower shore	Dense *Alaria esculenta* with *Laminaria digitata* and *L. hyperborea* in lower region	IR.HIR.KFaR.Ala.Myt, *IR.HIR.KFaR.Ala.Ldig, LR.FLR.Rkp.Cor.Cor*
S2	42.00	95.00	-3.70	-15.90	irregular bedrock with ridges and gullies; large gulley from 75 - 95 m on tape, 3-4 m deep	*Laminaria hyperborea* forest with *Alaria esculenta* and rich understorey of foliose red algae; dense *Desmarestia aculeata* in large gully	*IR.HIR.KFaR.LhypR.Ft,* IR.HIR.KSed.DesFilR
S3	95.00	127.00	-15.90	-14.50	irregular bedrock with ridges and small gullies	mixed kelp forest	IR.HIR.KSed.LsacSac
S4	127.00	132.00	-14.50	-20.00	steeply sloping bedrock	*Saccharina latissima* park	*IR.HIR.KSed.LsacSac*
TRANSECT: Scarfi Stack N (XX07)							
I1	0.0	6.4	7.00	5.31	uneven creviced bedrock with small rockpools	grey and yellow lichens with *Prasiola crispa* patches	LR.FLR.Lic.YG, LR.FLR.Lic.Pra, LR.FLR.Rkp.G
I2	6.4	16.0	5.31	2.73	uneven creviced	sparse *Verrucaria maura* with *Prasiola crispa*	LR.FLR.Lic.Ver.Ver, LR.FLR.Lic.Pra,

Table 3.1 continued

Zone	Tape distance (m)		Height above chart datum (m)		Substrate	Biogenic features of zone	Biotopes
	start	end	start	end			
					bedrock with small rockpools	patches	LR.FLR.Rkp.G
I3	16.0	18.9	2.73	1.99	flat inclined creviced bedrock	*Verrucaria maura* with *Porphyra umbilicalis*, *Blidingia minima*, *Patella vulgata* and sparse barnacles	LR.FLR.Lic.Ver.B
I4	18.9	24.0	1.99	0.50	flat inclined fissured bedrock with small rockpool	dense *Semibalanus balanoides*, *Porphyra umbilicalis and Mytilus edulis*	LR.HLR.MusB.MytB, LR.FLR.Rkp.Cor.Cor
S1	24.0	27.0	0.50		bedrock slope	*Laminaria hyperborea* forest with dense upper band of *Alaria esculenta*	*IR.HIR.KFaR.Ala, IR.MIR.KR.Lhyp.GzFt*
S2	27.0	32.0		-6.40	steep bedrock slope	mixed kelp forest	IR.HIR.KSed.LsacSac
S3	32.0	50.0	-6.40	-6.90	bedrock with large gully at 45 m on tape	mixed kelp forest	IR.HIR.KSed.LsacSac
S4	50.0	73.0	-6.90	-14.00	bedrock slope	mixed kelp forest	IR.HIR.KSed.LsacSac
S5	73.0	79.0	-14.00	-16.20	bedrock slope	mixed kelp forest	IR.HIR.KSed.LsacSac
S6	79.0	102.0	-16.20	-21.80	sloping bedrock slabs and extensive areas of boulders with sand infill	mixed kelp park	IR.HIR.KSed.LsacSac
S7	102.0	128.0	-21.80	-24.90	sloping bedrock slabs and areas of sandy sediment	*Alcyonium digitatum* with patchy turf of hydroids and filamentous and foliose algae	*CR.MCR.EcCr.FaAlCr.Adig*, SS.SCS.CCS
S8	128.0	135.0	-24.90	-26.10	slope of boulders (25%) and sand (75%) including sand-covered rock	patchy hydroid turf	*CR.HCR.XFa*, SS.SCS.CCS
TRANSECT: West Ham (XX08)							
I1	0.0	4.5	2.35	2.02	angular, uneven bedrock with small rockpools	grey and yellow lichens	LR.FLR.Lic.YG, LR.FLR.Rkp.G
I2	4.5	8.4	2.13	2.01	uneven bedrock with small and medium rockpools	mostly *Verrucaria maura* with grey and yellow lichens in elevated areas	LR.FLR.Lic.Ver.Ver, LR.FLR.Rkp.G, LR.FLR.Lic.YG
I3	8.4	10.7	2.22	1.55	uneven, creviced	*Verrucaria maura* with *Patella vulgata* and	LR.FLR.Lic.Ver.B

Table 3.1 continued

Zone	Tape distance (m)		Height above chart datum (m)		Substrate	Biogenic features of zone	Biotopes
	start	end	start	end			
					bedrock	sparse barnacles	
I4	10.7	14.7	1.28	0.69	slightly irregular, creviced, sloping bedrock	mosaic of *Fucus vesiculosus* and *Semibalanus balanoides*	LR.MLR.BF.FvesB
S1	14.7	22.0	0.69	-0.05	irregular, sloping bedrock	*dense Fucus serratus* with *Himanthalia elongata* and *Laminaria digitata*	LR.MLR.BF.Fser
S2	22.0	43.0	-0.05	-1.55	slope of bedrock and boulders	mixed kelp forest dominated by *Laminaria hyperborea* with *Saccharina latissima* and *Alaria esculenta*	IR.HIR.KSed.LsacSac
S3	43.0	52.0	-1.55	-2.05	slope of bedrock and boulders	mixed kelp forest dominated by *Saccharina latissima*	IR.HIR.KSed.LsacSac
S4	52.0	65.0	-2.05	-2.45	medium sand with scattered boulders	dense kelp and other algae, much of it unattached, and sand patches with *Arenicola marina*	*SS.SMP.KSwSS,* SS.SSA.IMuSa.AreISa
S5	65.0	75.0	-2.45	-2.45	medium sand with hummocks	*Dense Arenicola marina* with patches of unattached algae	SS.SSA.IMuSa.AreISa, *SS.SMP.KSwSS*
TRANSECT: Under Lee (XX10)							
I1	0.00	3.05	5.46	3.87	uneven, steep, stepped bedrock	dense *Verrucaria maura* with *Melaraphe neritoides* and patches of *Blidingia minima*	LR.FLR.Lic.Ver.Ver
I2	3.05	4.13	3.87	2.79	near-vertical bedrock	dense *Verrucaria maura* and *Melaraphe neritoides* with *Patella vulgata*	LR.FLR.Lic.Ver.B
I3	4.13	10.05	2.79	1.07	irregular, steep, stepped bedrock with small rockpool	*Semibalanus balanoides*, *Patella vulgata* and *Porphyra umbilicalis*	LR.HLR.MusB.Sem.Sem, LR.FLR.Rkp.Cor.Cor
I4	10.05	13.33	1.07	1.15	uneven, stepped, bedrock ledges with rockpools	dense *Semibalanus balanoides*, *Porphyra umbilicalis and Mytilus edulis*	LR.HLR.MusB.MytB, LR.FLR.Rkp.Cor.Cor
I5	13.33	20.00	1.15	0.2	uneven, stepped, bedrock ledges with rockpools	dense *Alaria esculenta*, *Mytilus edulis* and *Semibalanus balanoides*	IR.HIR.KFaR.Ala.Myt, LR.FLR.Rkp.FK
S1	20.00	20.00	0.2	-3.0	bedrock wall	*Alaria esculenta* band	IR.HIR.KFaR.Ala
S2	20.00	70.00	-3	-11.1	bedrock plateau and slope	*Laminaria hyperborea* dominated kelp forest, with upper band of dense foliose red algae	IR.HIR.KFaR.LhypR.Ft, *IR.HIR.KSed.LsacSac*

Table 3.1 continued

Zone	Tape distance (m)		Height above chart datum (m)		Substrate	Biogenic features of zone	Biotopes
	start	end	start	end			
S3	70.00	91.50	-11.1	-17.5	bedrock slope	*Saccharina latissima* dominated, mixed kelp forest	IR.HIR.KSed.LsacSac
S4	91.50	100.50	-17.5	-25.1	bedrock cliff	dense *Alcyonium digitatum* and *Spirobranchus* spp.	CR.MCR.EcCr.AdigVt
S5	100.50	114.00	-25.1	-29.6	boulders (80%) with cobbles, pebbles and coarse sand	algal and *Spirobranchus* encrusted rock with dense interstitial ophiuroids	CR.MCR.EcCr.FaAlCr.PomCR.MCR.EcCr.FaAlCr.Bri

Table 3.2 Profile data recorded along reef transects at five sites.

Feature	Tape distance (m)	Height above chart datum (m)	Horizontal distance (m)
TRANSECT: North Isle N (XX01)			
marker piton	0.00	8.5	0.00
Top of slope	3.84	7.4	3.70
Bottom of slope	8.40	4.4	7.15
zone I1/I2 boundary	14.20	4.8	12.94
zone I2/I3 boundary	16.80	2.2	13.26
zone I3/I4 boundary	19.13	1.8	15.55
zone I4/S1 boundary	23.84	1.0	20.20
Crest	26.37	1.3	22.72
water's edge	27.04	0.6	23.39
	28.50	-0.3	24.82
edge of gulley	30.00	-2.4	26.19
edge of gulley	32.00	-2.4	28.19
on top of plateau	35.00	-0.5	31.19
half way up step	40.00	-1.9	35.96
zone S1/S2 boundary (base of step)	43.00	-5.1	37.04
	45.00	-4.9	39.04
Dip	50.00	-5.4	44.04
top of rise	53.00	-4.6	46.90
vertical partway up step	55.00	-4.8	48.86
base of step	56.00	-5.3	49.84
	60.00	-5.6	53.83
edge of boulder	61.00	-5.6	54.78
top of boulder	64.00	-3.3	57.78
vertical halfway up side of boulder	65.00	-4.3	57.78
base of boulder	67.00	-5.6	59.30
	70.00	-5.8	62.30
zone S2/S3 boundary	72.00	-6.5	64.30
	75.00	-6.0	67.30
	80.00	-6.9	72.27
	85.00	-7.2	77.25
	90.00	-8.5	82.22
	95.00	-8.3	87.18
	100.00	-9.3	92.14
	105.00	-9.4	97.10
	110.00	-10.2	102.07
zone S3/S4 boundary	114.00	-10.4	106.05
	115.00	-10.6	107.05
	120.00	-11.2	112.03
	125.00	-11.2	117.00
	130.00	-11.8	121.96
TRANSECT: The Cellar NE (XX05)			
marker piton	0.00	4.2	0.00
zone I1/I2 boundary	3.65	3.6	3.59
zone I2/I3 boundary	7.65	2.5	7.44

Table 3.2 continued

Feature	Tape distance (m)	Height above chart datum (m)	Horizontal distance (m)
zone I3/S1 boundary	14.70	0.8	14.29
water's edge	17.50	0.5	17.08
	20.00	0.2	19.56
	25.00	-0.6	24.53
	30.00	-0.8	29.52
	31.00	-0.6	30.52
Gulley	34.80	-2.0	34.32
	35.00	-0.5	34.52
	40.00	-1.8	39.35
zone S1/S2 boundary	42.00	-3.7	41.29
	45.00	-3.4	44.25
	50.00	-4.3	49.20
	55.00	-3.7	54.17
	60.00	-4.9	59.17
	62.00	-3.6	61.11
	65.00	-5.6	63.34
base of step	66.00	-6.5	63.78
	70.00	-7.2	67.75
top of cliff	73.50	-8.7	70.81
	75.00	-10.1	71.35
	78.00	-13.4	74.35
	82.00	-14.5	78.19
	85.00	-13.5	81.02
	90.00	-14.9	85.92
zone S2/S3 boundary	95.00	-15.9	90.82
	100.00	-14.9	95.72
bottom of step	101.00	-15.7	96.72
	105.00	-15.9	100.71
	106.00	-15.9	101.71
	110.00	-12.6	101.71
	115.00	-12.5	106.63
	115.80	-12.5	107.16
edge of step	116.00	-12.2	107.36
	120.00	-12.7	111.36
	125.00	-13.8	116.10
zone S3/S4 boundary	127.00	-14.5	117.97
	130.00	-17.9	120.97
base of step	132.00	-20.0	122.97
TRANSECT: Scarfi Stack N (XX07)			
marker piton	0.00	7.0	0.00
zone I1/I2 boundary	6.40	5.3	6.17
zone I2/I3 boundary	16.00	2.7	15.42
zone I3/I4 boundary	18.90	2.0	18.22
zone I4/S1 boundary	24.00	0.5	23.10
zone S1/S2 boundary	25.00	-0.3	23.70
	30.00	-4.5	26.41

Table 3.2 continued

Feature	Tape distance (m)	Height above chart datum (m)	Horizontal distance (m)
zone S2/S3 boundary	32.00	-6.4	27.04
	35.00	-6.6	30.04
	40.00	-7.3	35.04
	45.00	-8.0	40.02
	46.00	-8.2	41.00
	46.50	-6.8	41.50
zone S3/S4 boundary	50.00	-6.9	45.00
	55.00	-9.0	49.70
	60.00	-9.6	54.58
	65.00	-12.3	59.35
	70.00	-12.5	64.15
zone S4/S5 boundary	73.00	-14.0	66.75
	75.00	-14.3	68.73
zone S5/S6 boundary	79.00	-16.2	72.54
	80.00	-16.1	73.50
	85.00	-18.0	78.30
	90.00	-18.7	83.15
	95.00	-19.3	88.07
	100.00	-20.3	92.97
zone S6/S7 boundary	102.00	-21.8	94.93
	105.00	-22.1	97.90
	110.00	-22.5	102.85
	115.00	-22.8	107.84
	120.00	-23.3	112.84
	125.00	-23.4	117.75
zone S7/S8 boundary	128.00	-24.9	120.62
	130.00	-25.0	122.55
	135.00	-26.1	127.32
TRANSECT: West Ham (XX08)			
marker piton	0.00	2.3	0.00
zone I1/I2 boundary	4.50	2.0	4.49
Peak	6.15	2.2	6.13
zone I2/I3 boundary	8.40	2.0	8.37
zone I3/I4 boundary	10.68	1.5	10.61
zone I4/S1 boundary	14.70	0.7	14.53
water's edge	15.00	0.6	14.82
	20.00	0.3	19.82
zone S1/S2 boundary	22.00	0.0	21.82
	25.00	-0.4	24.82
	30.00	-0.6	29.79
	35.00	-1.0	34.78
	40.00	-1.6	39.76
zone S2/S3 boundary	43.00	-1.6	42.75
	45.00	-1.4	44.75
	50.00	-1.9	49.74
zone S3/S4 boundary	52.00	-2.1	51.72

Table 3.2 continued

Feature	Tape distance (m)	Height above chart datum (m)	Horizontal distance (m)
	55.00	-2.3	54.68
	60.00	-2.3	59.68
zone S4/S5 boundary	65.00	-2.5	64.67
	70.00	-2.5	69.67
	75.00	-2.5	74.67
TRANSECT: Under Lee (XX10)	XX10		
marker piton	0.00	5.5	0.00
zone I1/I2 boundary	3.05	3.9	2.60
zone I2/I3 boundary	4.13	2.8	2.60
top of step	8.10	2.7	6.57
zone I3/I4 boundary	10.05	1.1	7.63
top of step	12.65	1.8	10.13
zone I4/I5 boundary	13.33	1.2	10.42
top of step	14.20	1.3	11.28
bottom of step	15.15	0.3	11.28
Peak	17.50	1.0	13.53
water's edge	18.50	0.4	14.33
zone I5/S1 boundary	20.00	0.2	15.81
zone S1/S2 boundary	20.00	-3.0	15.81
	25.00	-1.6	20.64
	30.00	-3.1	25.64
	35.00	-1.6	30.61
	40.00	-1.9	35.59
	45.00	-1.6	40.54
top of step	50.00	-3.6	45.49
	55.00	-5.1	50.32
	60.00	-7.2	54.16
base of step	64.00	-10.2	56.80
top of steep slope	65.00	-9.7	57.67
zone S2/S3 boundary (halfway up steep slope)	70.00	-11.1	62.47
base of steep slope	75.00	-14.3	66.86
	80.00	-16.1	71.63
	85.00	-16.1	76.50
	90.00	-17.3	81.36
zone S3/S4 boundary (top of cliff)	91.50	-17.5	82.84
half way up cliff	95.00	-20.7	84.26
	100.00	-25.1	86.64
zone S4/S5 boundary (base of cliff)	100.50	-25.1	87.14
	105.00	-26.9	91.41
	110.00	-27.7	96.08
	114.00	-29.6	99.86

Table 3.3 SACFOR abundance records for taxa recorded in zones during the MNCR phase 2 survey of the transect at North Isle N (XX01). Localised abundance values are bracketed. [1]in pools, [2]in crevices, [3]on kelp stipes, [4]on kelp fronds, [5]in upper part of zone, [6]in lower part of zone.

Taxa	Zone							
	I1	**I2**	**I3**	**I4**	**S1**	**S2**	**S3**	**S4**
Haliclona (Rhizoniera) viscosa						R		
Halichondria (Halichondria) panicea				R[1]	P[5]			
Obelia geniculata							P[4]	R
Alcyonium digitatum					(O)	(O)	R	
Urticina felina				P[1]				P
Sagartia elegans						P		
Sagartia elegans?							P	
Actinia equina				PC[1]				
Eupolymnia nebulosa							P	P
Salmacina dysteri/Filograna implexa						R		
Spirobranchus triqueter						R	R	R
Verruca stroemia								P
Balanidae spp.						R	R	
Balanus balanus							P	R
Balanus crenatus								R
Semibalanus balanoides			A	F	F(A)[5]			
Amphipoda tubes								P
Galathea strigosa							R	O
Pagurus bernhardus							R	P
Pagurus prideaux?								P
Pisidia longicornis							P	
Necora puber					P	P	P	P
Cancer pagurus						P		
Prostigmata sp.	P							
Polyplacophora indet.								P
Tectura spp.							F	F
Calliostoma zizyphinum					P	R	R	R
Patella spp.			A[1]		C			
Patella vulgata		F	C(A)	C	(C)[5]			
Patella pellucida					P[4]		P	O
Gibbula cineraria						O	F	F
Nassarius incrassatus							P	P
Nucella lapillus				P				
Lacuna vincta						C	C	(C)
Littorina saxatilis		P(A)						

Table 3.3 continued

Taxa	Zone							
	I1	**I2**	**I3**	**I4**	**S1**	**S2**	**S3**	**S4**
Littorina saxatilis?			PP[1]					
Melarhaphe neritoides		P(S)						
Anomiidae spp.								P
Mytilus edulis			RR[1]	S	(F)[5]			
Pectiniidae sp.								P
Polycera quadrilineata							O	O
Cradoscrupocellaria reptans								R
Scrupocellaria scruposa						P		P
Cellepora pumicosa						P		
Electra pilosa						O	R	P
Membranipora membranacea						O	R[4]	R
Cribrilina annulata								P
Escharella immersa								P
Celleporella hyalina								P
Plagioecia patina								P
Parasmittina trispinosa						R	R	R
Oshurkovia littoralis					P			
Tubulipora sp.								P
Disporella hispida								P
Asterias rubens					P		O	P
Crossaster papposus							P	R
Henricia sp.						R		
Henricia sanguinolenta					F		R	
Ophiuroidea indet.							P	
Ophiothrix fragilis					(A)[2]			
Ophiura albida							P	
Echinus esculentus					C	C	C	C
Ascidiacea sp. colonial						R		
Lissoclinum perforatum					P			
Botryllus schlosseri					R			
Labrus bergylta							O	
Taurulus bubalis						R	P	P
Cyclopterus lumpus							P	
Gobiusculus flavescens							P	
Ramalina siliquosa	P							
Tephromela atra var. *atra*	C							
Xanthoria parietina	O							
Caloplaca spp.	R							
Anaptychia runcinata?	R							
Ochrolechia parella	R							
Verrucaria maura	A	S	A					
Grey lichen spp. encrusting	O							
Porphyra umbilicalis			C	S	(C)[5]			

Table 3.3 continued

Taxa	Zone							
	I1	**I2**	**I3**	**I4**	**S1**	**S2**	**S3**	**S4**
Colaconema sp.					P[5]			
Mastocarpus stellatus					R[5]			
Callophyllis laciniata					F	F		
Palmaria palmata					P[3]	O	O[3]	
Bonnemaisonia hamifera								P
Corallina officinalis				OP[1]	O[5]			
Corallinaceae pink crust			S[1]	S[1]	A(S)[5]	C	C	C
Plocamium cartilagineum					F	O	O[3]	
Ptilota gunneri						F[3]	P[3]	
Aglaothamnion sepositum				C	R[5]			
Ceramium shuttleworthianum			C	O	P[5]			
Ceramium pallidum					P[5]			
Membranoptera alata						P[3]		
Hypoglossum hypoglossoides								P
Phycodrys rubens					P		P	
Cryptopleura ramosa					F	F	O	F
Pterosiphonia parasitica							P	P
Polysiphonia brodiei					P[5]			
Polysiphonia elongata?			P[1]					
Polysiphonia stricta					P	P[3]	P[3]	
Cutleria multifida (*Aglaozonia* phase)					C		A	A
Ectocarpaceae sp.			P[1]					
Ectocarpus fasciculatus					P[5]		O[3]	
Feldmannia irregularis?			P					
Asperococcus fistulosus?			P[1]					
Scytosiphon lomentaria			PF[1]		R[5]			
Himanthalia elongata					R[5]			
Laminaria hyperborea					A	A	C	F(C)
Saccharina latissima						C	F	F(C)
Alaria esculenta				P[1]	P(A)[5]		A(S)	A(S)
Saccorhiza polyschides						F	F	F
Desmarestia aculeata						F	P	R
Desmarestia viridis						P		
Acrosiphonia arcta			A[1]	CO[1]	P[5]			
Ulva linza			R	C				
Ulva prolifera			R[1]	P				
Blidingia minima			R					

Table 3.4 SACFOR abundance records for taxa recorded in zones during the MNCR phase 2 survey of the transect at The Cellar NE (XX05). Localised abundance values are bracketed. [1]in pools, [2]in crevices, [3]on kelp stipes, [4]on kelp fronds, [5]in upper part of zone, [6]in lower part of zone.

Taxa	Zone						
	I1	**I2**	**I3**	**S1**	**S2**	**S3**	**S4**
Leucosolenia variabilis?					R	P	
Halichondria (Halichondria) panicea			RP[1]	RR[1]			
Obelia geniculata					R[4]	F[4]	
Kirchenpaueria pinnata							O
Alcyonium digitatum						R	R
Haliclystus sp.				R			
Urticina felina					P	P	F
Actinia equina			PP[1]	P[1]			
Sagartia elegans					R		
Corynactis viridis							R
Caryophyllia (Caryophyllia) smithii						R	O
Nereididae sp.						P	
Eupolymnia nebulosa						P	
Salmacina dysteri/Filograna implexa						R	
Spirobranchus triqueter					R	R	R
Serpula vermicularis/Protula tubularia							R
Balanidae spp.		R(C[2])			R		R
Chthamalus stellatus		R					
Semibalanus balanoides		R	C	CP[1]			
Necora puber							P
Prostigmata sp.	P						
Polyplacophora sp.							P
Tectura spp.				F			
Calliostoma zizyphinum						R	P
Patella spp.		C[1]	P[1]	F(C)C[1]			
Patella vulgata		F(C)	C(A[2])	P			
Gibbula cineraria					O	O	F
Nucella lapillus			FP[1]	PF[1]			
Trivia monacha							P
Lacuna vincta				C	(F)		
Littorina saxatilis	PP[1]						
Littorina saxatilis?		P	P				
Melarhaphe neritoides	(S)	(S)					
Mytilus edulis	P[1]		O[2]	(F)[5]			

Table 3.4 continued

Taxa	Zone						
	I1	**I2**	**I3**	**S1**	**S2**	**S3**	**S4**
Aplysia punctata						R	
Onchidoridídae sp.					P		
Polycera faeroensis							R
Polycera quadrilineata					C[4]	(C)	O
Bugulina flabellata					R		
Cradoscrupocellaria reptans					F	F	
Celleporina caliciformis					P		
Electra pilosa					P	P	P
Membranipora membranacea				O[4]	R[4]	R[4]	O[4]
Parasmittina trispinosa						R	R
Oshurkovia littoralis				O	O		
Crisia eburnea					F	F(A)	
Antedon bifida						O	F
Antedon sp. pentacrinoids							O(F)
Asterias rubens							F
Henricia sp.				R			O
Ophiura albida							P
Echinus esculentus						R	F
Clavelina lepadiformis					F	R	R
Diplosoma spongiforme					R		
Sidnyum turbinatum					P		
Polyclinidae sp.?					R		
Polyclinum aurantium						R	
Botryllus schlosseri				R	R	P	
Ascidia virginea							P
Ascidia mentula							O
Taurulus bubalis			P[1]			P	P
Verrucaria maura	F	C					
Verrucaria mucosa?			P				
Porphyra umbilicalis	R	C	S	P			
Porphyra sp.				PP[1]			
Acrochaetium alariae				P			
Mastocarpus stellatus			RP[1]	FO[1]			
Callophyllis laciniata						O	
Palmaria palmata				R[3]	R[3]		
Lomentaria clavellosa				R			
Corallina officinalis		P[1]	RS[1]	RS[1]	R		
Corallinaceae pink crust		S[1]	P[1]	A			R
Hildenbrandia sp.	P[1]	P[1]	P	P			
Plocamium cartilagineum				R	P	O	P
Compsothamnion thuyoides							P
Ptilota gunneri						P	
Aglaothamnion sepositum			F	P			

Table 3.4 continued

Taxa	Zone						
	I1	**I2**	**I3**	**S1**	**S2**	**S3**	**S4**
Ceramium shuttleworthianum			R				
Membranoptera alata					P	P	
Delesseria sanguinea					P(A)	O(A)	O
Phycodrys rubens						R	
Nitophyllum punctatum						R	
Cryptopleura ramosa					(F)	F	
Brongniartella byssoides						R	
Polysiphonia brodiei			P[1]				
Polysiphonia stricta				R	A[3]		
Polysiphonia stricta?		P[1]					
Polysiphonia sp.						P	
Odonthalia dentata					A	A	
Cutleria multifida							S
Ectocarpaceae sp.		P[1]					
Ectocarpus fasciculatus				P			
Scytosiphon lomentaria		P[1]					
Laminaria spp.				C			
Laminaria digitata				P			
Laminaria hyperborea				P	A	A(C)	
Saccharina latissima					F(A)	F(C)	C
Alaria esculenta			P[1]	A(S)A[1]	C	C	
Saccorhiza polyschides						C(A)	
Desmarestia aculeata					R(A)	R(C)	R
Desmarestia viridis						P	
Dictyota dichotoma			P[1]		P	O(A)	A
Urospora penicilliformis	F						
Acrosiphonia arcta		P[1]	(C)P[1]	R			
Ulva compressa		P[1]					
Ulva lactuca			P[1]				
Ulva linza			R				
Ulva prolifera?	P[1]						
Blidingia minima		C	P				
Codium fragile subsp. *atlanticum*		P[1]					
Chlorophyta encrusting sp.				P			

Table 3.5 SACFOR abundance records for taxa recorded in zones during the MNCR phase 2 survey of the transect at Scarfi Stack N (XX07). Localised abundance values are bracketed. [1]in pools, [2]in crevices, [3]on kelp stipes, [4]on kelp fronds, [5]in upper part of zone, [6]in lower part of zone.

Taxa	Zone											
	I1	**I2**	**I3**	**I4**	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**
Clytia hemisphaerica						P	O				P	
Obelia geniculata						F	C[4]	(O)[4]	P		P	R
Nemertesia antennina										O	R	O
Plumularia setacea										O	P	O
Kirchenpaueria pinnata										F	R	O
Halecium halecinum										O	F	C
Halecium beanii											P	
Abietinaria sp.?										P		
Alcyonium digitatum						P	O			R	A	O
Cerianthus lloydii											P	P
Urticina felina						O		P		R	O	
Actinia equina				P								
Metridium dianthus					F							
Sagartia elegans											P	
Sagartia elegans?				PA[1]								
Caryophyllia (Caryophyllia) smithii										R	P	
Phyllodoce sp.										P		
Lanice conchilega												P
Eupolymnia nebulosa											O(F)	
Sabella pavonina											P	
Spirobranchus triqueter						O		R		R(A)	R(S)	R(S)
Balanidae spp.						P	R	R			R	R
Balanus balanus										P		
Balanus crenatus								P				
Chthamalus stellatus			R									
Chthamalus montagui			R									
Semibalanus balanoides			O	A	C							
Pseudoprotella phasma										P	P	P
Pandalus montagui										R	R	R
Caridea sp.								P				
Galathea sp.											P	
Pagurus bernhardus											O	R
Macropodia sp.											O	
Macropodia rostrata											P	P
Inachus sp.												P

Table 3.5 continued

Taxa	Zone											
	I1	**I2**	**I3**	**I4**	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**
Hyas coarctatus											R	P
Necora puber							P			P		
Prostigmata sp.	P	P										
Polyplacophora indet.						O						R
Tectura spp.						F	O	O				
Calliostoma zizyphinum				P			P			R	O	
Patella spp.				A[1]	(F)[5]							
Patella vulgata			C									
Gibbula cineraria						O	F	F	F	R	O	R
Nassarius incrassatus										P		
Buccinum undatum											O	
Nucella lapillus				A[2]								
Rissoa parva										P		
Lacuna vincta						F	(C)[4]	(A)[4]	O			
Anomiidae spp.						O	R					
Pecten maximus										P		P
Mytilus edulis				F(A)								
Modiolus modiolus										R	O	F
Eubranchus farrani									P	P		
Aldisa zetlandica?										P		
Polycera quadrilineata						O	R	P				
Limacia clavigera											P	
Nudibranchia sp.								P				
Eledone cirrhosa										P	P	
Electra pilosa						P	P			P	P	
Membranipora membranacea						F	(F)[4]	(R)[4]	P	P	P	
Haplopoma impressum											P	
Parasmittina trispinosa						R					R	R
Disporella hispida											P	R
Alcyonidium diaphanum												P
Antedon bifida										F	P(A)	O
Asterias rubens						P				P	R	
Luidia ciliaris										P	O	P
Ophiocomina nigra										R		
Ophiothrix fragilis											P(A)	
Ophiura albida									F(C)	F(C)	C	P
Echinus esculentus					C	P	P	C	C	C	F	C
Ciona intestinalis												P
Clavelina lepadiformis										R		
Botryllus schlosseri											R	
Ascidia mentula											O	
Gadus morhua juvenile							P					
Callionymus lyra									P		R	O
Pomatoschistus pictus											P	P

Table 3.5 continued

Taxa	Zone											
	I1	**I2**	**I3**	**I4**	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**
Taurulus bubalis							O				P	
Ramalina siliquosa	R											
Tephromela atra var. *atra*	P											
Xanthoria parietina	O	R										
Caloplaca spp.	O	R										
Verrucaria maura	O	O(C)	F									
Light grey lichen sp.	O											
Dark grey lichen sp.	F											
Foliose light grey lichen sp.	F											
Porphyra umbilicalis			C	S								
Callophyllis laciniata							O		O	P		
Euthora cristata										P		
Palmaria palmata					(A)	O		O				
Lomentaria orcadensis										P		
Bonnemaisonia hamifera										P		
Corallina officinalis				A[1]								
Corallinaceae pink crust				A[1]	C	A	O	R	R	F	A	O
Hildenbrandia sp.				PP[1]								
Plocamium cartilagineum						O		O		P	R	R
Aglaothamnion bipinnatum										P	P	
Aglaothamnion sepositum				P								
Ceramium shuttleworthianum				P								
Hypoglossum hypoglossoides								P				
Delesseria sanguinea										P	R	R
Phycodrys rubens										P	O	
Cryptopleura ramosa							O	R(O)			P	
Polysiphonia sp.											P	
Filamentous red algae											P	
Cutleria multifida						A	S	S	S	S	C	C
Ectocarpus sp.							O					
Laminaria hyperborea					A		C	C	C	C		
Saccharina latissima						A	A	A(C)	A			
Alaria esculenta					A		C					
Saccorhiza polyschides						C	C(A)	F		F	F	
Desmarestia aculeata						R	R	R		R		
Dictyota dichotoma									O	C	R(O)	
Prasiola crispa	A	F										
Acrosiphonia arcta				CC[1]								
Ulva intestinalis	P[1]	P[1]										
Ulva lactuca						O						
Ulva linza				P								
Blidingia minima			C									
Armeria maritima	R											

Table 3.6 SACFOR abundance records for taxa recorded in zones during the MNCR phase 2 survey of the transect at West Ham (XX08). Localised abundance values are bracketed. [1]in pools, [2]in crevices, [3]on kelp stipes, [4]on kelp fronds, [5]in upper part of zone, [6]in lower part of zone.

Taxa	Zones								
	I1	**I2**	**I3**	**I4**	**S1**	**S2**	**S3**	**S4**	**S5**
Leucosolenia sp.						R			
Leucosolenia variabilis?								R	
Sycon ciliatum						R			
Grantia compressa					R				
Hymeniacidon perlevis						R			
Halichondria (Halichondria) panicea					O	R		R	
Clytia hemisphaerica						P			
Obelia geniculata					P	P	R[4]	P[4]	
Haliclystus salpinx								R	
Urticina felina					R	O	P		
Actinia equina			P	OP[1]	F				
Metridium dianthus					R				
Sagartia elegans							R		
Arenicola marina								O(C)	C
Lanice conchilega								P	O
Spirobranchus triqueter								O	
Balanus crenatus						O	O	C	
Semibalanus balanoides			R[2]	AP[1]	O				
Idotea balthica								P	
Caridea sp.						P			
Pagurus bernhardus									R
Hyas araneus								O	
Necora puber						R		O	P
Cancer pagurus					R	P			
Carcinus maenas	P[1]		P					O	O
Prostigmata sp.		P							
Tectura spp.					P		O		
Patella spp.					C	P			
Patella vulgata			F(C[2])	CP[1]	P				
Patella pellucida						O(C)	P	P	
Gibbula cineraria						F	C	O	
Nucella lapillus			P[2]	C					
Rissoa parva								P	
Lacuna vincta						(C)[4]	O	A	
Littorina obtusata				P					
Littorina saxatilis			P[2]	P					

Table 3.6 continued

Taxa	Zones								
	I1	**I2**	**I3**	**I4**	**S1**	**S2**	**S3**	**S4**	**S5**
Littorina saxatilis?				P					
Mytilus edulis				P[2]					
Polycera quadrilineata						R	R	P	P
Limacia clavigera									P
Alcyonidium gelatinosum					R				
Alcyonidium hirsutum					O	P	R	P	
Celleporina caliciformis							P		
Electra pilosa					P	P	P		
Membranipora membranacea						R	R[4]	P	
Callopora lineata							R		
Celleporella hyalina							P		
Flustrellidra hispida					O				
Haplopoma impressum						P			
Scruparia chelata						P			
Oshurkovia littoralis						O	R	R	
Asterias rubens							O	P	
Henricia sp.						R			
Echinus esculentus							P		
Diplosoma spongiforme							R	R	
Diplosoma spongiforme?						P			
Polyclinidae sp.?					P				
Sidnyum turbinatum								P	
Aplidium proliferum						P			
Botryllus schlosseri					R	R	R	R	
Pollachius virens						P			
Taurulus bubalis								O	
Gobiidae sp.									P
Ramalina siliquosa	R	R							
Tephromela atra var. *atra*	P	P							
Xanthoria parietina	O	R							
Caloplaca spp.		P							
Verrucaria maura	CP[1]	A	C	R					
Verrucaria mucosa?			P						
Grey lichen spp.	A	O							
Bryophyta spp.	R								
Porphyra umbilicalis			R	R					
Porphyra sp.					P				
Acrochaetium sp.								P	
Dumontia contorta					P				
Chondrus crispus							P		
Mastocarpus stellatus				R	O				
Callophyllis laciniata						R			
Cystoclonium purpureum						R		P	

Table 3.6 continued

Taxa	Zones								
	I1	**I2**	**I3**	**I4**	**S1**	**S2**	**S3**	**S4**	**S5**
Polyides rotunda								R	
Dilsea carnosa						R	O	O	O
Palmaria palmata							R		
Lomentaria articulata					P				
Corallina officinalis				P[1]	(C)	P			
Corallinaceae pink crust				S[1]	S	R	O	O	
Hildenbrandia sp.		P[1]	P						
Plocamium cartilagineum						P	R	R	
Ptilota gunneri						P	P		
Ceramium virgatum					P	P	P	O	
Ceramium shuttleworthianum				P[2]					
Ceramium pallidum				R					
Ceramium sp				P	P	R	P		
Membranoptera alata						P	P		
Delesseria sanguinea								O	
Phycodrys rubens						R	P	O	
Cryptopleura ramosa						R	R	R	
Osmundea osmunda					P				
Polysiphonia brodiei				P					
Polysiphonia fibrillosa							P	P	
Vertebrata lanosa				P					
Rhodomela confervoides						P	P		
Odonthalia dentata						O	O		
Ectocarpus fasciculatus						A	O	F	
Elachista fucicola				C	P				
Asperococcus fistulosus				P[1]					
Asperococcus fistulosus?								P	
Dictyosiphon foeniculaceus								A	
Dictyosiphon foeniculaceus?					P				
Leathesia marina				P[1]	P				
Chordaria flagelliformis				P[1]	P				
Filamentous brown algae									S
Sphacelaria sp.								P	
Fucus vesiculosus				C					
Fucus serratus				RP[1]	A	P			
Fucus spiralis			R						
Pelvetia canaliculata			R						
Halidrys siliquosa						R	O		
Himanthalia elongata					C				
Laminaria digitata					C				
Laminaria hyperborea						A	C(A)	F(A)	R
Saccharina latissima						C(A)	S	C	R
Alaria esculenta					R	C	C	F	R

Table 3.6 continued

Taxa	Zones								
	I1	**I2**	**I3**	**I4**	**S1**	**S2**	**S3**	**S4**	**S5**
Saccorhiza polyschides							C	O	
Desmarestia aculeata							R	P	
Prasiola stipitata		P							
Acrosiphonia arcta				R					
Ulva compressa			P	F	F			R	O
Ulva compressa?				P[1]					
Ulva intestinalis	P[1]	P[1]							
Ulva lactuca				P[1]	P	O	F	C	C
Ulva linza			P						
Ulva prolifera	P[1]								
Cladophora rupestris					R	P			
Cladophora sericea			P	R	P				
Cladophora sp.							P		
Schizonema sp.				P					
Armeria maritima	R								

Table 3.7 SACFOR abundance records for taxa recorded in zones during the MNCR phase 2 survey of the transect at Under Lee (XX10). Localised abundance values are bracketed. [1]in pools, [2]in crevices, [3]on kelp stipes, [4]on kelp fronds, [5]in upper part of zone, [6]in lower part of zone.

Taxa	Zones									
	I1	**I2**	**I3**	**I4**	**I5**	**S1**	**S2**	**S3**	**S4**	**S5**
Halichondria (Halichondria) panicea				R						
Myxillidae sp.?								R		
Myxilla (Myxilla) incrustans							R			
Porifera sp. yellow									R	
Clytia hemisphaerica									P	
Obelia geniculata							(F)[4]	P[4]	R	
Nemertesia antennina										P
Nemertesia ramosa?									R	
Kirchenpaueria pinnata									F	O(F)
Alcyonium digitatum							(A)		A	
Urticina felina								O		
Metridium dianthus									O	
Sagartia elegans							R	P		
Sagartia elegans?				P[1]	P[1]					
Corynactis viridis							R	R	R	
Caryophyllia (Caryophyllia) smithii							P	P	P	O
Chaetopterus variopedatus									R	
Eupolymnia nebulosa										P
Filograna implexa							R			
Spirobranchus triqueter							O	R(O)	S	C(A)
Balanidae spp.							R		R	
Chthamalus stellatus			R							
Chthamalus montagui			R							
Semibalanus balanoides			CC[1]	AA[1]	A	S[5]				
Pseudoprotella phasma									P	
Caprella septentrionalis							P			
Oniscidea sp.	P									
Pandalus montagui								O	O	O
Pagurus bernhardus								P	P	F(S)
Hyas araneus							O			
Necora puber							O		P	
Cancer pagurus										O
Tectura spp.								O		
Emarginula fissura								P		

Table 3.7 continued

Taxa	Zones									
	I1	**I2**	**I3**	**I4**	**I5**	**S1**	**S2**	**S3**	**S4**	**S5**
Calliostoma zizyphinum							O	R	O(F)	P
Patella spp.			C[1]	C[1]	P[1]	C[5]				
Patella vulgata		C	C(A)	CP[1]	C					
Patella pellucida							O			
Gibbula cineraria							P	P		R
Nassarius incrassatus										R
Nucella lapillus			P[1]	PC[1]	P					
Trivia monacha								P		
Lacuna vincta							O	O		
Littorina saxatilis		P[2]		P						
Littorina saxatilis?			P	P						
Melarhaphe neritoides	P[2]	S[2]								
Anomiidae spp.									P	R
Mytilus edulis			RP[1]	AR[1]	C	R				
Modiolus modiolus										C(F)
Polycera quadrilineata							P	P		
Limacia clavigera							P	P		R
Doto coronata							P			
Eledone cirrhosa										P
Cradoscrupocellaria reptans							R(O)			
Electra pilosa							P	P		
Membranipora membranacea							(O)[4]	P[4]		
Escharoides coccinea							P			
Parasmittina trispinosa							P		O	R
Crisia denticulata							P			
Antedon bifida								P	O	P
Asterias rubens							O	O	F	O
Marthasterias glacialis								P		
Crossaster papposus								F	F	R
Henricia sp.							O		P	
Luidia ciliaris								P		P
Ophiuroidea indet.								O		
Ophiocomina nigra										C(A)
Ophiothrix fragilis										A
Ophiopholis aculeata?							P			
Ophiura albida								P		P
Amphipholis squamata							P			
Echinus esculentus							F	C	C	A(C)
Clavelina lepadiformis							R			
Polyclinum aurantium							P			
Botryllus schlosseri							R			
Ascidia virginea								P		
Ascidia sp. juv.							P		P	
Callionymus lyra								R		
Trisopterus minutus										P

Table 3.7 continued

Taxa	Zones									
	I1	**I2**	**I3**	**I4**	**I5**	**S1**	**S2**	**S3**	**S4**	**S5**
Molva molva										R
Taurulus bubalis							P	R	P	P
Verrucaria maura	S	A	F							
Verrucaria mucosa?				P						
Porphyra umbilicalis			A(S)P[1]	S	C					
Acrochaetium secundatum?								P		
Mastocarpus stellatus			P[1]	R	R					
Callophyllis laciniata							O	P		
Kallymenia reniformis							P			
Palmaria palmata							(A)[3]	P		
Lomentaria articulata					P[1]					
Lomentaria orcadensis								P		
Corallina officinalis			R[1]	RA[1]	RC[1]					
Corallinaceae pink crust			A[1]	RC[1]	AP[1]	C[5]	A	F	O(A)	S
Hildenbrandia sp.		R	P	P	P					
Plocamium cartilagineum					P[1]	A[6]	(A)[5]	R		
Ptilota gunneri							P[3]	P		
Aglaothamnion sepositum			R	A	F		R			
Ceramium shuttleworthianum			(C)	P						
Membranoptera alata					P[1]					
Delesseria sanguinea							(A)[5]			
Phycodrys rubens							P[3]	P		
Nitophyllum punctatum							R			
Cryptopleura ramosa							O	R		
Polysiphonia brodiei				PP[1]						
Polysiphonia stricta							P	P		
Odonthalia dentata						A[6]	(S)[5]	P		
Cutleria multifida (Aglaozonia phase)							A	A		F
Ectocarpaceae sp.			P[1]					P		
Ectocarpus fasciculatus				P[1]						
Scytosiphon lomentaria				R						
Laminaria digitata				C[1]						
Laminaria hyperborea							A	A(C)		
Saccharina latissima							O	A(C)		
Alaria esculenta				A[1]	SS[1]	A	F(C)	P		
Saccorhiza polyschides							F	F(C)		
Desmarestia aculeata							P(F)	F		
Desmarestia viridis							P	P		
Dictyota dichotoma								R		
Acrosiphonia arcta				R	R					
Ulva sp.			PP[1]							
Blidingia minima	P	P	P							
Chlorophyta encrusting sp.				P	P					
Cyanobacteria spp.	P									

Table 3.8 Biota recorded in ten 0.25 m^2 quadrats in zone I4 of transect XX01. Percentage cover was recorded for dominant species, with presence (P) being noted for subdominants. Quadrats were placed haphazardly between the 20 and 23 m marks on the transect tape and within 3 m on the east side of the line and 3 m on the west side.

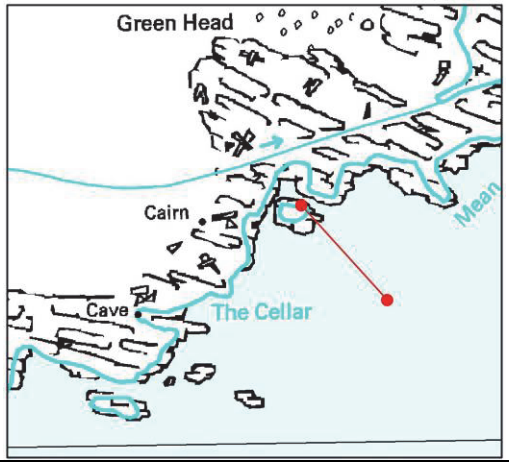
	Quadrat									
	Q1	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**
EAST (E) OR WEST (W)	E	E	E	E	E	W	W	W	W	W
Halichondria panicea					P					
Actinia equina		P	P		P	P	P		P	
Semibalanus balanoides	8	10	10	5	13	30	7	15	5	5
Littorina saxatilis								P		
Patella vulgata	P	P	P	P	P	P	P	P	P	P
Mytilus edulis	65	75	75	75	80	50	65	50	90	95
Aglaothamnion sepositum	10	10	10	2	5	20	20	10	5	1
Audouinella sp.	P	P		P		P	P	P	P	P
Acrochaetium secundatum			P							
Ceramium shuttleworthianum	P	P				P	P	P	P	P
Corallina officinalis			P	P	P		P	P		
Corallinaceae pink crust		P		P	P					
Erythrotrichia bertholdii				P						
Porphyra umbilicalis	75	60	95	70	75	60	75	65	88	83
Ectocarpus fasciculatus								P	P	P
Ectocarpus sp.					P					
Feldmannia irregularis?	P		P	P		P	P			
Punctaria sp.					P					
Alaria esculenta juvenile					P					
Scytosiphon lomentaria	P	P	P	P	P	P				P
Acrosiphonia arcta	P	P	P	P		P	P	P	P	P
Spongonema tomentosum										P
Ulva linza	20	20	7	5	3	45	20	13	5	5
Ulva prolifera	P		P		P				P	P
Fragilaria sp.					P					

Table 3.9 Biota recorded in ten 0.25 m^2 quadrats in zone I4 of transect XX07. Percentage cover was recorded for dominant species, with presence (P) being noted for subdominants. Quadrats were positioned at random either side of a 10 m tape perpendicular to the main transect tape on the south side at the 21 m mark. Quadrat locations were either on the upshore side or downshore side of the tape.

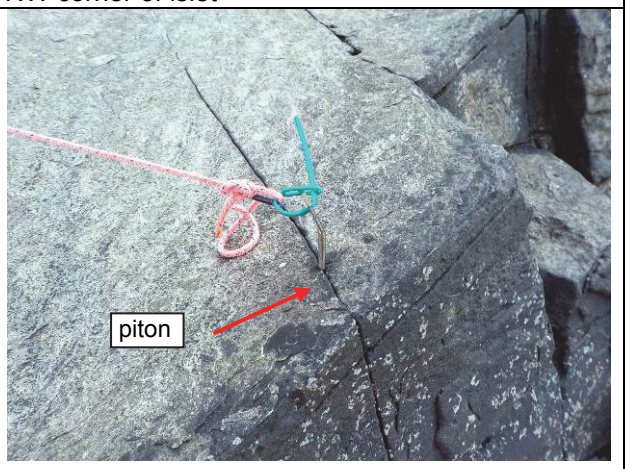
	Quadrat									
	Q1	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**
DISTANCE (m)	1.81	3.89	4.96	6.07	8.11	0.69	1.56	3.02	5.08	8.99
UPSHORE (U) OR DOWNSHORE (D)	D	D	D	D	D	U	U	U	U	U
Actiniaria sp. (white)	P	P	P			P	P		P	
Semibalanus balanoides	10	60	60	25	50	75	50	15	70	25
Idotea sp.	P		P		P	P	P			P
Patella vulgata		P		P		P	P	P	P	P
Nucella lapillus	P	P	P		P	P	P	P	P	P
Littorina saxatilis		P			P					
Mytilus edulis	75	18	40	50	30	25	55	60	25	75
Aglaothamnion sepositum	P	P	P	P	P	P	P	P	P	
Ceramium shuttleworthianum		P	P	P			P		P	
Corallina officinalis		P				P		P	P	
Hildenbrandia rubra		P	P		P	P		P	P	P
Mastocarpus stellatus		P		P			P	P	P	
Corallinaceae pink crust	P	P		P	P					
Porphyra umbilicalis	100	65	90	95	55	95	97	99	60	80
Acrosiphonia arcta	2	5	10	1	5	2	5	5	15	0
Ulva compressa			P	P		P				
Ulva linza			P	P	P				P	

Table 3.10 Relocation data for reef transect XX05 (The Cellar NE)

Transect name	The Cellar NE
Site code	XX05
Position of marker	59.99125°N 1.16957°W
Type of marker	Metal piton in rock crevice
Bearing of transect from top (°T)	143
Position of offshore transect end	59.99044°N 1.16817°W
Access	By boat to NW corner of islet



Transect location



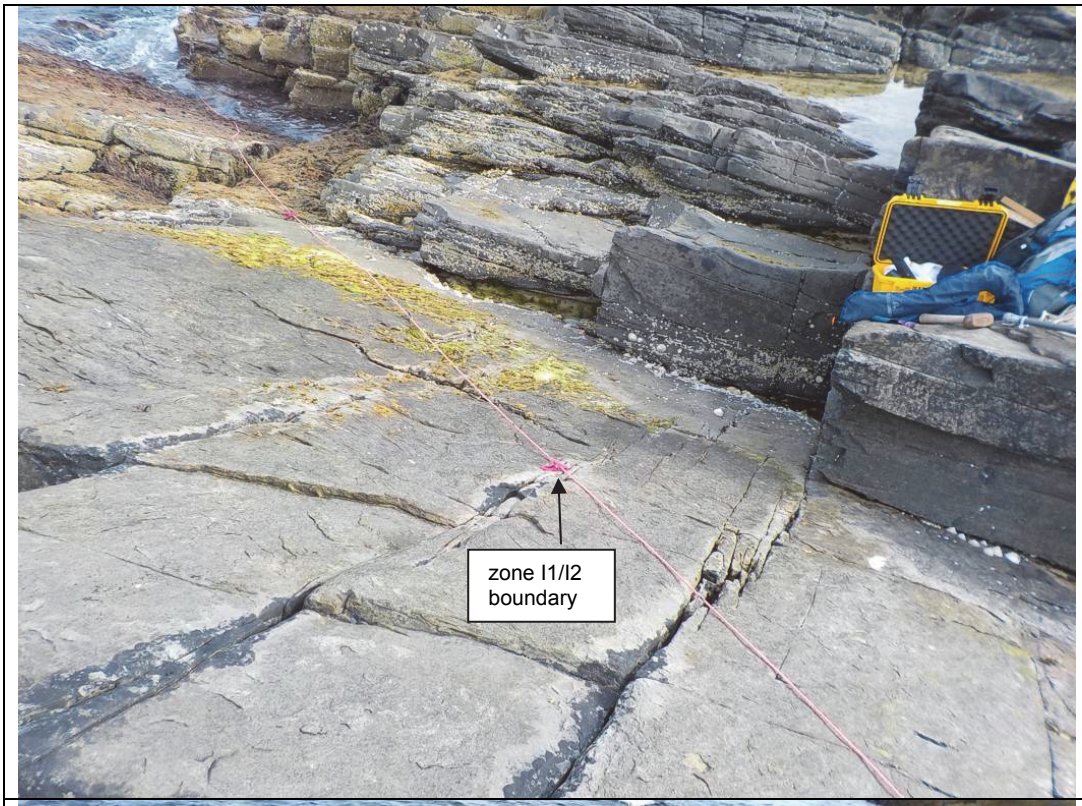
DSCN1167.jpg Transect marker piton in crevice

DSCN1164.jpg.

View down transect from above the transect marker (arrowed) from 59.99126°N 1.16961°W. Bearing 143°T

DSCN1165.jpg.

View of transect marker position (arrowed) from 59.99127°N 1.16964°W. Bearing 113°T



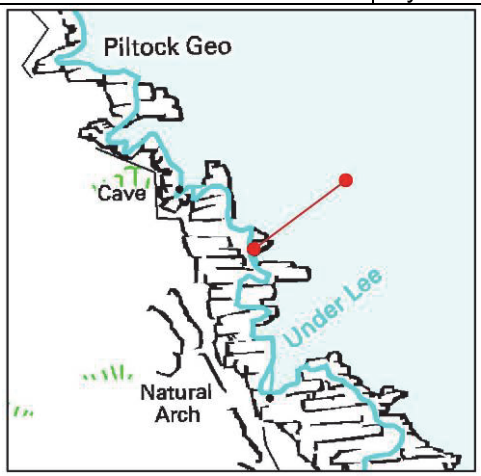
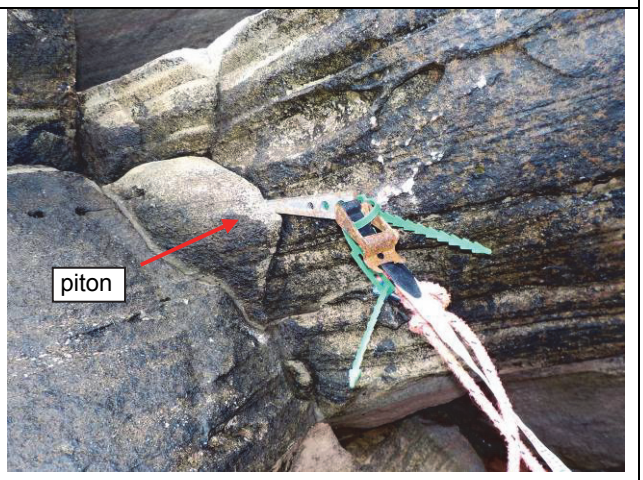
DSCN1169.jpg.

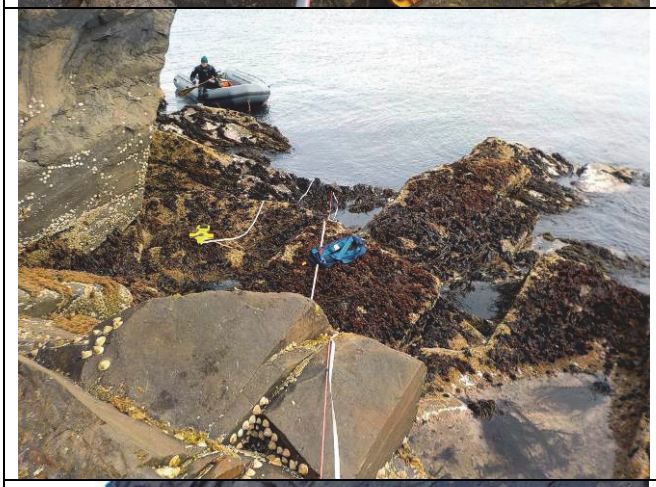
View of transect route - middle to lower region

DSCN1170.jpg.

View of transect route - lower region

Table 3.11 Relocation data for reef transect XX10 (Under Lee)

Transect name	Under Lee
Site code	XX10
Position of marker	59.99999°N 1.16722°W (possibly unreliable due to proximity of cliff)
Type of marker	Metal piton in rock crevice
Additional marker	60.00003°N 1.16740°W. Metal piton in rock crevice on a 50 cm vertical cliff adjacent to small rockpool (30 x 80 cm) in zone I3
Bearing of transect from top (°T)	52
Position of offshore transect end	60.000470°N 1.165850°W
Access	By boat
	
Transect location	DSCN1015.jpg Transect marker piton in crevice
	DSCN1016.jpg. View of main transect marker (arrowed) from 60.00001°N 1.16744°W. Bearing 283°T. Piton is c.1 m above base of c.10 m high bedrock cliff. Approximately 2 m below piton is rock platform c. 2.0 x 2.5 m in extent.
	DSCN1017.jpg. View of additional marker (arrowed) from 60.00003°N 1.16732°W.

	DSCN1014.jpg. View down transect from main marker 59.99999°N 1.16722°W (possibly unreliable due to proximity of cliff). Bearing 52°T
	DSCN1018.jpg. View down transect from additional marker 60.00003°N 1.16740°W. Bearing 52°T
	DSCN0985.jpg. View up transect. Bearing 232°T

ANNEX 4: SEA CAVE DATA

Annex 4.1 – Cave Inventory

This annex provides summary information on all known Mousa caves. This supersedes the corresponding tables and maps presented in Harries et al*. (2009). Details are tabulated in Annex 4.1.1 and locations are shown in Annex 4.1.2. Five caves were subject to detailed survey in 2008 & 2016 (sites. 3, 6, 9, 12 & 13) and detailed information on these is provided in Annex 4.1.4. Images and / or sketches of a further 21 sites are provided in Annex 4.1.3. These records include apparent cave sites and rock arches to avoid future scrutiny of the locations.*

Annex 4.1.1 – Tabulated summary of Mousa caves

Site	Est. length	Type	Survey history	Site code / name	Physical / environmental notes	Biological notes	Latitude	Longitude
1	25 m	Partially submerged	Posford Haskoning 2003 - notes & sketch HWU 2008 - notes & sketch	Cave below lighthouse	Entrance ~5 m wide, much wider above waterline. About 4 m water depth at entrance with a floor of very large boulders. About half way into the cave the passage narrows to ~2-3 m width and becomes shallower with boulders breaking the surface. The last 5 m of the cave has an intertidal boulder beach. Cave is well illuminated throughout.	Upper walls and ceiling with *Hildenbrandia* (**LR.FLR.CvOv.VmucHil**). Walls from waterline to ~2 m above with pink coralline crusts (S), barnacles & *Patella* (**LR.FLR.CvOv.ScrFa**). Entrance area with abundant foliose red algae (mainly *Membranoptera* but *Cryptopleura* also significant) on floor and left (southern) wall (**IR.FIR.SG.FoSwCC**), right (northern) wall with dwarf *Metridium* (S), *Tubularia* (A) & *Alcyonium* (**IR.FIR.SG.CrSpAsAn**). Half way into the cave sponge crusts (C, incl. *Clathrina* & *Halichondria*), foliose reds (O), pink coralline crusts (S), Barnacles (A), *Echinus* (C), *Laminaria* sporelings (p) (**IR.FIR.SG.FoSwCC**).	59.997079	-1.157174
2		No cave present	Posford Haskoning 2003 – notes HWU 2008 - notes	The Cellar	Cave is noted on the OS map and when viewed from the sea it appears a cave is present. The Cellar is a wide inlet ending in a rock wall and boulder beach. There is no cave present.		59.990378	-1.172312

Site	Est. length	Type	Survey history	Site code / name	Physical / environmental notes	Biological notes	Latitude	Longitude
3	115 m	Partially submerged	HWU 2008 - detailed survey HWU 2016 - repeat survey	MI08CV01 / MI16CV01 / Masti Geo Cave	Several metres wide for entire length. Floor 3 m BCD at entrance, rising to 0 m BCD ~50 m into cave, boulder beach at back of cave. Floor of rounded boulders, cobbles and pebbles. For full details refer to survey records for MI08CV01 & MI16CV01. Rear of cave not in total darkness but torches are required. NB This is not the 'cave at Masti Geo' noted in the Posford Haskoning 2003 survey - that cave corresponds to MI08CV03 studied during this survey.	Ceiling and walls above waterline either bare rock or dominated by *Hildenbrandia* sp. Floor and walls below waterline are scoured with a somewhat sparse encrusting fauna of calcareous tubeworms, barnacles and sponges. Towards the rear of the cave there are areas with large patches of *Clathrina coriacea* and *Dendrodoa grossularia*. For full details refer to survey records for MI08CV01 & MI16CV01.	59.9911	-1.177067
4	4 m	Intertidal	HWU 2008 - notes & sketch	no name	Three short (each ~4 m) parallel tunnels running approximately north-south through a rock outcrop. Tunnels slope steeply (~30deg) upward from water level on the south side and emerge ~3 m above water level on the north side. Shaded but almost fully illuminated.	Biota appeared similar to neighbouring areas of open shore.	59.992833	-1.181783
5	5 m	Intertidal	Posford Haskoning 2003 - cave presence noted HWU 2008 - notes & sketch	no name	Short (~5 m) intertidal cave running approximately west-east into the cliff a few metres to the south of cave MI08CV03. Cave floor slopes steeply (~30deg) upward from water level. Shaded but almost fully illuminated.	Biota appeared similar to neighbouring areas of open shore.	59.992833	-1.181783

Site	Est. length	Type	Survey history	Site code / name	Physical / environmental notes	Biological notes	Latitude	Longitude
6	85 m	Partially submerged	Posford Haskoning 2003 - notes & sketch HWU 2008 - detailed survey HWU 2016 - repeat survey	MI08CV03 / MI16CV03 / Cave south of the Broch	Tall narrow passage some 2-3 m in width for most of length. Floor 6-7 m BCD at entrance, rising gradually but remaining below chart datum for most of the length. Floor mostly composed of rounded boulders and cobbles. For full details refer to survey records for MI08 CV03 & MI16CV03. Rear of cave in total darkness. NB This corresponds to 'cave at Masti Geo' noted in the 2003 mapping survey.	Ceiling and walls above waterline either bare rock or dominated by *Hildenbrandia* sp. Floor and lower walls are scoured with a sparse fauna. Upper parts of walls below waterline relatively rich (especially on overhangs) with anemones, athecate hydroids and crisid bryozoans. Increased levels of scour apparent towards the rear of the cave. For full details refer to survey records for MI08CV03 & MI16CV03.	59.992833	-1.181783
7	9 m	Intertidal	Posford Haskoning 2003 – notes HWU 2008 - notes & sketch	no name	Cave fully intertidal & ~9 m in length. Runs approximately NE into the cliff. Floor slopes up steeply from the entrance to the back of the cave. Cave is almost divided into two parallel passages by two rock pillars. Shaded but almost fully illuminated.	At entrance near water level the biota was dominated by *Semibalanus*, *Porphyra* & *Mytilus* (**LR.HLR.MusB.MytB**). As tidal level increases further into the cave the dominant biota includes *Hildenbrandia*, green crusts & patches of *Audouinella* (**LR.FLR.CvOv.VmucHil** / **LR.FLR.CvOv.GCv**).	59.99305	-1.18175
8	10 m	Intertidal	Posford Haskoning 2003 – notes HWU 2008 - notes & sketch	no name	Two short parallel caves in the upper shore located within ~4 m of each other. Both caves run approximately east into the cliff. Cave to the north is ~3 m wide and ~4 m long. Cave to the south is ~3 m wide and ~10 m long. Cave floors of clean scoured cobbles and boulders with the appearance of a sloping storm beach. Cave to the north is fully illuminated throughout. Cave to the south is shaded but still well illuminated at the back.	Cave to the north with sparse *Porphyra*, *Enteromorpha* and *Patella* at the entrance (**LR.FLR.Eph.EntPor**). Clean scoured floor within the cave (**LR.FLR.CvOv.BarCv**) and green crusts on upper walls & ceiling (**LR.FLR.CvOv.GCv**). Cave to the south is similar with *Audouinella* present on the walls. Biota of both caves impoverished due to high position on shore and heavy scour.	59.994583	-1.1823

Site	Est. length	Type	Survey history	Site code / name	Physical / environmental notes	Biological notes	Latitude	Longitude
9	40 m	Partially submerged	HWU 2008 - detailed survey HWU 2016 - repeat survey	MI08CV02 / MI16CV02 / Cave at Scarfi Stack	Relatively low passage some 2-3 m in width and 3-4 m in height although narrowing where obstructed by rock pillars. Floor 1 m BCD at entrance, rising to 0 m BCD ~30 m into cave, boulder beach at back of cave. Floor mostly composed of rounded boulders and cobbles. For full details refer to survey records for MI08CV02 & MI16CV02. Rear of cave not in total darkness but torches are required. Approach to entrance is a narrow (<1 m in places) deep (4-5 m) surge gully with a rich community on the walls including *Grantia*, *Leucosolenia*, *Metridium* (dwarf form restricted to upper walls), *Halichondria*, *Clathrina* & some foliose red algae (**IR.FIR.SG.CrSpAsAn**).	Heavily scoured. Fauna sparse apart from a turf of small muddy sabellid tubes. For full details refer to survey records for MI08CV02 & MI16CV02.	59.998083	-1.18385
10	25 m	Partially submerged	HWU 2008 - notes & sketch	no name	Cave at the back of a kelp dominated surge gully. Cave about 25 m in length. Water depth ~1.5 m at entrance with boulder floor which rises to boulder beach at back of the cave. Constriction (<1 m width) just within entrance then cave widens before narrowing to the boulder beach at the rear. Cave runs approximately east into the cliff.	Biota very sparse. A few spirorbins & barnacles were noted (**IR.FIR.SG.CC.BalPom** / **IR.FIR.SG.CC.Mo**).	59.998667	-1.1849

Site	Est. length	Type	Survey history	Site code / name	Physical / environmental notes	Biological notes	Latitude	Longitude
11	15 m	Partially submerged	HWU 2008 - notes & sketch	no name	Cave runs approximately north into a headland. Cave about 15 m in length and ~6 m wide at entrance. Water depth ~2 m at entrance with floor of rounded smooth boulders rising to a boulder beach at back of the cave. Fully illuminated at back of the cave.	Lower walls with pink coralline crusts and *Patella* (**LR.FLR.CvOv.ScrFa**?). Upper walls with *Hildenbrandia* and *Verrucaria* (**LR.FLR.CvOv.VmucHil**).	59.999067	-1.185067
12	25 m	Partially submerged	HWU 2008 - detailed survey HWU 2016 - repeat survey	MI08CV04 / MI16CV04 / Cave near West Ham	Cave narrows to ~2 m just within entrance but becomes broader further back. Boulder floor ~1 m BCD just inside entrance rising to chart datum 18 m within cave. For full details refer to survey records for MI08CV04 & MI16CV04. Back of cave is dark and torches needed but some light present.	Below the waterline the rock surfaces had a scoured appearance and biota was generally sparse and dominated by crusts of spirorbid worms and a turf of polychaete tubes. For full details refer to survey records for MI08CV04 & MI16CV04.	59.999833	-1.18545
13	24 m	Partially submerged	Posford Haskoning 2003 - notes & sketch HWU 2008 - detailed survey HWU 2016 - repeat survey	MI08CV05 / MI16CV05 / Cave at Blow Geo	Cave narrows just within entrance but becomes broader further back. Boulder floor ~1 m BCD at entrance rising to chart datum 10 m within cave, boulder beach at back. Low ceiling. For full details refer to survey records for MI08CV05 & MI16CV05.	Below the waterline the rock surfaces had a scoured appearance and biota was generally sparse and dominated by crusts of spirorbid worms and a turf of polychaete tubes. For full details refer to survey records for MI08CV05 & MI16CV05.	60.003617	-1.192517

Site	Est. length	Type	Survey history	Site code / name	Physical / environmental notes	Biological notes	Latitude	Longitude
14	5 m	Partially submerged	HWU 2008 - notes & sketch	no name	Approach to entrance is an 8 m long gully enclosed by a partial boulder blockage at the seaward end. Cave is ~5 m in length, well illuminated throughout and runs ~NNW. Water depth of ~1 m at entrance with floor of boulders & gravel rising to a boulder beach at the rear of the cave.	Floor and areas at back of cave appear scoured (**IR.FIR.SG.CC.BalPom** / **IR.FIR.SG.CC.Mo**). Walls with *Patella*, *Actinia*, *Nucella*, Barnacles & coralline crusts (**LR.FLR.CvOv.ScrFa**?). Upper walls & ceiling with *Hildenbrandia* (**LR.FLR.CvOv.VmucHil**).	60.003717	-1.192717
15	5 m	Intertidal	HWU 2008 - notes & sketch	no name	Cave runs ~NNE into the side of a headland. About 5 m in length and 4 m in width. Fully intertidal consisting of a steep slope of large boulders. Well illuminated at back of the cave. Light seen at the back of the cave indicates it runs through the headland but no entrance was obvious on the opposite side and it is assumed that inconspicuous fissures well above tidal level were the source of the light.	Biota impoverished by scour (**LR.FLR.CvOv.BarCv**?).	60.005867	-1.192033
16	5 m	Partially submerged	Posford Haskoning 2003 – notes HWU 2008 - notes & sketch	no name	Cave runs ~N into the side of a headland. About 5 m in length. Water depth about 2 m at entrance with a floor of boulders & bedrock. Surge striking ceiling at back of cave prevented a thorough examination but it appears to end as a rock wall. Well illuminated at back of the cave.	Entrance area with barnacles, *Patella* & *Nucella*. Further back coralline crusts & *Actinia* were notable (**LR.FLR.CvOv.ScrFa**?).	60.007433	-1.192133

Site	Est. length	Type	Survey history	Site code / name	Physical / environmental notes	Biological notes	Latitude	Longitude
17	25 m	Partially submerged	Posford Haskoning 2003 - notes & sketch HWU 2008 – notes HWU 2016 - notes & sketch	Boom Cave	The site was inspected by Posford 2003 and viewed from a distance by HWU 2008 (could not be approached due to wave surge). Posford's 2003 reported that the entrance and passage size for the first 60 m is very large and is fully illuminated. The passage then becomes very narrow (~1 m) and continues for an estimated 40 m. At the point of narrowing the floor is several metres deep then rises gradually to reach the surface by the end of the cave. The site was inspected by a snorkeler in 2016. Extent estimates are considerably less than those reported by Posford. About 15 m of large well-illuminated cave passage with a water depth of ~3 m BCD led from the entrance to a boulder blockage at the waterline (with a water depth of ~2 m BCD). Beyond this, ~10 m of narrow and progressively shallower cave passage was visible. It appeared very unlikely that the passage would continue for a further 30 m as reported by Posford but this cannot be confirmed because the snorkeler was unable to go beyond the boulder blockage.	Previous survey records provide no records from the narrow inner part of the cave. Previous records from the fully illuminated outer part of the cave indicate **LR.FLR.CvOv.GCv** and **LR.FLR.CvOv.VmucHil** on the upper walls and ceiling, **LR.HLR.MusB.MytB** near the waterline and **IR.FIR.SG.FoSwCC** with **IR.FIR.SG.CrSpAsAn** on rock walls just inside the entrance. HWU 2016 noted red foliose algae and *Semibalanus* in the well-illuminated outer part of the cave and coralline crusts and *Semibalanus* beyond the boulder blockage. Green algal crusts were prominent on the supralittoral rock walls.	60.007526	-1.184938

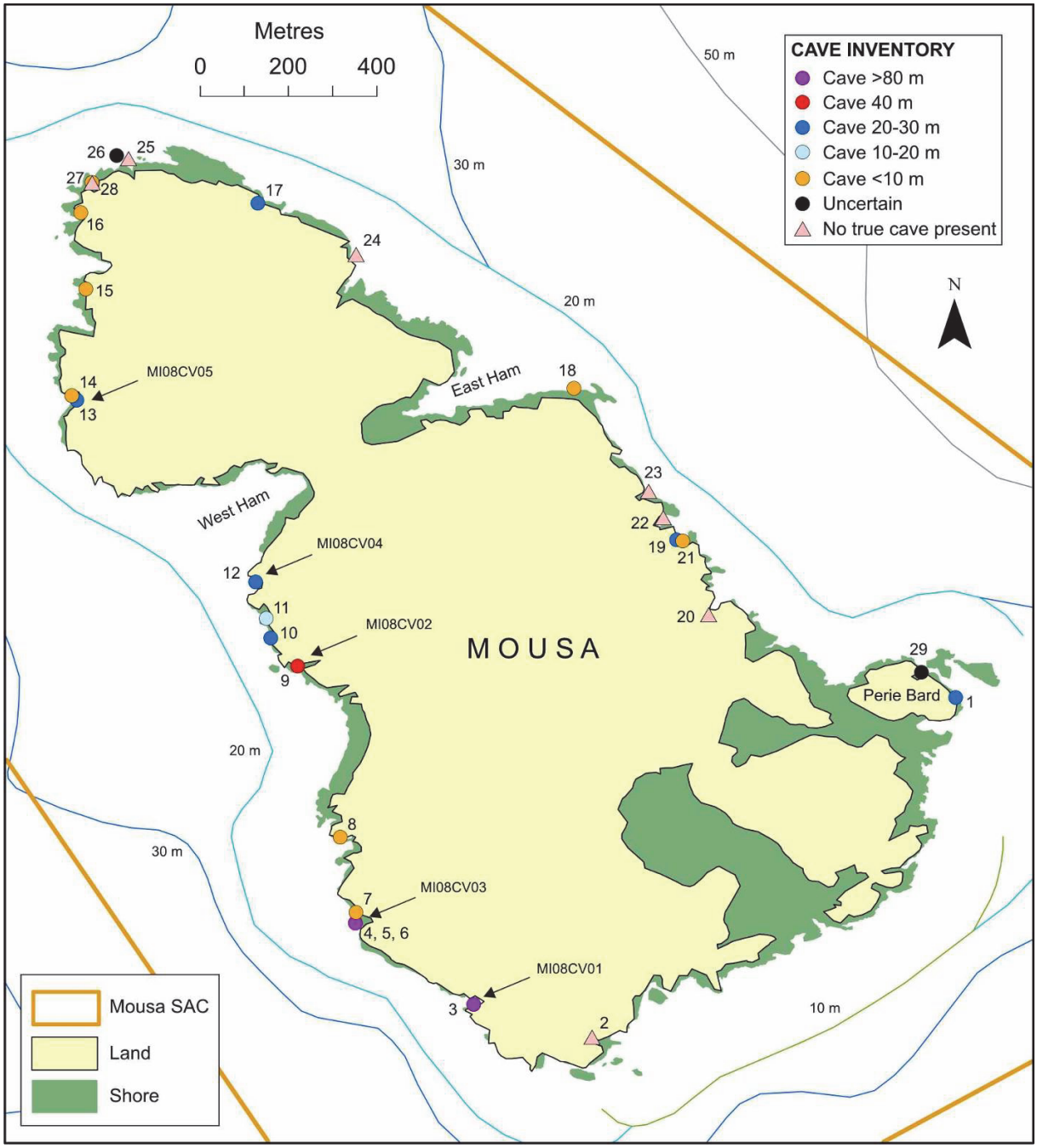
Site	Est. length	Type	Survey history	Site code / name	Physical / environmental notes	Biological notes	Latitude	Longitude
18	5 m	Partially submerged	Posford Haskoning 2003 - notes & sketch HWU 2008 – notes HWU 2016 - notes & sketch	Cave at East Ham	The site was inspected by Posford 2003 and viewed from a distance by HWU 2008 (could not be approached closely due to wave surge). HWU 2008 noted the cave consists of complex of 5 interconnected entrances. The width of shore with entrances is ~20 m and the back wall of the cave is ~10 m in from the entrances. Several metres of water depth at the entrance and appears to be fully illuminated throughout. The site was inspected by a snorkeler in 2016. Broad agreement with the 2008 description. Deeply undercut cliff with broad rock pillars between floor and ceiling. Rear wall ~5 m from entrances. Water depth ~3 to 4 m BCD in central area but considerably shallower in the eastern entrance.	Previous survey records indicate presence of **LR.FLR.CvOv.GCv** and **LR.FLR.CvOv.VmucHil** on the upper walls and ceiling with **LR.FLR.Lic.Ver.Ver** at the entrance. Walls near the waterline with **LR.HLR.MusB.Sem** within the cave and with **LR.HLR.MusB.MytB** and **IR.HIR.KFaR.Ala.Myt** near the entrance. HWU 2016 noted dense *Semibalanus* in most areas. Well illuminated throughout.	60.003585	-1.172314

Site	Est. length	Type	Survey history	Site code / name	Physical / environmental notes	Biological notes	Latitude	Longitude
19	21 m	Partially submerged	Posford Haskoning 2003 – notes HWU 2016 - notes & sketch	no name	Observations by the Posford Haskoning 2003 survey note a record of 'narrow inlet / cave' but does not give further details or specifically state that a cave exists. In 2008 wave surge prevented close inspection by HWU surveyors. The site was inspected by a snorkeler in 2016. Noted entrance of 2-3 m in width and water depth of ~0.5 m BCD. This extended for ~15 m at which point the passage narrowed to <1 m in width with a water depth of ~0 m BCD. The passage extended a further ~6 m before terminating.	Previous survey records indicate presence of **LR.FLR.CvOv.GCv**, **LR.FLR.CvOv.VmucHil**, **LR.HLR.MusB.Sem** and **LR.HLR.MusB.MytB**. HWU 2016 confirmed prominence of *Hildenbrandia* on supralittoral gully walls and extensive areas of green algal crusts above the *Hildenbrandia*. *Semibalanus* was dense at the waterline and also in the narrow inner passage of the cave. Large patches of *Halichondria* were present on the walls of the outer part of the cave.	60.000445	-1.168313
20	4 m	Surge gully with rock arch	Posford Haskoning 2003 – notes HWU 2016 - notes & sketch	no name	Observations by the Posford Haskoning 2003 survey note a record of 'narrow cave' but notes that the cave roof is open - i.e. suggesting a surge gully not a cave. In 2008 wave surge prevented close inspection by HWU surveyors. The site was inspected by a snorkeler in 2016. Noted a ~8 m long surge gully leading into the cliff. This became roofed over by a rock arch several metres above the waterline. The arch was ~4 m long beyond which the gully was open to the sky once more extending for a further ~4 m to the rear wall.	Previous survey records indicate presence of **LR.FLR.CvOv.GCv**, **LR.FLR.CvOv.VmucHil**, **LR.HLR.MusB.Sem** and **LR.HLR.MusB.MytB**. HWU 2016 confirmed prominence of *Hildenbrandia* on supralittoral gully walls and dominance of *Semibalanus* and *Patella* on intertidal walls. Subtidal rock walls and floor with 100% cover of pink coralline crusts at back of gully. Subtidal gully walls with prominent foliose red algae, *Tubularia*, *Sagartia* and *Grantia*.	59.998901	-1.167112

Site	Est. length	Type	Survey history	Site code / name	Physical / environmental notes	Biological notes	Latitude	Longitude
21	10 m	Partially submerged	HWU 2016 - notes	no name	The site was inspected by a snorkeler in 2016. Noted a ~10 m long cave leading into the cliff. Roof formed by jammed boulders giving the appearance of a partially collapsed surge gully. Water depth ~0.5 m BCD in entrance area but rapidly shallowing with cave floor at ~1 m ACD in rear half of the cave.	Floor and walls with dense *Semibalanus* throughout the cave.	60.000418	-1.168077
22		No cave present	HWU 2016 - notes	no name	Site inspected in 2016 because it appears that a cave may be present when viewed from a distance. Large dark cleft in cliff with boulder slope at base and jammed boulders at higher level.	None taken.	60.000905	-1.168839
23	15 m	Surge gully	HWU 2016 - notes	no name	The site was inspected by a snorkeler in 2016. Noted a ~15 m long surge gully leading into the cliff. At entrance there was a floor of large boulders at a depth of ~2 m BCD. The back half of the gully was considerably shallower.	Intertidal walls and back half of the gully with dense *Semibalanus*. Foliose red algae and *Halichondria* prominent in the outer part of the gully.	60.001454	-1.169397
24	10 m	Surge gully	HWU 2016 - notes	no name	Small surge gully. No cave present.	None taken.	60.006444	-1.181025
25		No cave present	HWU 2016 - notes	no name	Site inspected in 2016 because it appears that a cave may be present when viewed from a distance. Boulder filled gully with surface depression beyond. Likely to be a collapsed gully / cave.	None taken.	60.008511	-1.190143
26	?	Intertidal?	HWU 2016 - notes	no name	Narrow rift. Very shallow with rocks at waterline at the entrance. Not entered.	None taken.	60.008576	-1.190622

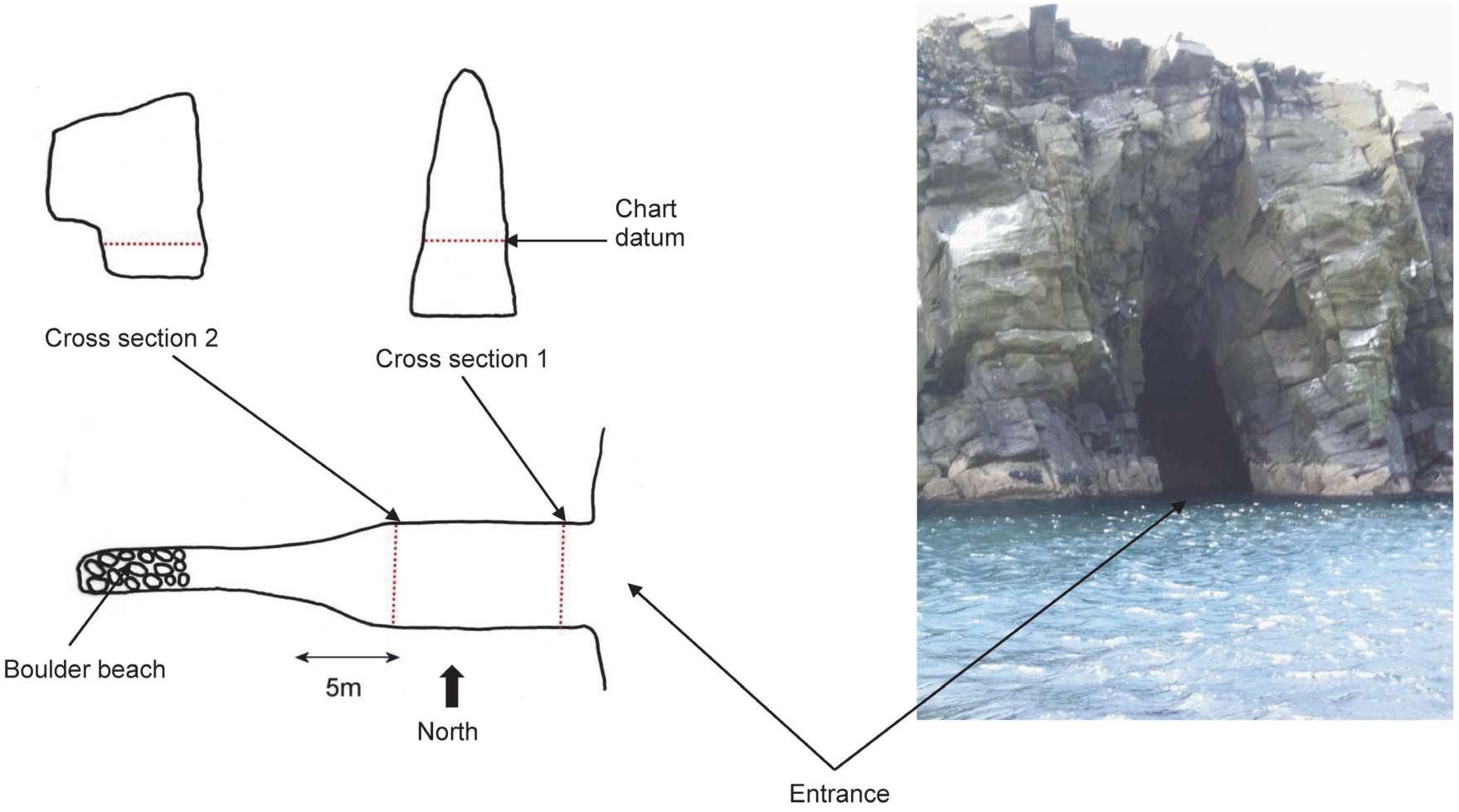
Site	Est. length	Type	Survey history	Site code / name	Physical / environmental notes	Biological notes	Latitude	Longitude
27	>8 m	Partially submerged	HWU 2016 - notes & sketch	no name	Narrow rift, passage <1 m wide, water depth at entrance ~0.5 m BCD, ceiling met waterline within ~8 m of the entrance.	None taken.	60.008043	-1.191655
28	6 m	rock arch	HWU 2016 - notes & sketch	no name	Rock arch with water depth of ~2.5 m BCD.	Scoured rocky floor, *Metridium* & *Tubularia* on rock walls.	60.008043	-1.191655
29	?	?	HWU 2016 - notes	no name	Pronounced gully on north shore of Perie Bard. There is potential for the presence of a cave at the rear of the gully but it could not be accessed in either 2008 or 2016. There was no clear view to the back of the gully but it is likely to be a boulder slope with no cave present.	None taken.	59.997608	-1.158515

Annex 4.1.2 – Map of Mousa caves

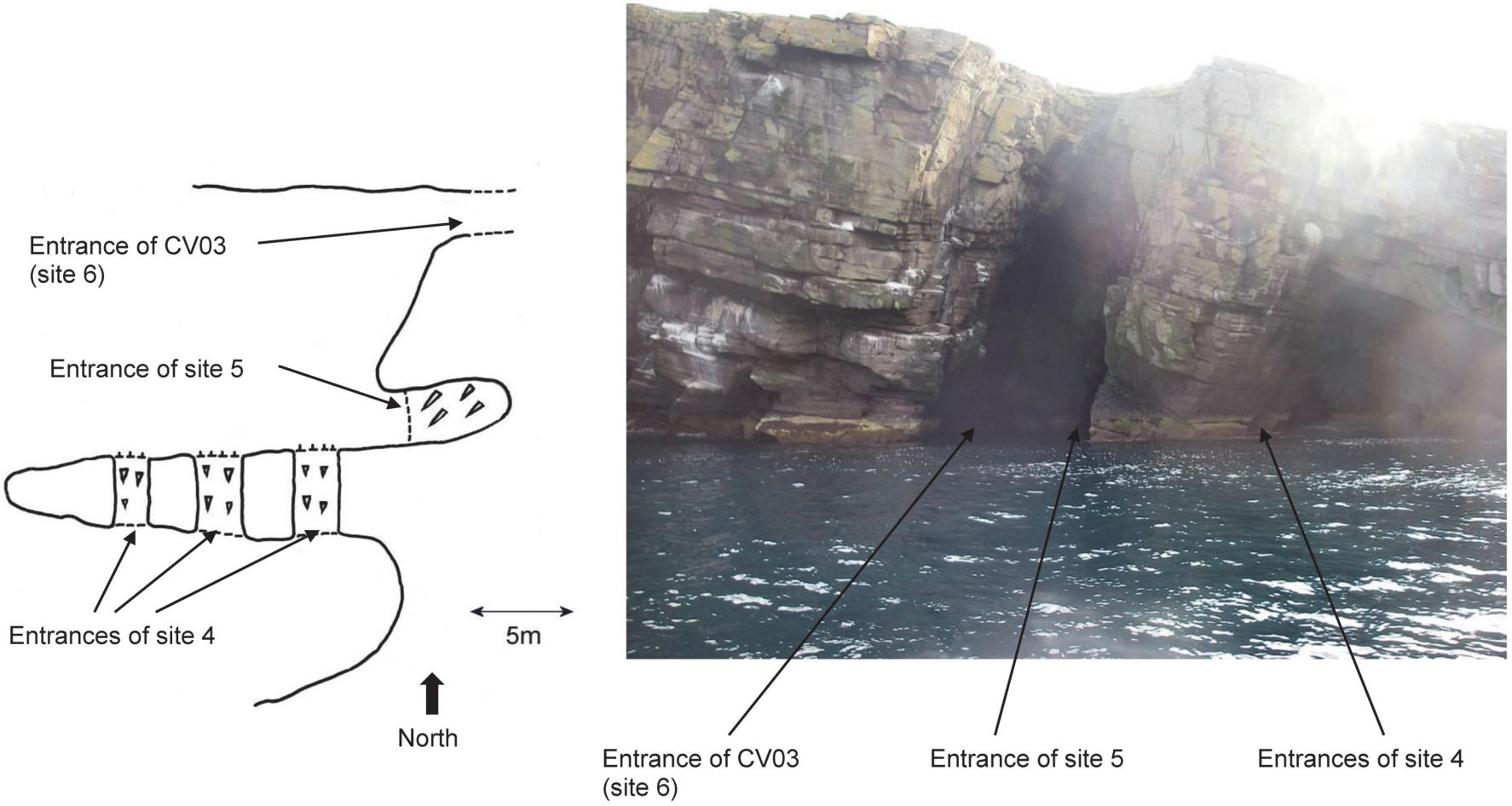


Annex 4.1.3 – Images & sketches of cave inventory sites

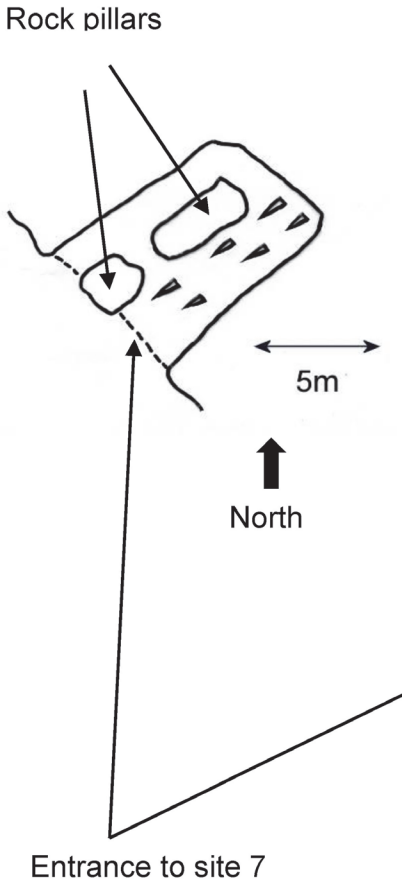
Site 1

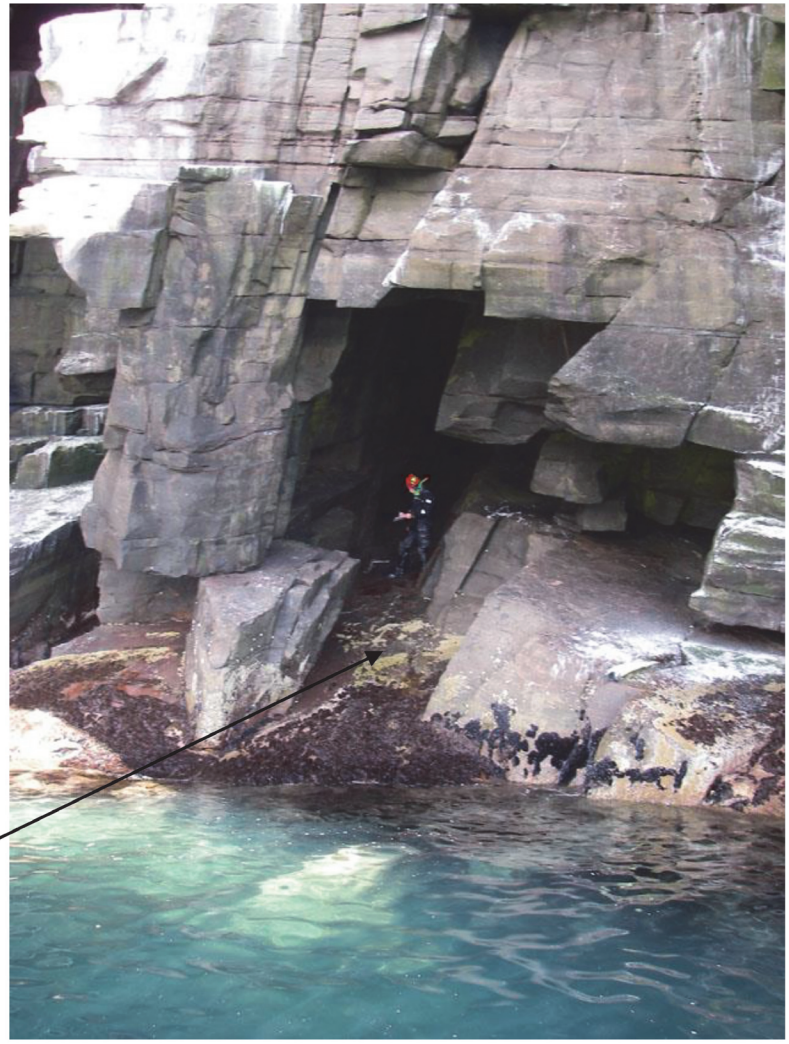


Sites 4, 5 & 6 (CV03)

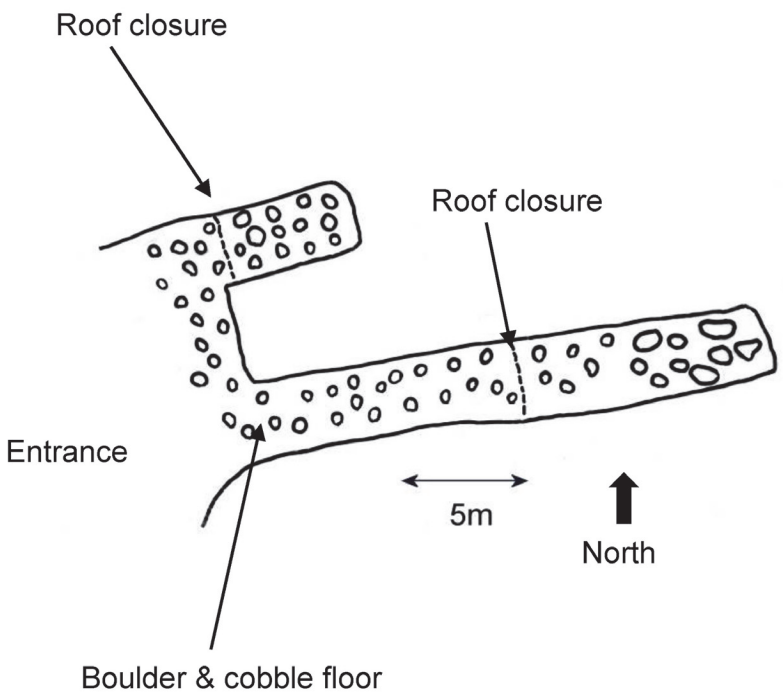


Site 7

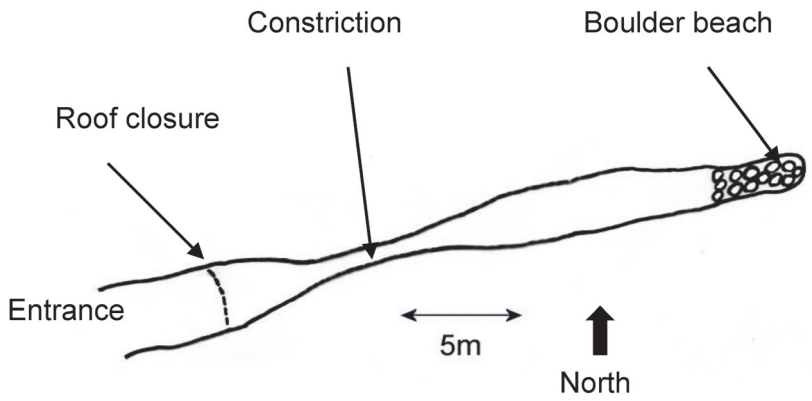


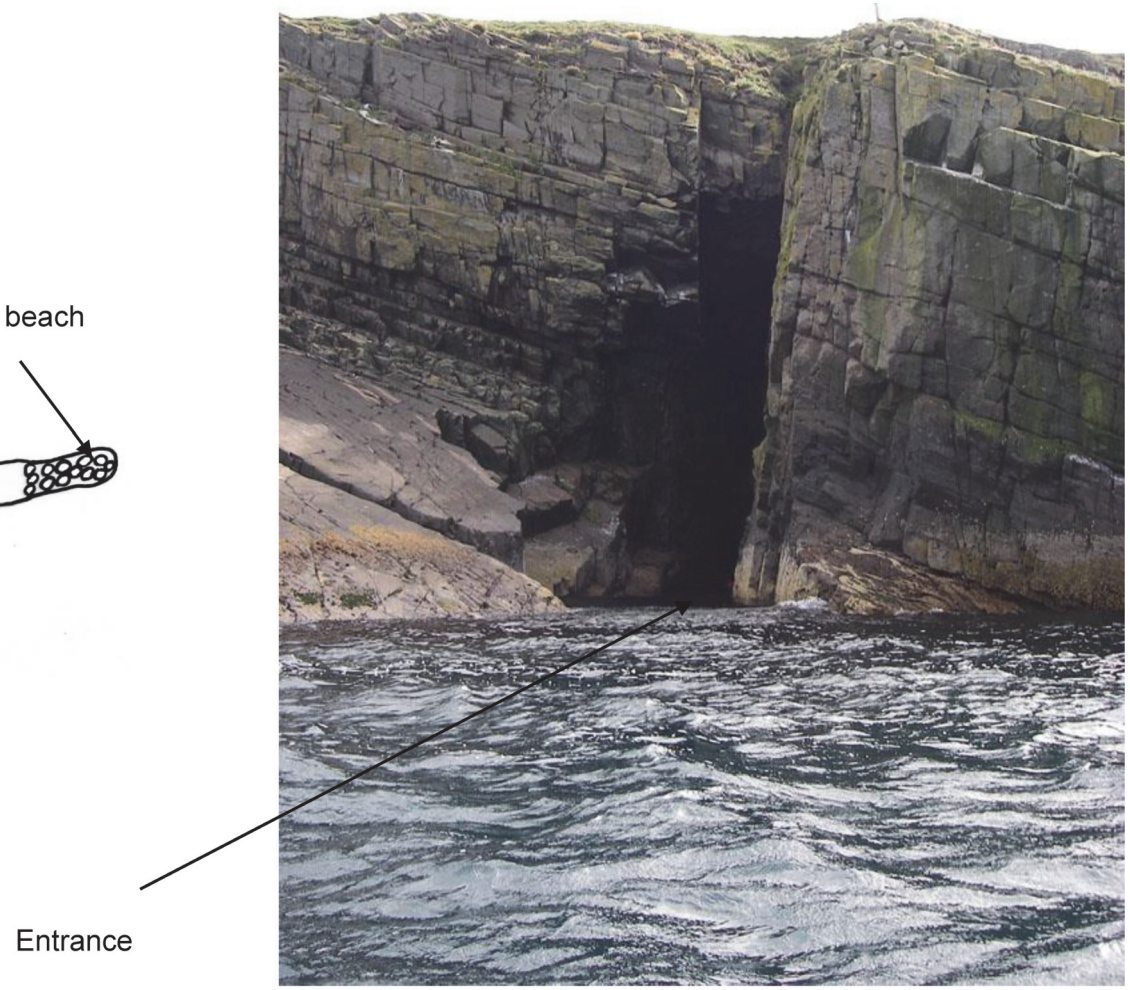


Site 8

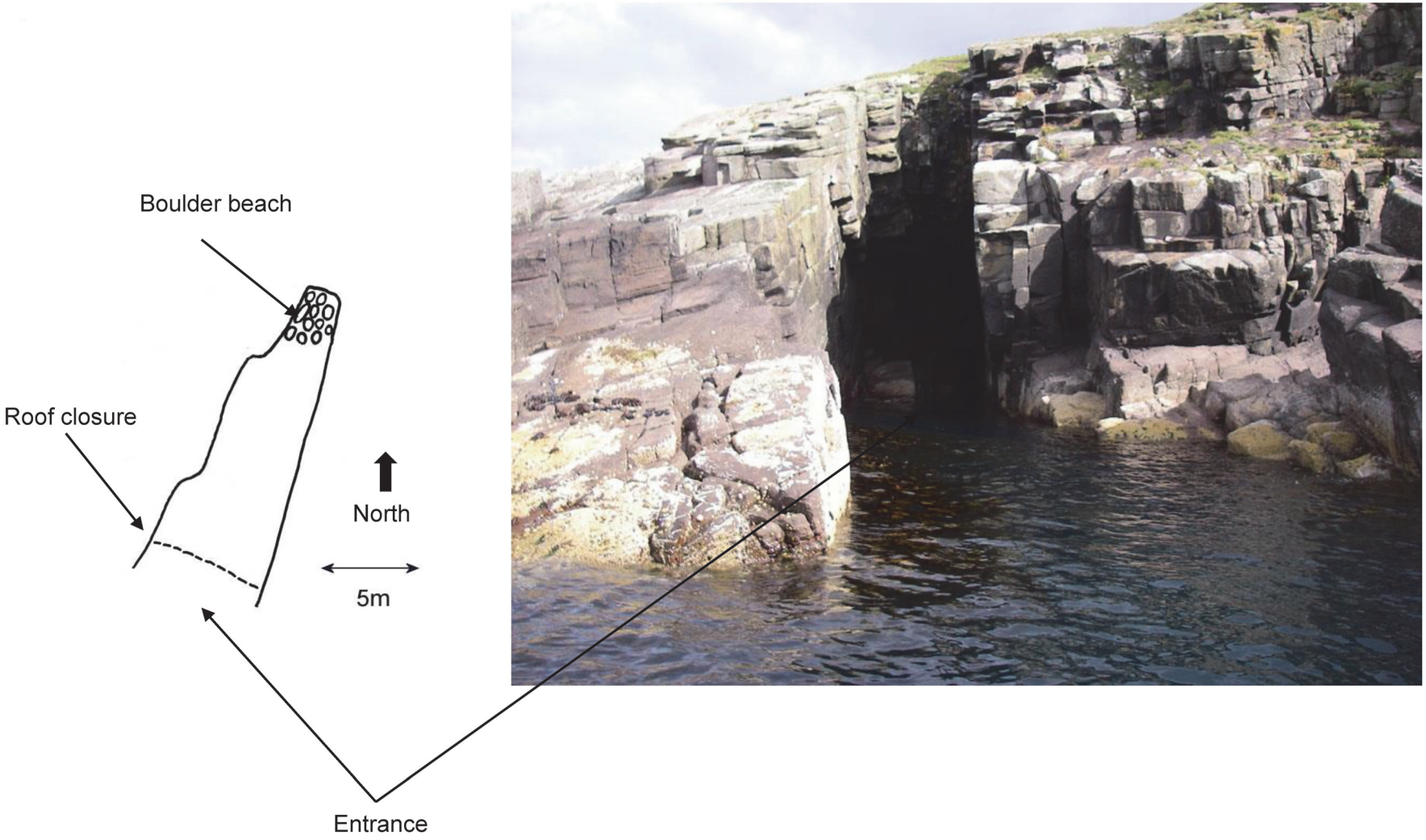

Roof closure
Roof closure
Entrance
5m
North
Boulder & cobble floor

Site 10

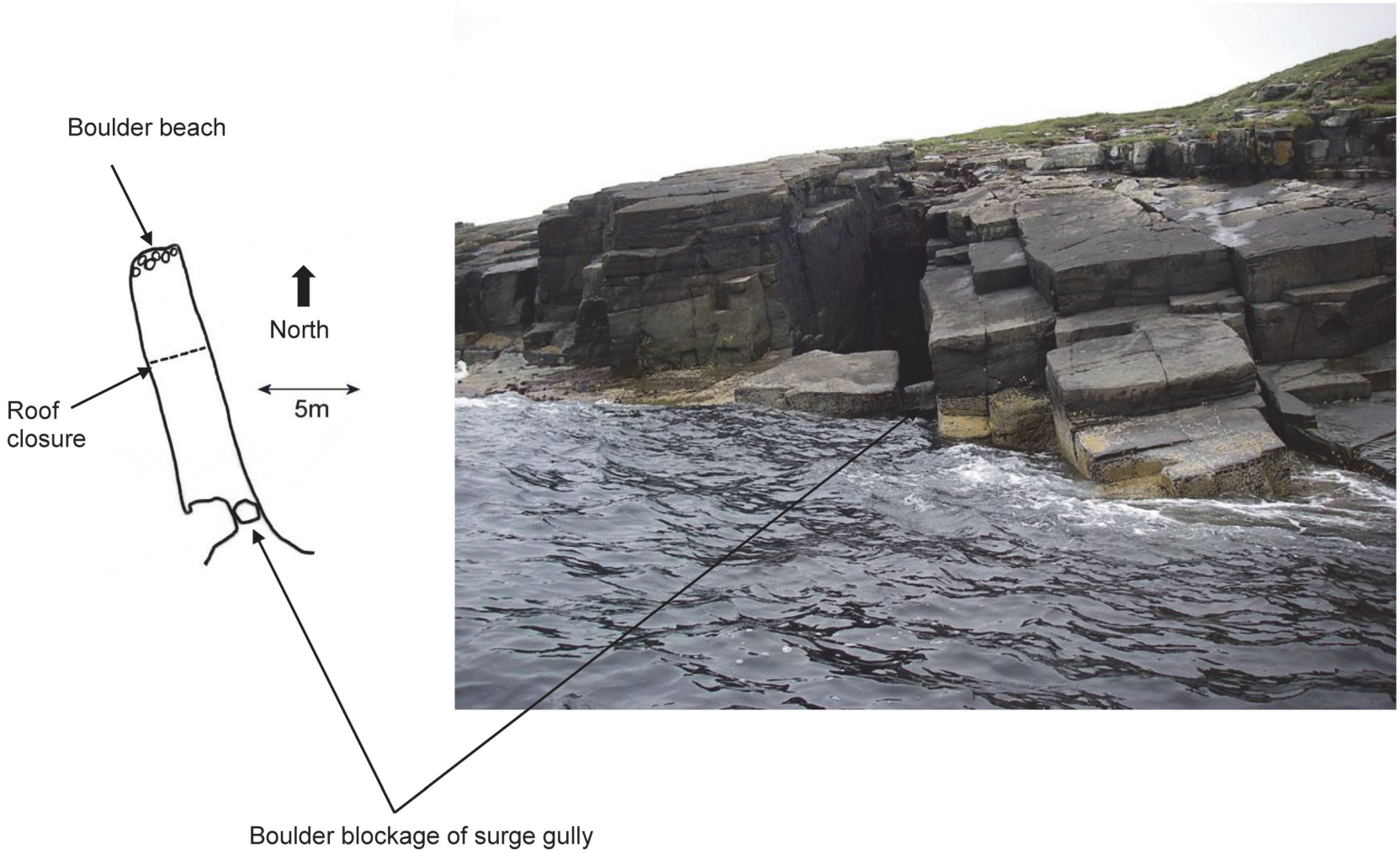

Constriction
Boulder beach
Roof closure
Entrance
5m
North


Entrance

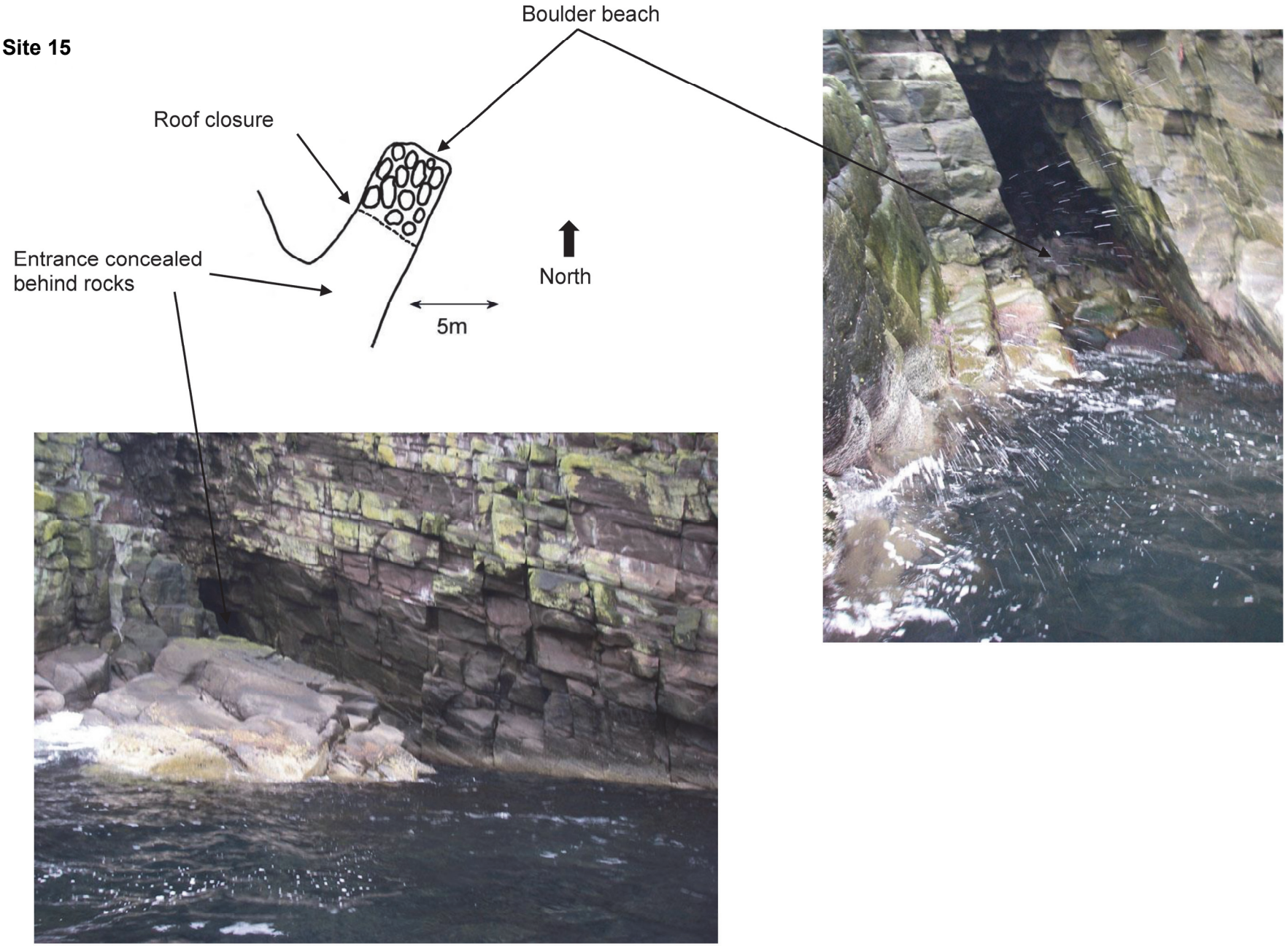
Site 11



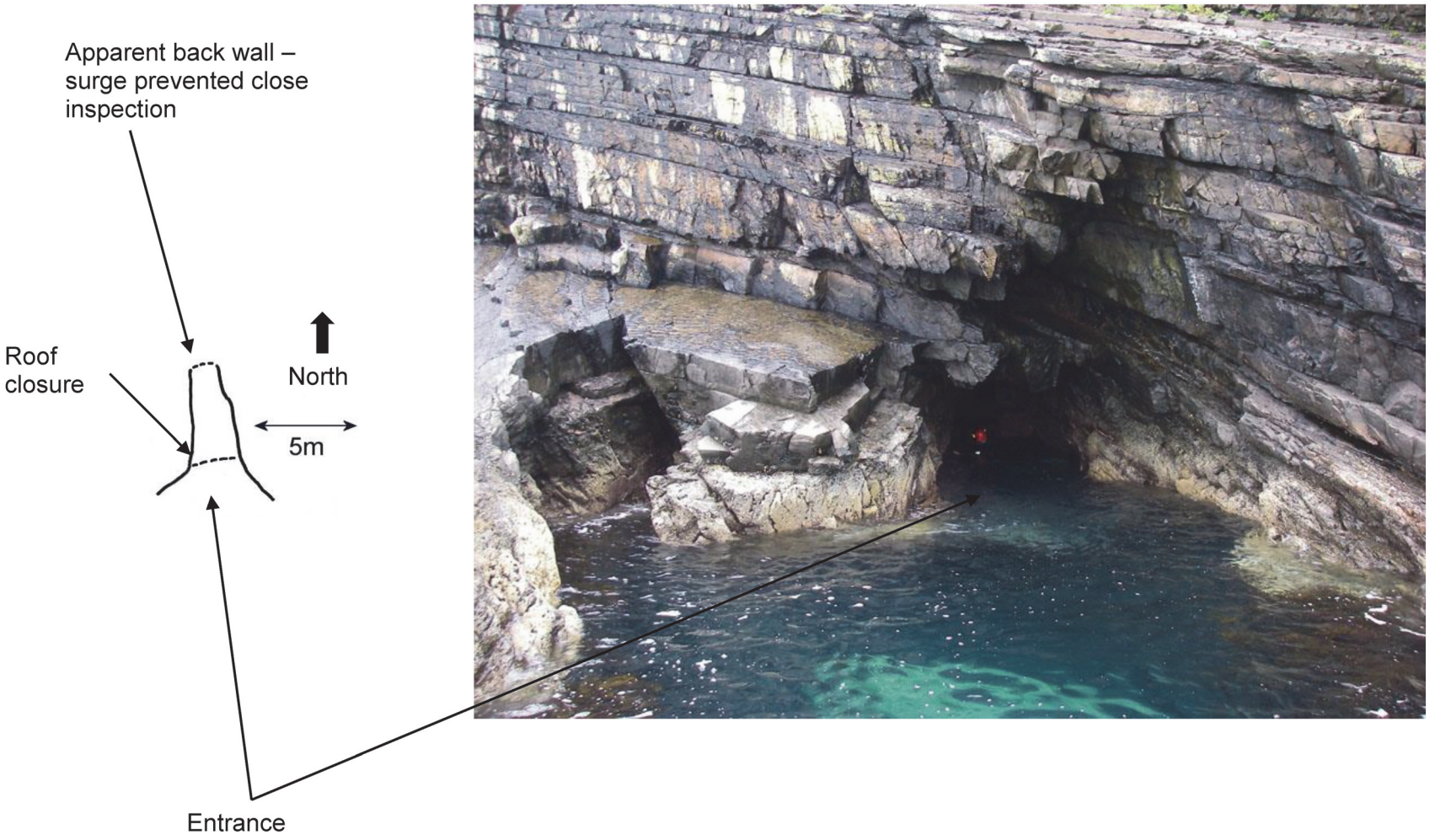
Site 14


Boulder beach
North
5m
Roof closure
Boulder blockage of surge gully

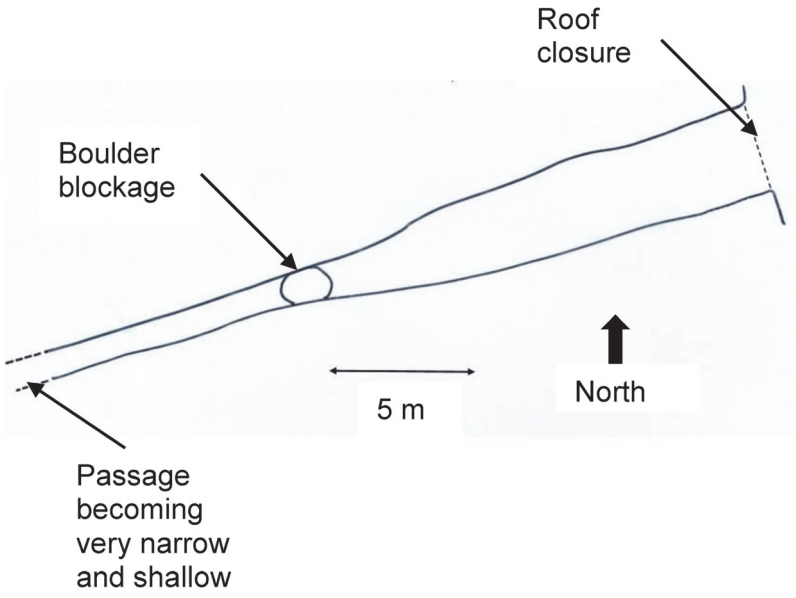
Site 15


Boulder beach
Roof closure
Entrance concealed
behind rocks
North
5m

Site 16

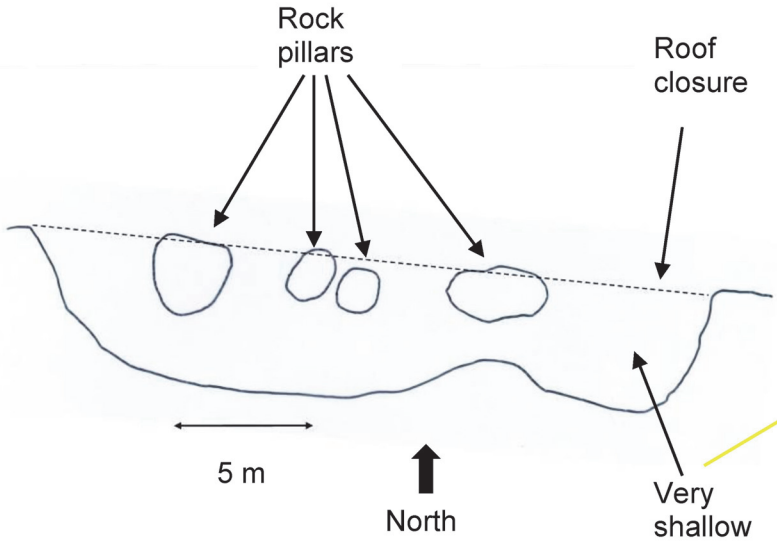

Apparent back wall – surge prevented close inspection
Roof closure
North
5m
Entrance

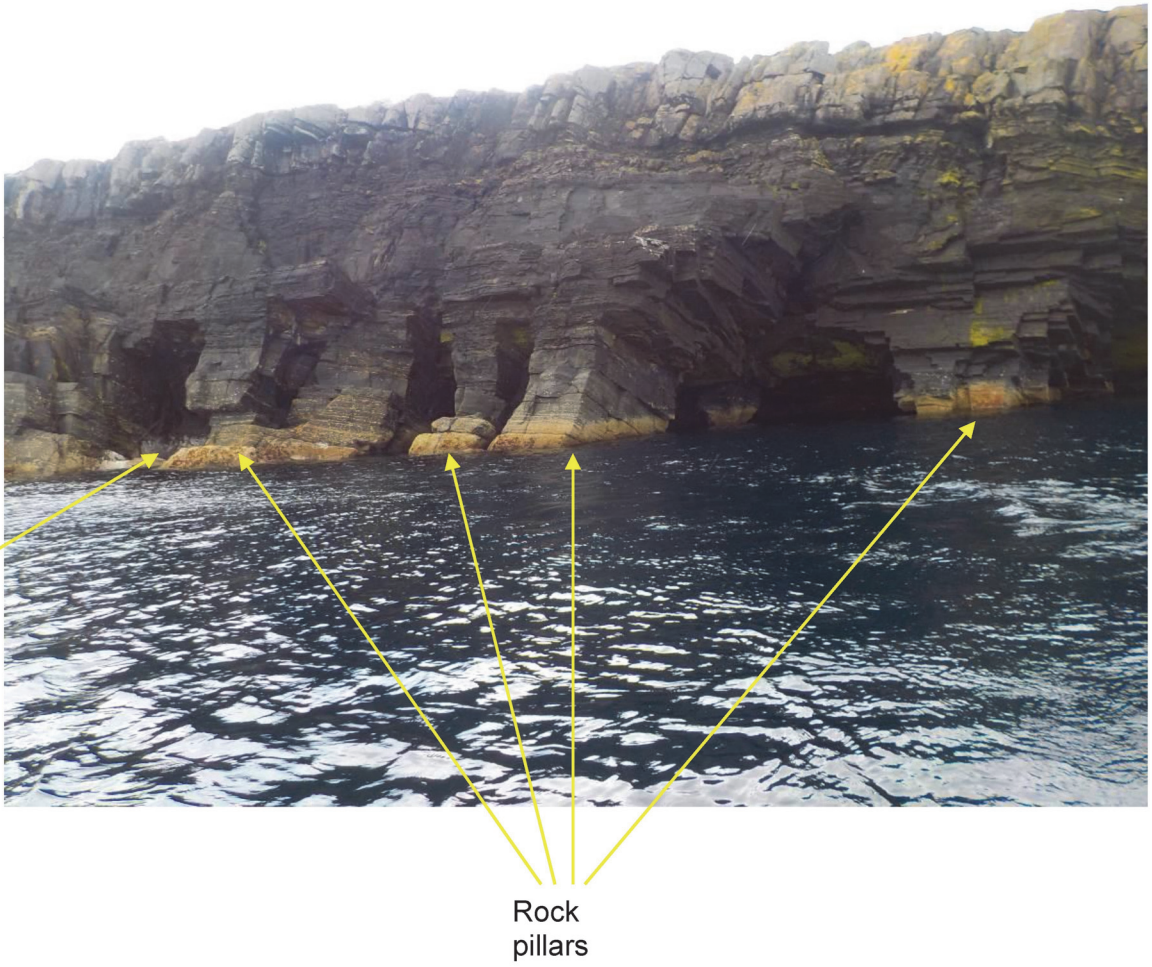
Site 17


Roof
closure
Boulder
blockage
5 m
North
Passage
becoming
very narrow
and shallow

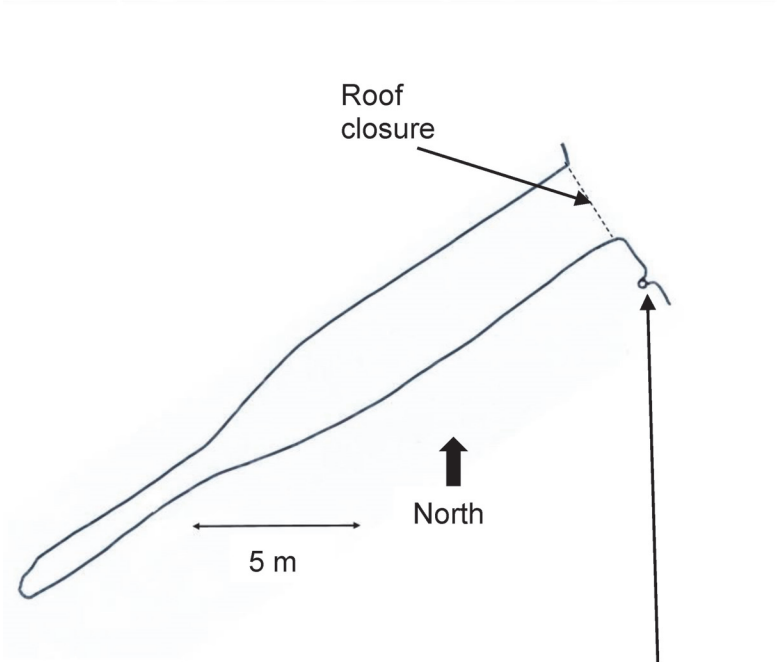
Site 18

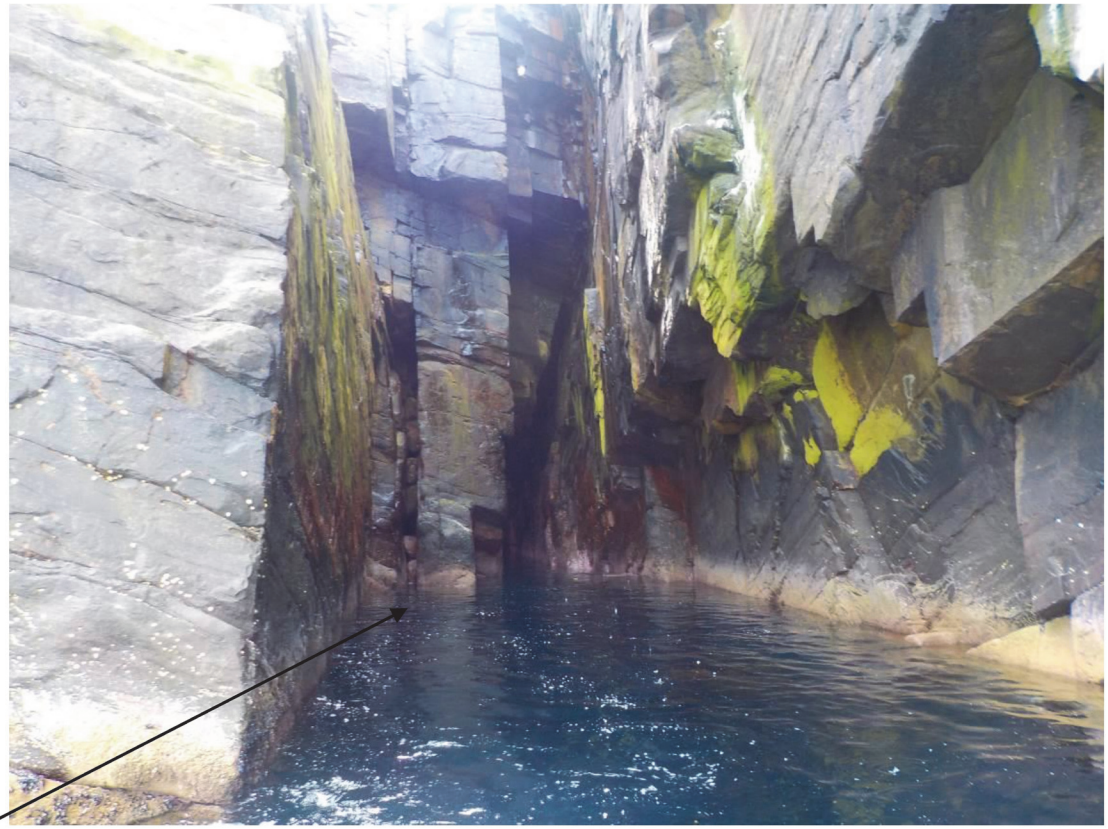
NB – Sketch & image in opposite orientation. Image view is ~south.





Site 19

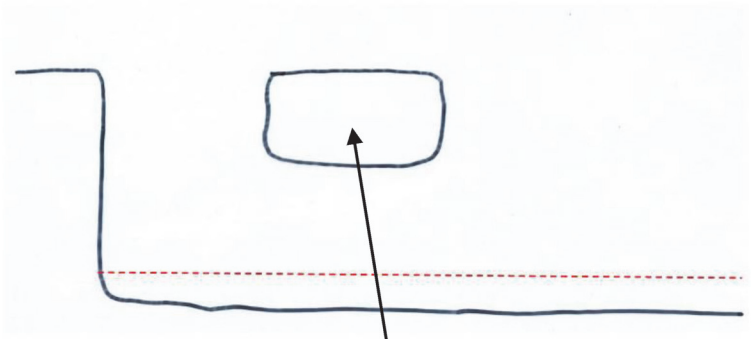




Fissure with
jammed
boulders

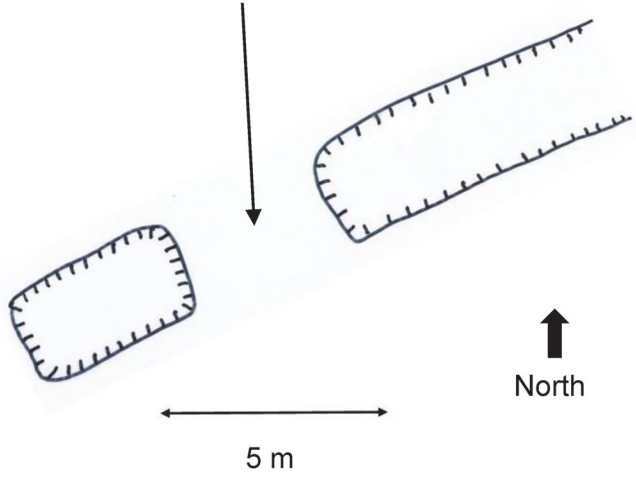
Site 20

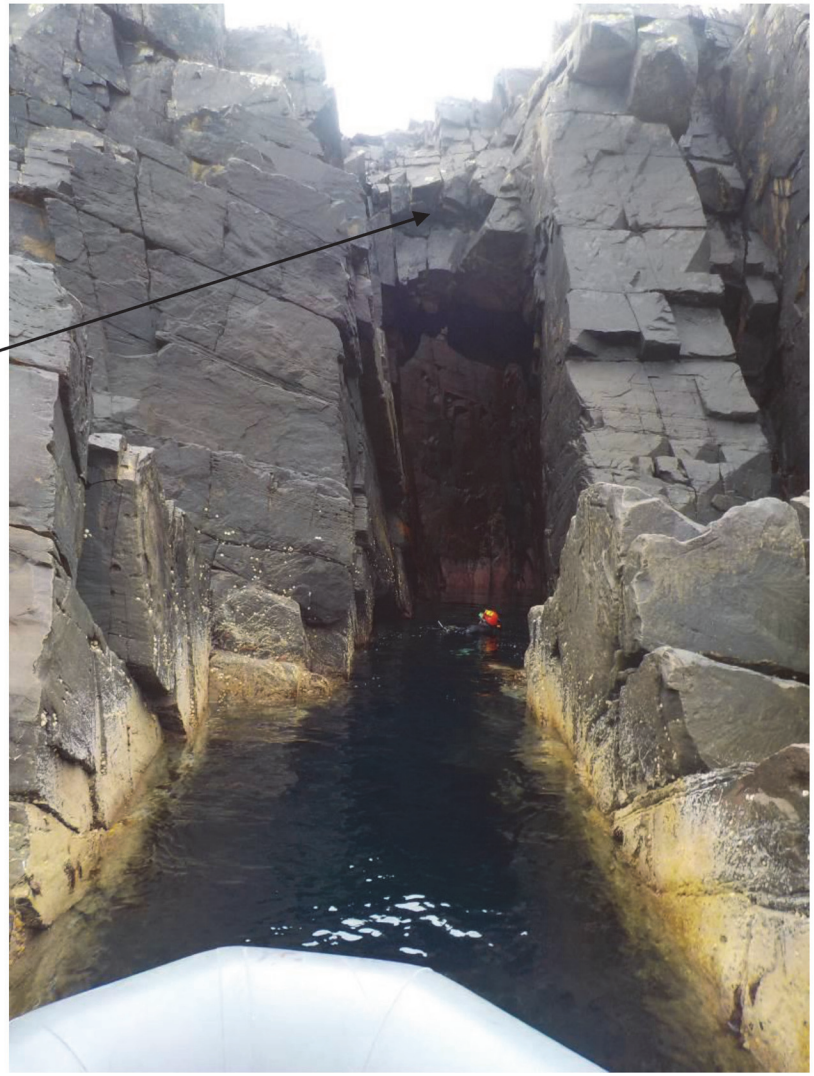
Side elevation



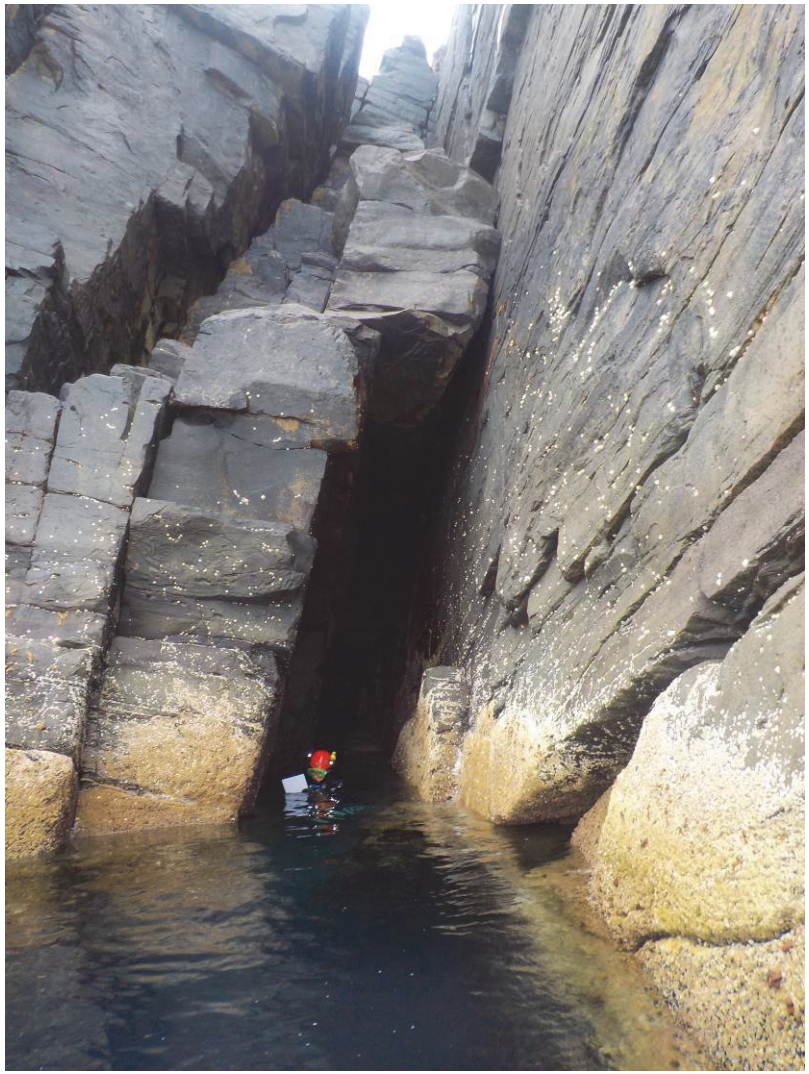
Rock arch

Plan view

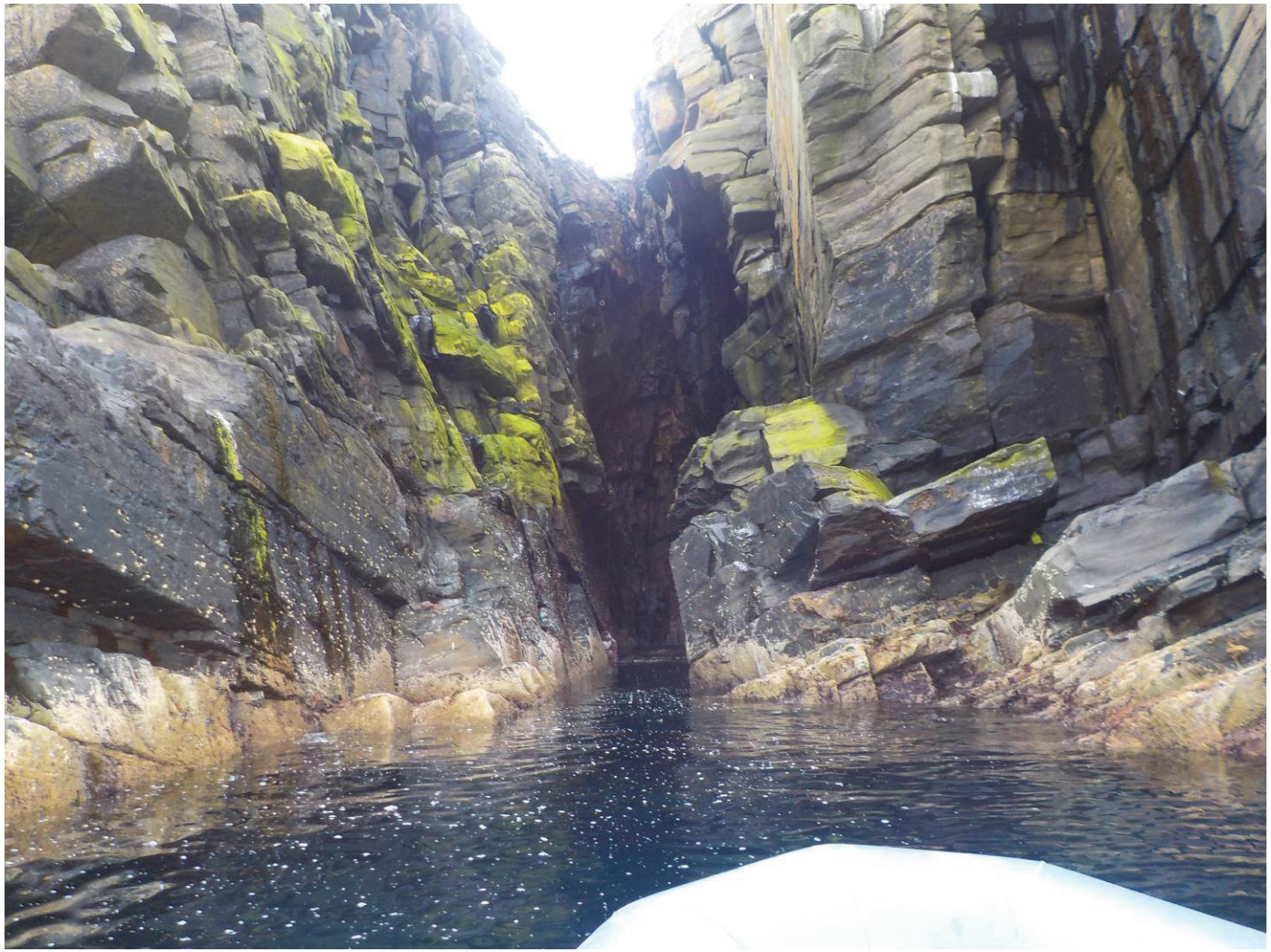




Site 21



Site 23

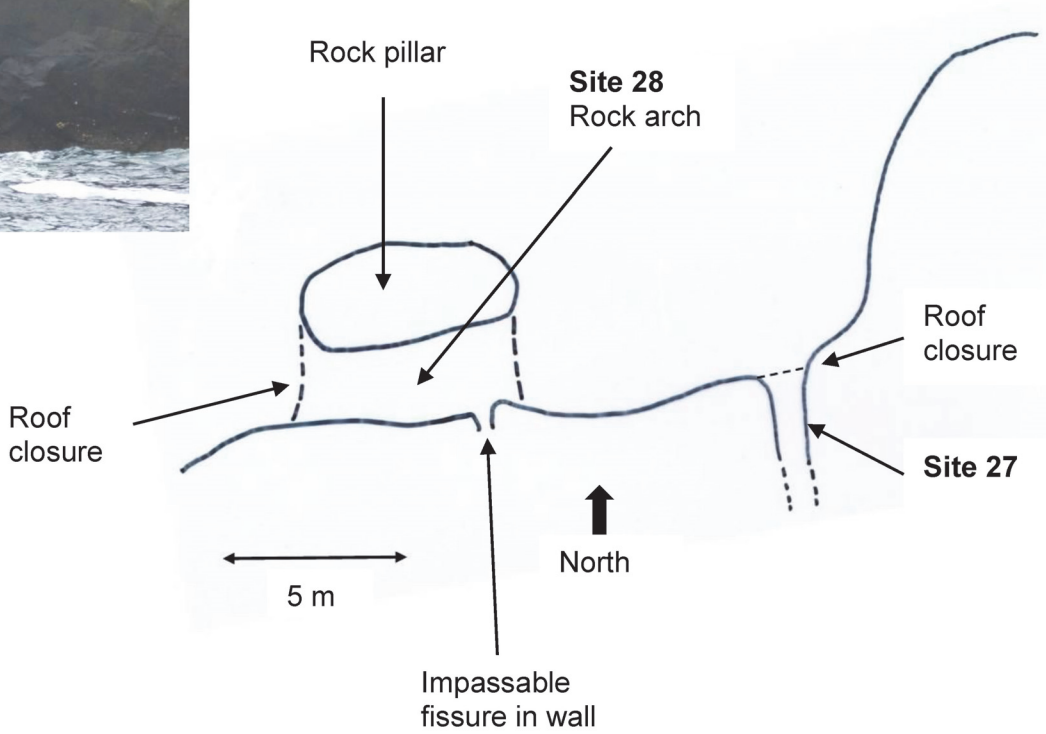


Site 25

Site 26

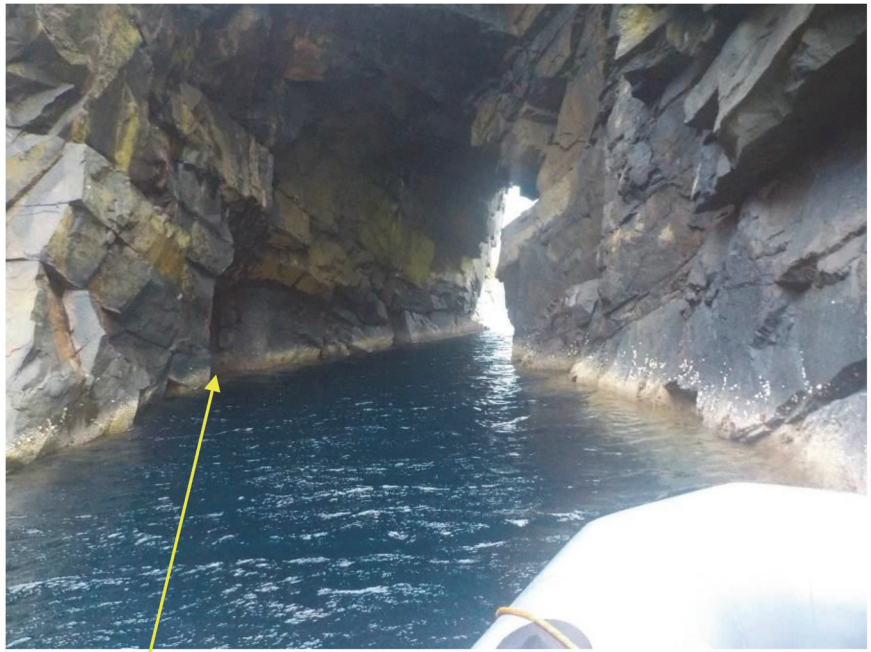
Site 27


Entrance


Rock pillar
Site 28
Rock arch
Roof
closure
Roof
closure
Site 27
North
5 m
Impassable
fissure in wall

Site 28

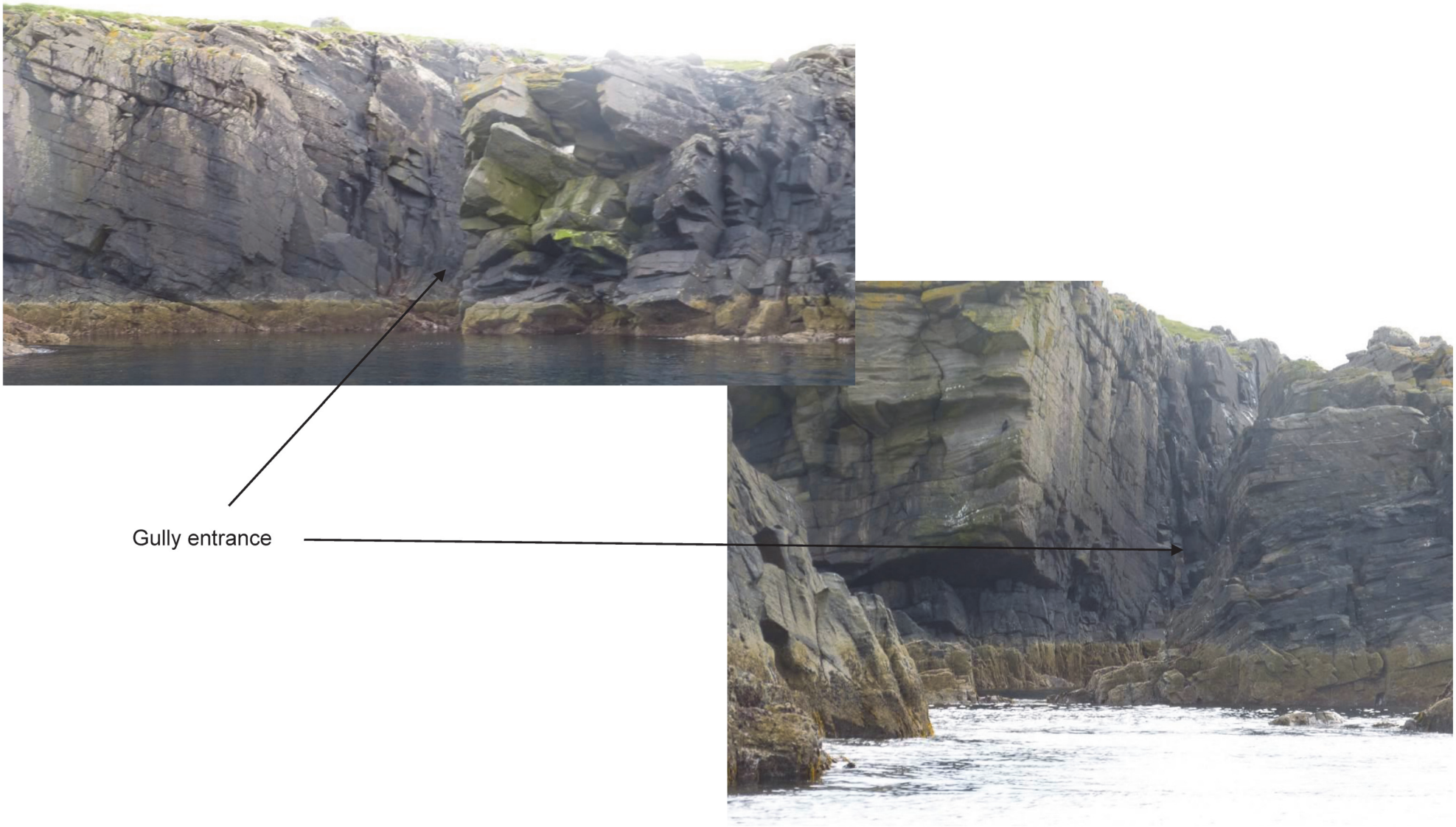
View into arch
from east side



Impassable
fissure in wall

View into arch
from west side

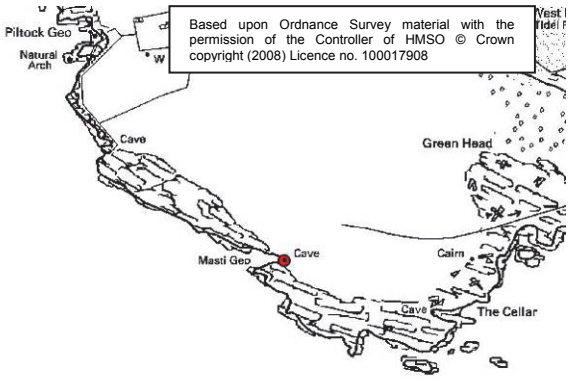
Site 29



Annex 4.1.4 – Cave site relocation details with physical and biological data

Cave relocation sheet

Cave name	Masti Geo Cave
Site code	MI08CV01
Position of entrance	59.9911°N 1.177067°W
How start point is marked	Galvanised relocation piton in rock crevice in southern (right) wall at about 3.5 m ACD situated just below where the cave roof closes over.
Notes on relocation	Look for the ledges on the wall and the square cut indent to the left of the piton (see photos).
Access	by boat



Cave location

IMGP0976.JPG Towards entrance from 59.99103°N 1.17860°W, 85°M

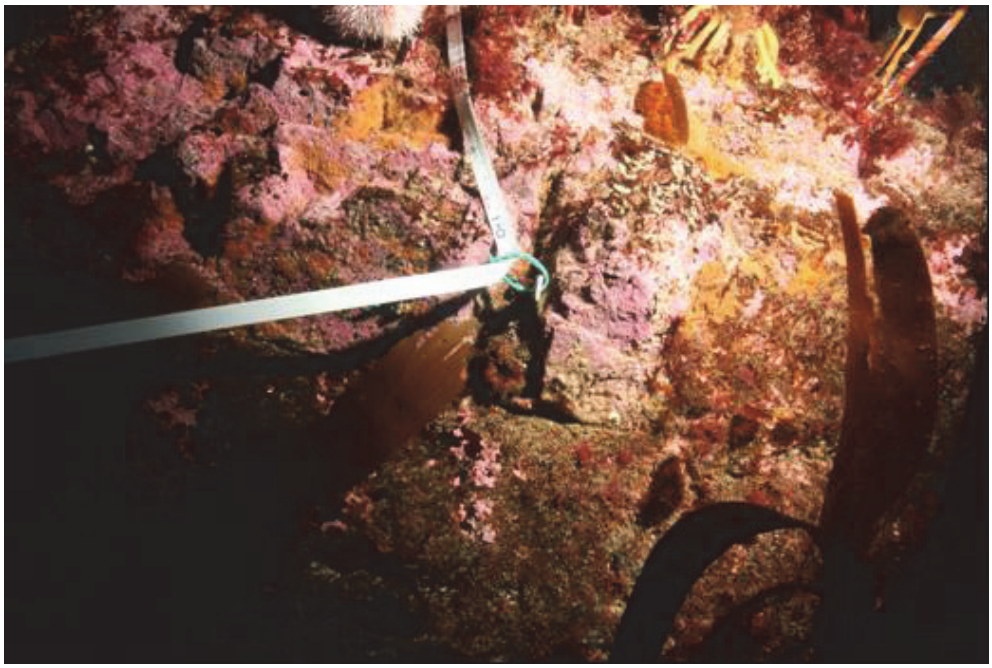
IMGP0969.JPG Towards entrance from 59.99116°N 1.17683°W, 116°M

IMGP0974.JPG Close up of piton, no fix possible.

Cave datum line relocation information

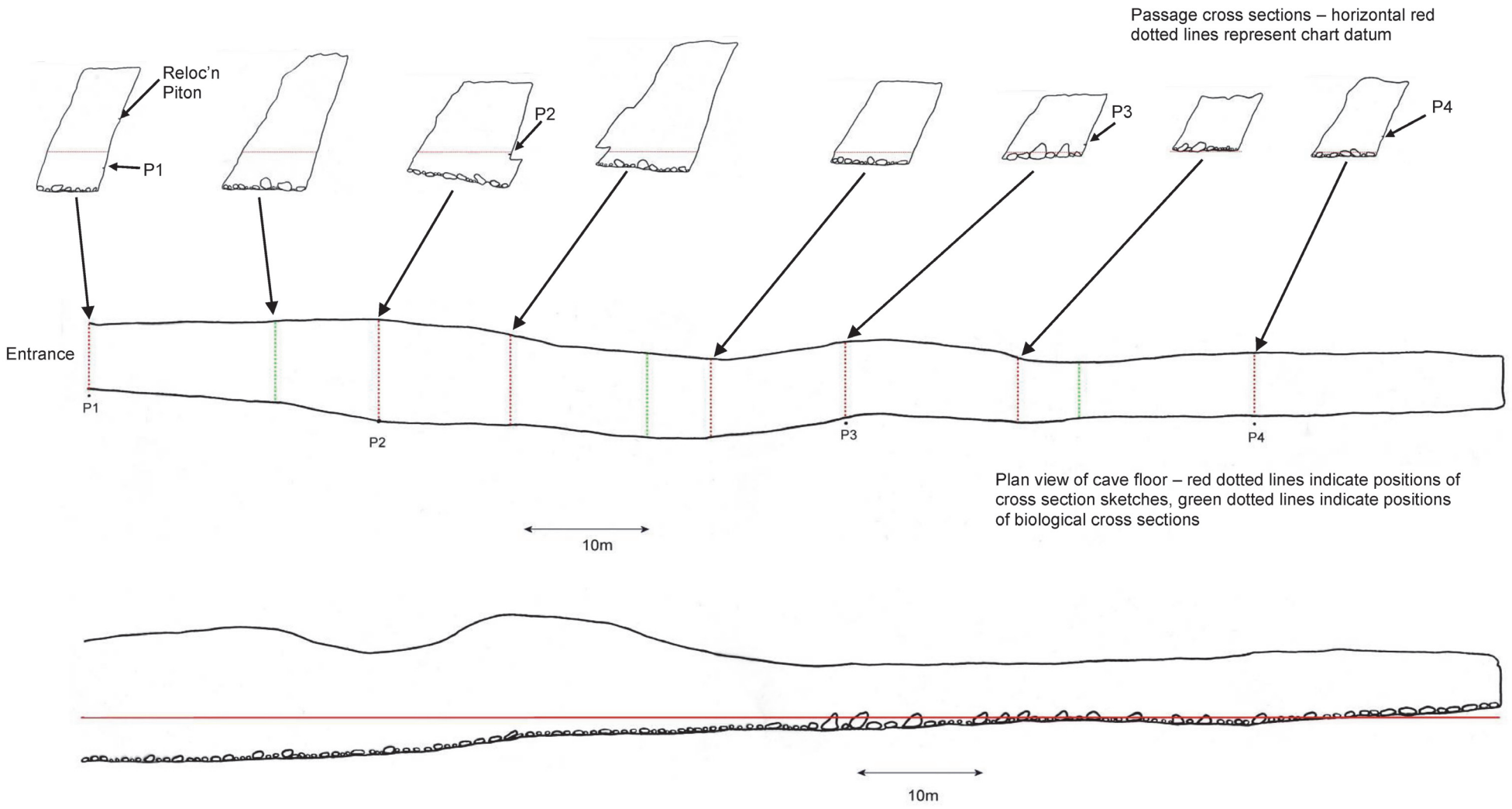
Cave name	Masti Geo Cave
Site code	MI08CV01
Position of piton 1	Directly below relocation piton at a distance of 5.1 m

Piton number	Depth of Piton (relative to chart datum)	Distance (m) to next piton	Distance (m) on tape	Bearing (degrees magnetic) to next piton
Piton 1	1.5 BCD	23.5	5.1	95
Piton 2	0.1 BCD	37.6	28.6	90
Piton 3	0.6 ACD	33.0	66.2	90
Piton 4	1.2 ACD	N/A	99.2	N/A

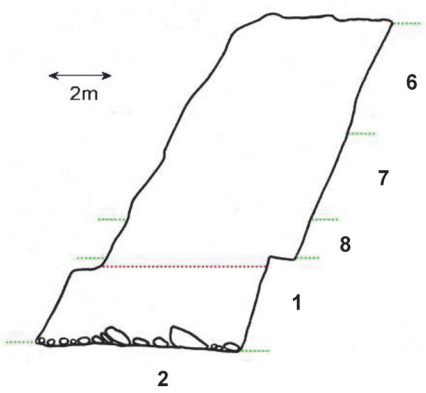


Piton 1

MI08CV01 / Masti Geo Cave – Physical survey

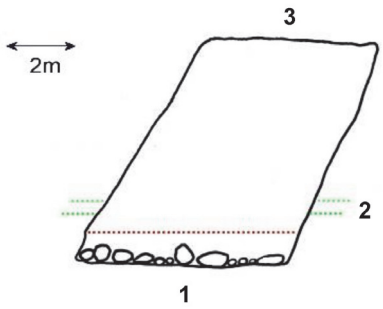


MI16CV01 / Masti Geo Cave – Biological cross section 1 (~15 m from entrance, 20 m on tape)



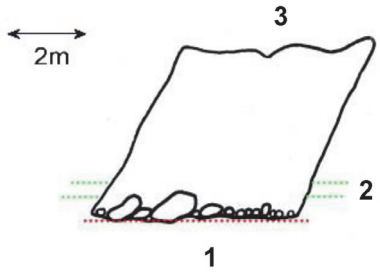
zone	upper limit (ACD)	lower limit (ACD)	Location	Substrate notes	Biological notes	Biotope
1	0.4	-2.7	Right wall below waterline	Steep upward facing rock on right wall	Frequent pink coralline algal crusts. Sparse encrusting biota. Frequent *Spirobranchus triqueter* & *Heteranomia squamula*. Locally frequent *Oscarella lobularis*. *Dendrodoa grossularia* & *Verruca stroemia* present.	**IR.FIR.SG.CC.BalPom**
2	-2.5	-2.7	Floor	Cave floor of small, medium & large boulders with cobbles & pebbles	Frequent pink coralline algal crusts becoming abundant in better illuminated areas. Sparse encrusting biota. Frequent *Spirobranchus triqueter* & *Heteranomia squamula*. Locally frequent *Oscarella lobularis* & *Spirorbis tridentatus*. Occasional *Dendrodoa grossularia*. Abundances of encrusting biota often higher on stable vertical surfaces.	**IR.FIR.SG.CC.Mo**
6	8.7	4.7	Upper right wall	Steep upward facing rock on upper right wall	Superabundant green algal crusts / stains & common *Hildenbrandia*.	**LR.FLR.CvOv.GCv**
7	4.7	1.7	Upper right wall	Steep upward facing rock on upper right wall	Superabundant *Hildenbrandia*.	**LR.FLR.CvOv.VmucHil**
8	1.7	0.4	Right wall at waterline	Steep upward facing rock on right wall	Steep rock with abundant *Semibalanus balanoides* and frequent *Patella*. Pink coralline algal crusts were common and *Tectura* occasional.	**LR.HLR.MusB.Sem**

MI16CV01 / Masti Geo Cave – Biological cross section 2 (~45 m from entrance, 50 m on tape)



zone	upper limit (ACD)	lower limit (ACD)	Location	Substrate notes	Biological notes	Biotope
1	0.7	-0.3	Floor & walls below waterline	Cave floor of boulders, cobbles & pebbles. Walls below waterline of steeply sloping (right wall) rock.	Boulders & cobbles with sparse encrusting biota including occasional *Spirorbis tridentatus* and rare *Clathrina coriacea* & *Oscarella lobularis*.	**IR.FIR.SG.CC.Mo** **IR.FIR.SG.CC.BalPom**
2	1.0	0.7	Walls at waterline	Walls at waterline of steeply sloping (right wall) rock.	Steep rock with rare *Semibalanus* and spirorbins.	**LR.FLR.CvOv.ScrFa**
3	5.7	1.0	Upper walls & ceiling	Upper walls & ceiling	Steep rock wall with rare *Hildenbrandia* on lower parts & abundant cave mould on upper wall.	**LR.FLR.CvOv.VmucHil** **Barren rock**

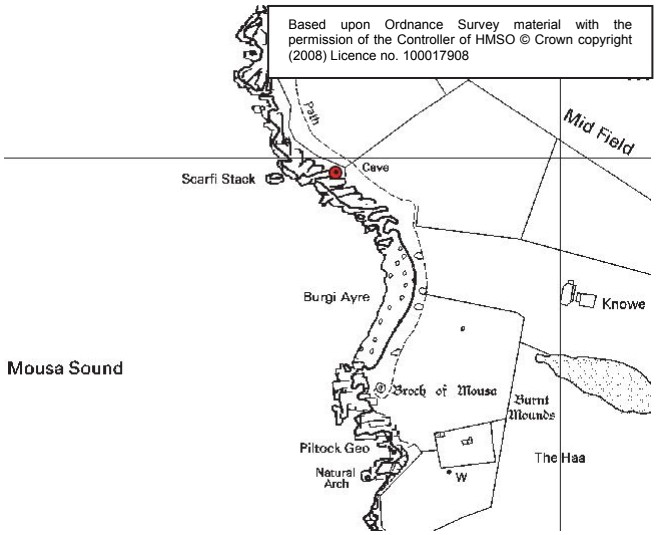
MI16CV01 / Masti Geo Cave – Biological cross section 3 (~80 m from entrance, 85 m on tape)



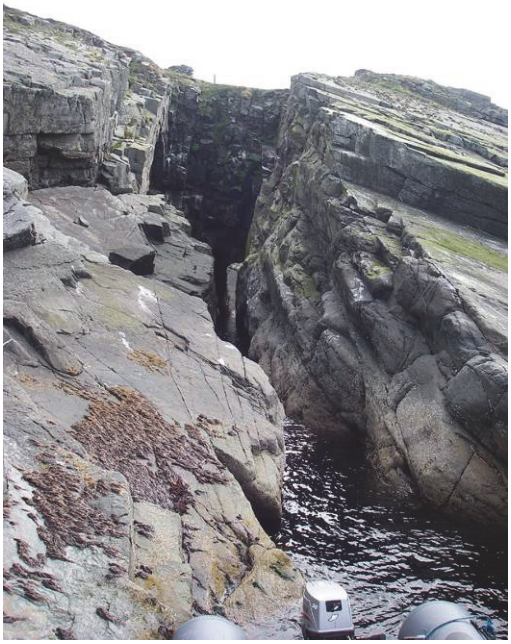
zone	upper limit (ACD)	lower limit (ACD)	Location	Substrate notes	Biological notes	Biotope
1	0.7	0.3	Floor & walls below waterline	Cave floor of boulders. Walls below waterline of steeply sloping (right wall) rock.	Boulders & cobbles with sparse encrusting biota including patchy *Spirorbis tridentatus* (locally frequent) and large patches of *Clathrina coriacea* and *Dendrodoa grossularia*. Abundances of encrusting biota often higher on stable vertical surfaces.	**IR.FIR.SG.CC.Mo** **IR.FIR.SG.CC.DenCcor**
2	1.0	0.7	Walls at waterline	Walls at waterline of steeply sloping (right wall) rock.	Steep rock with sparse *Semibalanus*.	**LR.FLR.CvOv.ScrFa**
3	4.7	1.0	Upper walls & ceiling	Upper walls & ceiling	Steep rock wall with sparse *Hildenbrandia*.	**LR.FLR.CvOv.VmucHil**

Cave relocation sheet

Cave name	Cave at Scarfi Stack
Site code	MI08CV02
Position of entrance	59.99808°N 1.18385°W
How start point is marked	Galvanised relocation piton in rock crevice in northern (left) wall at about 2 m ACD situated a couple of metres outside of where the cave roof closes over.
Notes on relocation	Go through obvious surge gully to the east of Scarfi Stack. Look for the horizontal crevice on the wall (see photo).
Access	by boat



Cave location



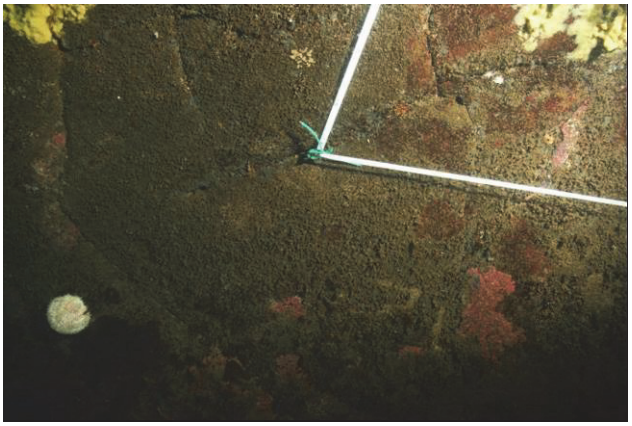
IMGP0899.JPG Entrance of surge gully

IMG_1898.JPG Close up of piton, no fix possible.

Cave datum line relocation information

Cave name	Cave at Scarfi Stack
Site code	MI08CV02
Position of piton 1	Directly below relocation piton at a distance of 2.2 m

Piton number	Depth of Piton (relative to chart datum)	Distance (m) to next piton	Distance (m) on tape	Bearing (degrees magnetic) to next piton
Piton 1	0.0 BCD	16.5	2.2	85
Piton 2	0.4 BCD	15.0	18.7	75
Piton 3	0.4 BCD	9.6	33.7	90
Piton 4	2.1 ACD	N/A	43.3	N/A

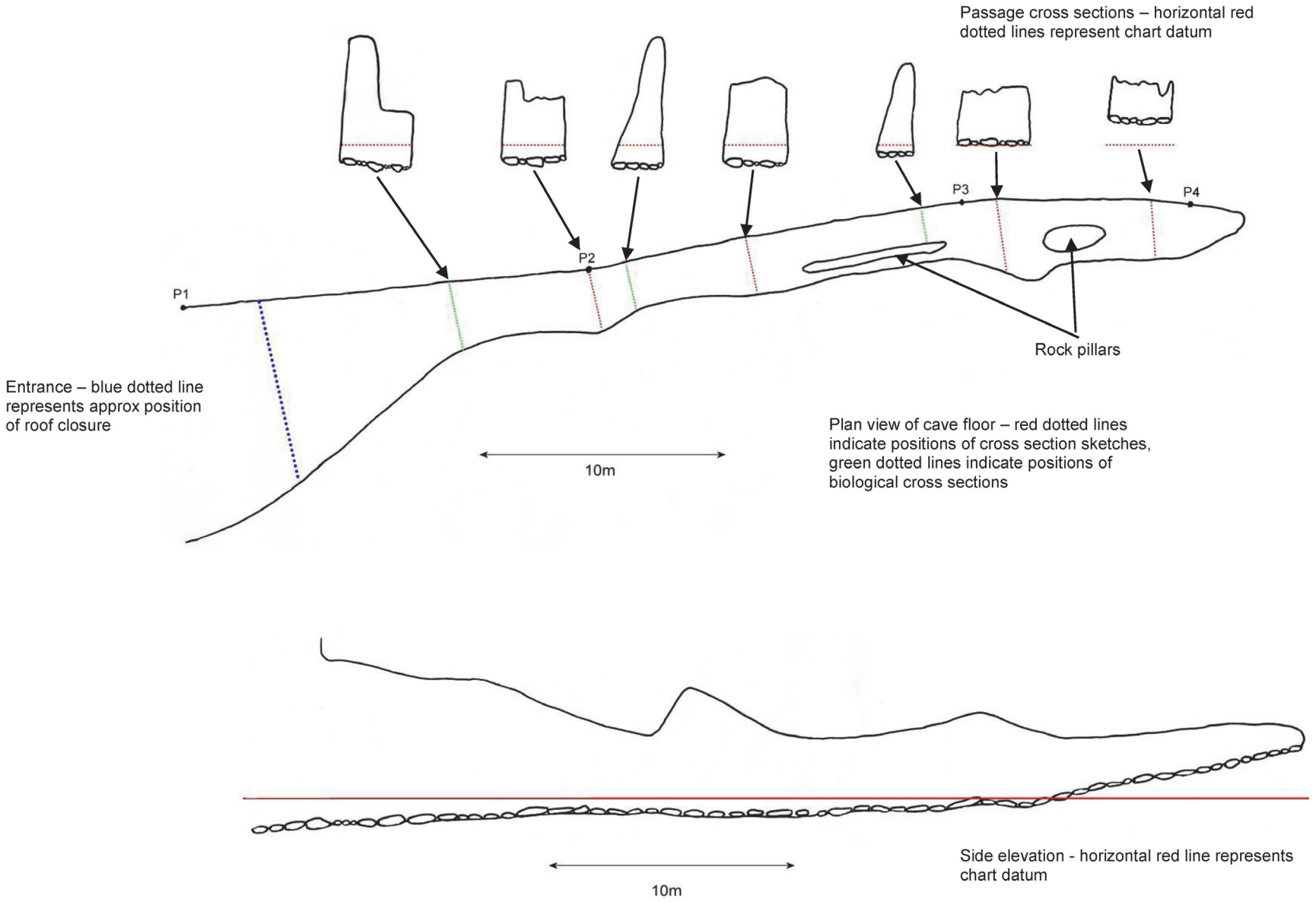


Piton 1

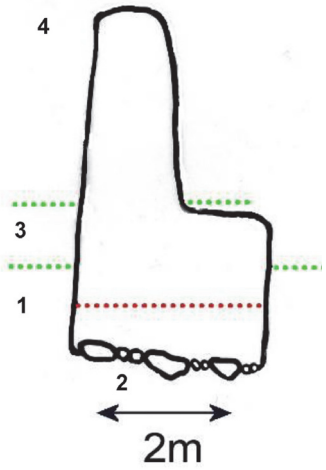
Piton 2

Piton 3

MI08CV02 / Cave at Scarfi Stack – Physical survey

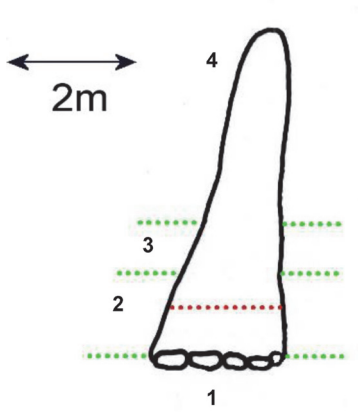


MI16CV02 / Cave at Scarfi Stack – Biological cross section 1 (~9 m from entrance, 13 m on tape)



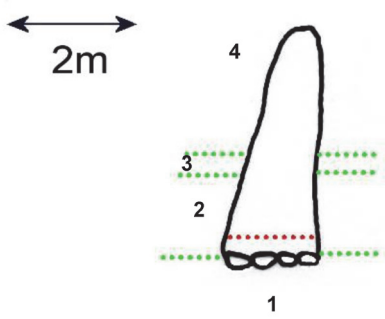
zone	upper limit (ACD)	lower limit (ACD)	Location	Substrate notes	Biological notes	Biotope
1	0.5	-1.0	Walls below waterline	Steep to vertical rock	Steep rock with occasional algal crusts and sparse encrusting biota including occasional *Fabricia stellaris* tube turf and rare *Leucosolenia complicata* & *Spirorbis tridentatus*. Biota tending to be more abundant higher on wall with *Fabricia stellaris* tube turf becoming common and *Leucosolenia complicata* becoming occasional.	**IR.FIR.SG.CC.BalPom**
2	-1.0	-1.0	Floor	Cave floor of boulders & cobbles	Boulders & cobbles with abundant algal crusts, frequent *Actinia* and sparse encrusting biota including rare sabellid tube turf & *Spirorbis tridentatus*.	**IR.FIR.SG.CC.Mo**
3	2.3	0.5	Walls at waterline	Steep to vertical rock	Steep rock with common *Semibalanus balanoides* and frequent *Patella vulgata* and littorinids.	**LR.HLR.MusB.Sem**
4	4.3	2.3	Upper walls & ceiling	Steep to overhanging rock	Steep rock wall with superabundant *Hildenbrandia*, frequent green algal stains & occasional *Verrucaria*.	**LR.FLR.CvOv.VmucHil**

MI16CV02 / Cave at Scarfi Stack – Biological cross section 2 (~16 m from entrance, 20 m on tape)



zone	upper limit (ACD)	lower limit (ACD)	Location	Substrate notes	Biological notes	Biotope
1	-0.9	-0.9	Floor	Cave floor of boulders & cobbles	Boulders & cobbles with frequent *Actinia* and sparse encrusting biota including rare sabellid tube turf & *Spirorbis tridentatus* on the larger boulders.	**IR.FIR.SG.CC.Mo**
2	0.5	-0.9	Walls below waterline	Steep to vertical rock	Steep rock with rare *Fabricia stellaris* tube turf becoming frequent in upper part of the zone.	**IR.FIR.SG.CC.BalPom**
3	1.3	0.5	Walls at waterline	Steep to vertical rock	Steep rock with sparse (rare) biota including *Hildenbrandia*, *Fabricia stellaris* tube turf & *Semibalanus balanoides*.	**LR.FLR.CvOv.ScrFa**
4	4.3	1.3	Upper walls & ceiling	Steep to overhanging rock	Steep rock wall with common *Hildenbrandia* & frequent green algal stains.	**LR.FLR.CvOv.VmucHil**

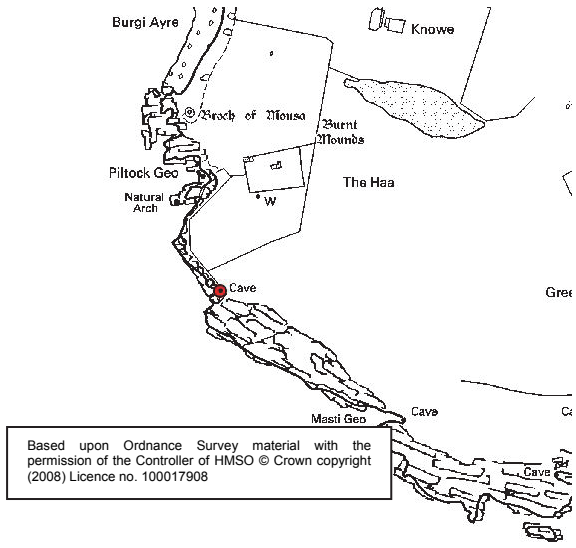
MI16CV02 / Cave at Scarfi Stack – Biological cross section 3 (~28 m from entrance, 32 m on tape)



zone	upper limit (ACD)	lower limit (ACD)	Location	Substrate notes	Biological notes	Biotope
1	-0.3	-0.3	Floor	Cave floor of boulders & cobbles	Boulders & cobbles with sparse biota including *Actinia* (frequent), infaunal polychaetes (frequent) and *Carcinus* (present).	**IR.FIR.SG.CC.Mo**
2	1.0	-0.3	Walls below waterline	Steep to vertical rock	Steep rock with sparse biota including sabellid tube turf (rare).	**IR.FIR.SG.CC.BalPom**
3	1.3	1.0	Walls at waterline	Steep to vertical rock	Steep rock with no biota recorded.	**Barren rock**
4	3.3	1.3	Upper walls & ceiling	Steep to overhanging rock	Steep rock with no biota recorded.	**Barren rock**

Cave relocation sheet

Cave name	Cave south of the Broch
Site code	MI08CV03
Position of entrance	59.99283°N 1.181783°W
How start point is marked	Two galvanised relocation pitons in northern (left) wall situated a couple of metres outside of where the cave roof closes over. First relocation piton is in a vertical crevice at about 4 m ACD (green algal zone). Second relocation piton is below the first and located in a crevice at the back of a small ledge just above the water surface at about 2 m ACD (upper part of barnacle zone).
Notes on relocation	Look for obvious narrow cave entrance at back of inlet then work back out along wall referring to photos to find piton placements.
Access	by boat



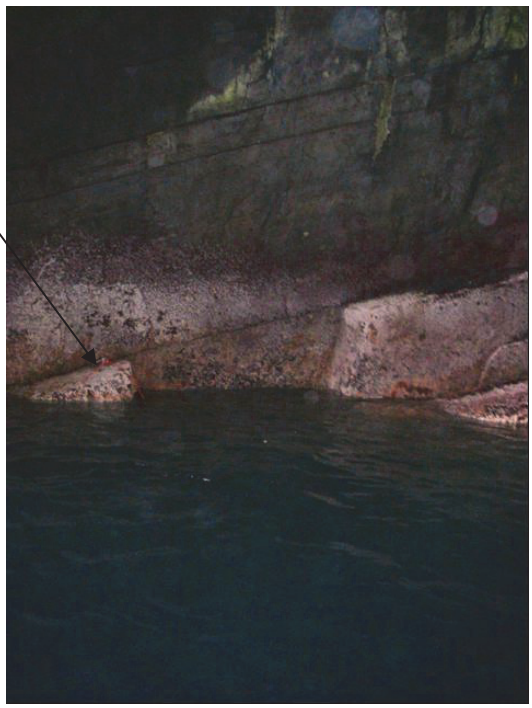
Cave location

IMGP0988.JPG Towards entrance from 59.99285°N 1.18322°W, 70°M

IMGP1010.JPG 1st relocation piton, no fix possible.

IMGP1007.JPG Close up of 1st relocation piton, no fix possible.

IMGP0984.JPG 2nd relocation piton, no fix possible.

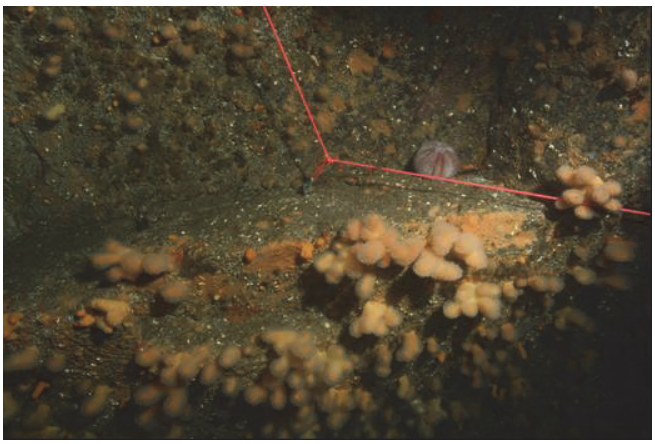


IMGP0980.JPG 2nd relocation piton, no fix possible.

Cave datum line relocation information

Cave name	Cave south of the Broch
Site code	MI08CV03
Position of piton 1	Directly below 2nd relocation piton at a distance of 4.0 m

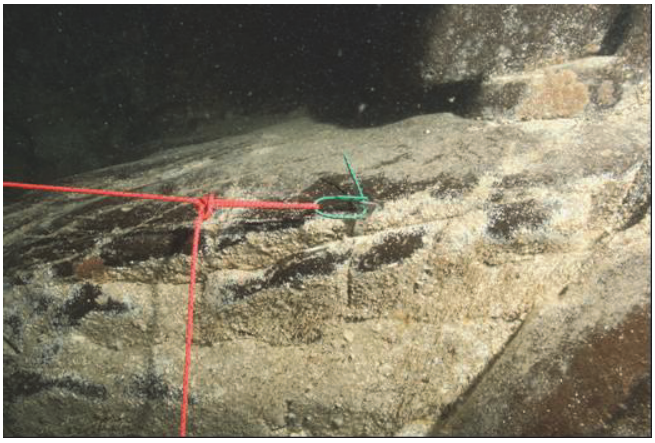
Piton number	Depth of Piton (relative to chart datum)	Distance (m) to next piton	Distance (m) on tape	Bearing (degrees magnetic) to next piton
Piton 1	1.4 BCD	21.0	4.0	100
Piton 2	0.8 ACD	31.0	25.0	90
Piton 3	0.4 ACD	18.0	56.0	95
Piton 4	0.5 ACD	N/A	74.0	N/A



Piton 1

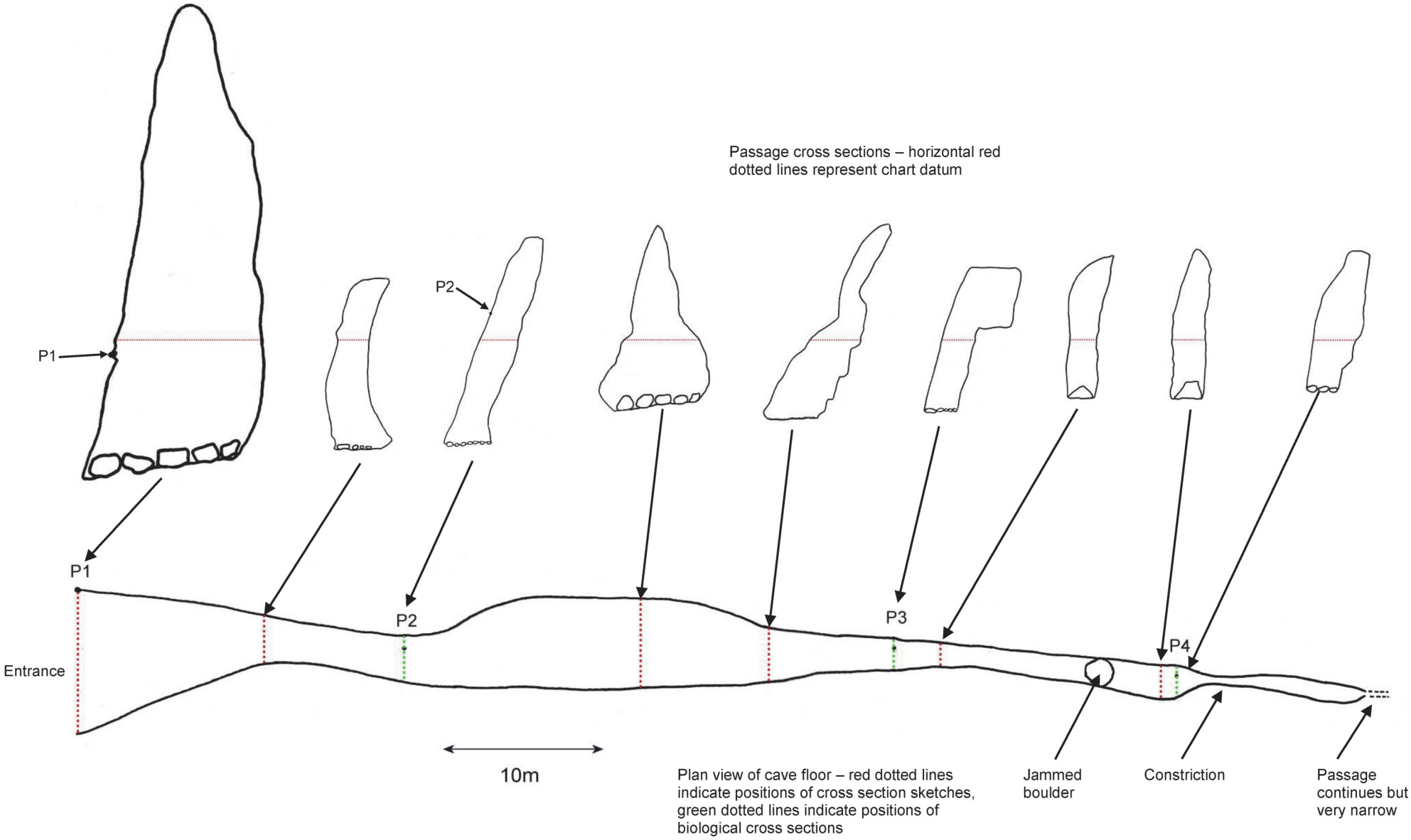
Piton 2

Piton 3

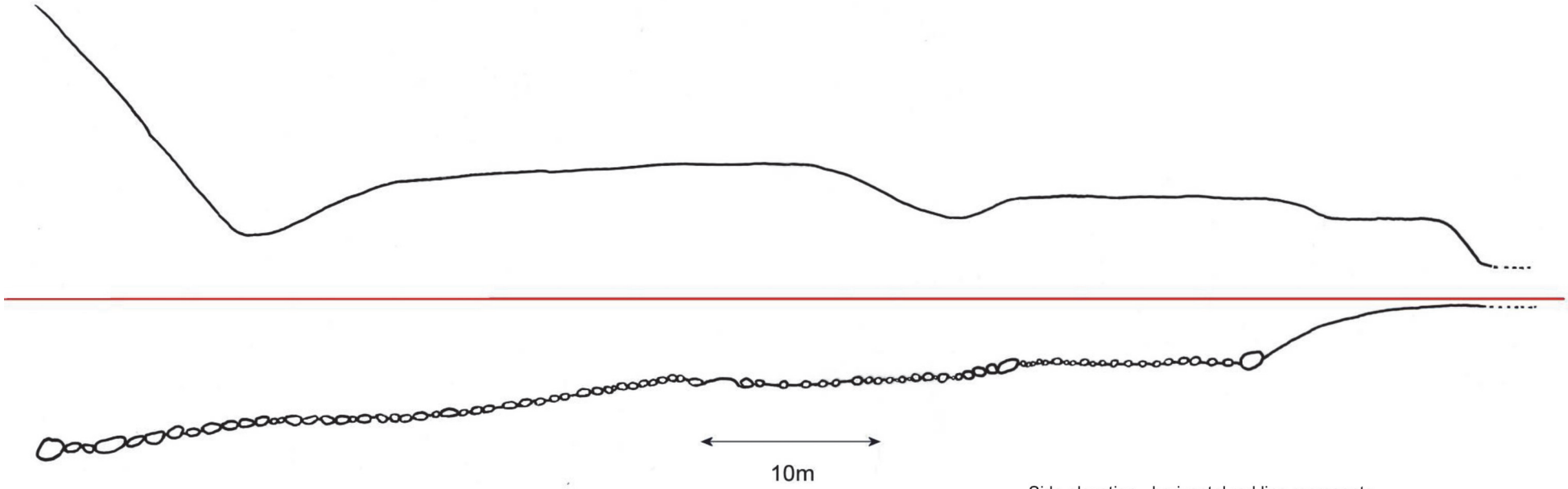


Piton 4

MI08CV03 / Cave south of the Broch – Physical survey

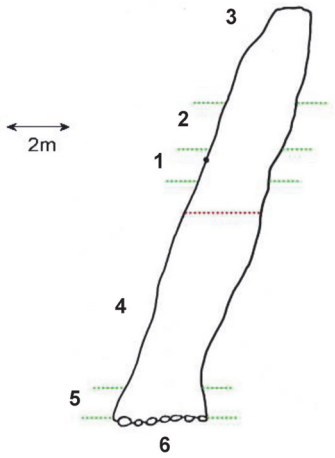


MI08CV03 / Cave south of the Broch – Physical survey (cont'd)



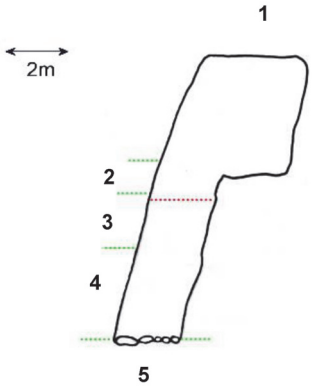
Side elevation - horizontal red line represents chart datum

MI16CV03 / Cave S of the Broch – Biological cross section 1 (~19 m from entrance, 25 m on tape)



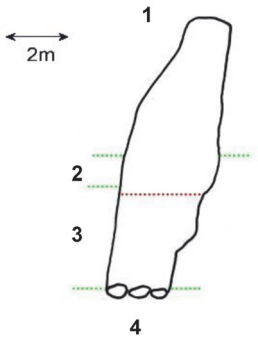
zone	upper limit (ACD)	lower limit (ACD)	Location	Substrate notes	Biological notes	Biotope
1	2.0	1.0	Walls at waterline	Overhanging rock on left wall, upward facing rock on right wall	Steep rock with superabundant *Semibalanus balanoides* and frequent *Patella vulgata*.	**LR.HLR.MusB.Sem**
2	3.5	2.0	Walls above waterline	Overhanging rock on left wall, upward facing rock on right wall	Steep rock with abundant *Hildenbrandia* and frequent green algal crusts.	**LR.FLR.CvOv.VmucHil**
3	6.5	3.5	Upper walls	Overhanging rock on left wall, upward facing rock on right wall	Steep rock with abundant green algal crusts and frequent *Hildenbrandia*.	**LR.FLR.CvOv.GCv**
4	1.0	-5.5	Walls below waterline	Slightly overhanging rock on left wall, steep upward facing rock on right wall	Overhanging wall with diverse fauna dominated by abundant *Tubularia indivisa* and common *Metridium dianthus* and bryozoan crusts (mostly *Oshurkovia litoralis*) on upper parts of the wall. Elsewhere on the wall there were frequent sponge crusts, frequent bryozoan turf and sparse (rare) colonial ascidians.	**IR.FIR.SG.CrSpAsAn**
5	-5.5	-6.5	Walls near cave floor	Slightly overhanging rock on left wall, steep upward facing rock on right wall	Steep rock with sparse attached biota.	**IR.FIR.SG.CC.BalPom**
6	-6.5	-6.5	Floor	cobbles, pebbles & gravel	Boulders & cobbles with sparse attached biota.	**IR.FIR.SG.CC.Mo**

MI16CV03 / Cave S of the Broch – Biological cross section 2 (~50 m from entrance, 56 m on tape)



zone	upper limit (ACD)	lower limit (ACD)	Location	Substrate notes	Biological notes	Biotope
1	3.6	1.3	Walls above waterline	Slightly overhanging rock on left wall.	Bare rock with no obvious biota.	**Barren rock**
2	1.3	0.3	Left wall at waterline	Slightly overhanging rock on left wall	Steep rock with occasional *Semibalanus*, rare *Mytilus* & *Actinia*.	**LR.FLR.CvOv.ScrFa**
3	0.3	-1.4	Upper part of left wall below waterline	Slightly overhanging rock on left wall	Steep rock with abundant polychaete tube turf, *Corynactis* and *Grantia*. *Metridium* & *Sagartia* locally common in upper part of the zone.	**IR.FIR.SG.CrSpAsAn**
4	-1.4	-4.4	Lower part of left wall below waterline	Slightly overhanging rock on left wall	Steep rock with abundant polychaete tube turf (mostly terebellids), common *Dendrodoa* and *Grantia*, frequent *Spirorbis tridentatus*. *Clathrina* and *Leucosolenia complicata* frequent in upper part of the zone.	**IR.FIR.SG.CC.BalPom**
5	-4.4	-4.4	Floor	boulders, cobbles & pebbles	Boulders & cobbles with sparse attached biota.	**IR.FIR.SG.CC.Mo**

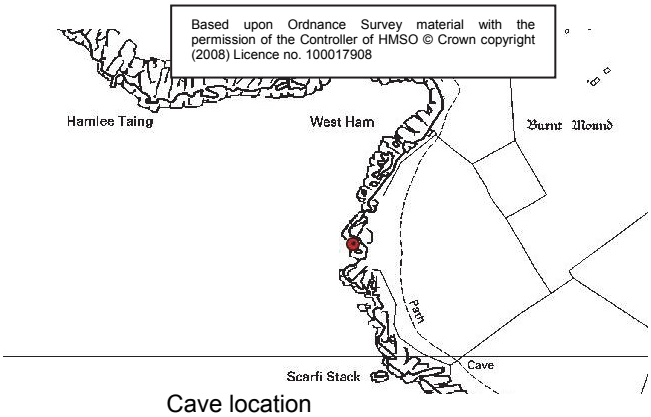
MI16CV03 / Cave S of the Broch – Biological cross section 3 (~68 m from entrance, 74 m on tape)



zone	upper limit (ACD)	lower limit (ACD)	Location	Substrate notes	Biological notes	Biotope
1	5.7	1.4	Walls above waterline	Steep to overhanging rock	Bare rock with no obvious biota.	**Barren rock**
2	1.4	0.4	Left wall at waterline	Slightly overhanging rock on left wall	Steep rock with frequent *Actinia* and rare polychaete tube turf, *Spirorbis tridentatus*, *Semibalanus* & *Mytilus*.	**LR.FLR.CvOv.ScrFa**
3	0.4	-2.8	Left wall below waterline	Slightly overhanging rock on left wall	Steep rock with hydroid turf becoming abundant in upper areas. Polychaete tube turf & *Spirorbis tridentatus* common. *Grantia* frequent becoming common in upper zone. *Dendrodoa* and *Sagartia* frequent.	**IR.FIR.SG.CC.BalPom** **IR.FIR.SG.CrSpAsAn**
4	-2.8	-2.8	Floor	boulders, cobbles & pebbles	Boulders & sediment patches with sparse biota including locally frequent tube turf, *Spirorbis tridentatus*, *Grantia* and polychaete casts.	**IR.FIR.SG.CC.Mo**

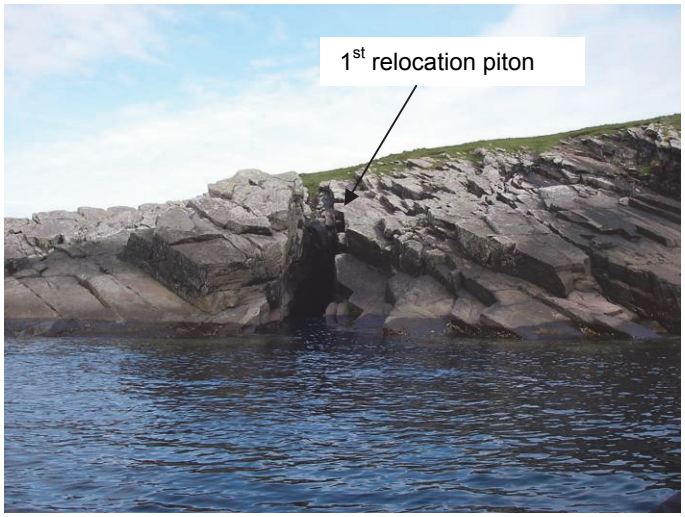
Cave relocation sheet

Cave name	Cave near West Ham
Site code	MI08CV04
Position of entrance	59.99983°N 1.18545°W
How start point is marked	Two galvanised relocation pitons. First relocation piton is in a crevice in the supralittoral lichen dominated rock of the open shore above the cave entrance. This is about 7.5 m ACD and 5 m directly above the second relocation piton. The second relocation piton is at about 2.5 m ACD in the SE (right) wall of the surge gully just below where the cave roof closes over.
Notes on relocation	Use photographs to relocate first piton then hang tape measure into surge gully to establish position of second piton.
Access	by boat



Cave location


IMGP1025.JPG Towards entrance from 59.99956°N 1.18643°W, 60°M



IMGP1023.JPG Towards entrance from 59.99982°N 1.18555°W, 51°M

IMGP1022.JPG 1st relocation piton from 59.99998 °N 1.18502°W, 18°M

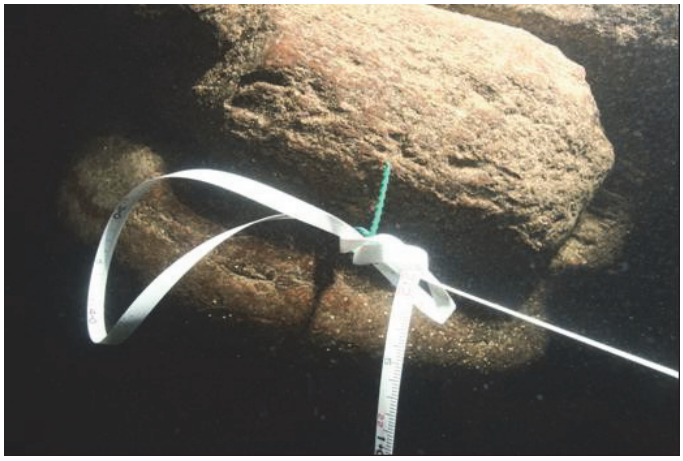
Cave datum line relocation information

Cave name	Cave near West Ham
Site code	MI08CV04
Position of piton 1	Directly below 2nd relocation piton at a distance of 2.25 m

Piton number	Depth of Piton (relative to chart datum)	Distance (m) to next piton	Distance (m) on tape	Bearing (degrees magnetic) to next piton
Piton 1	0.2 ACD	7.6	0	40
Piton 2	0.7 ACD	13.2	7.6	40
Piton 3	1.5 ACD	N/A	20.8	N/A

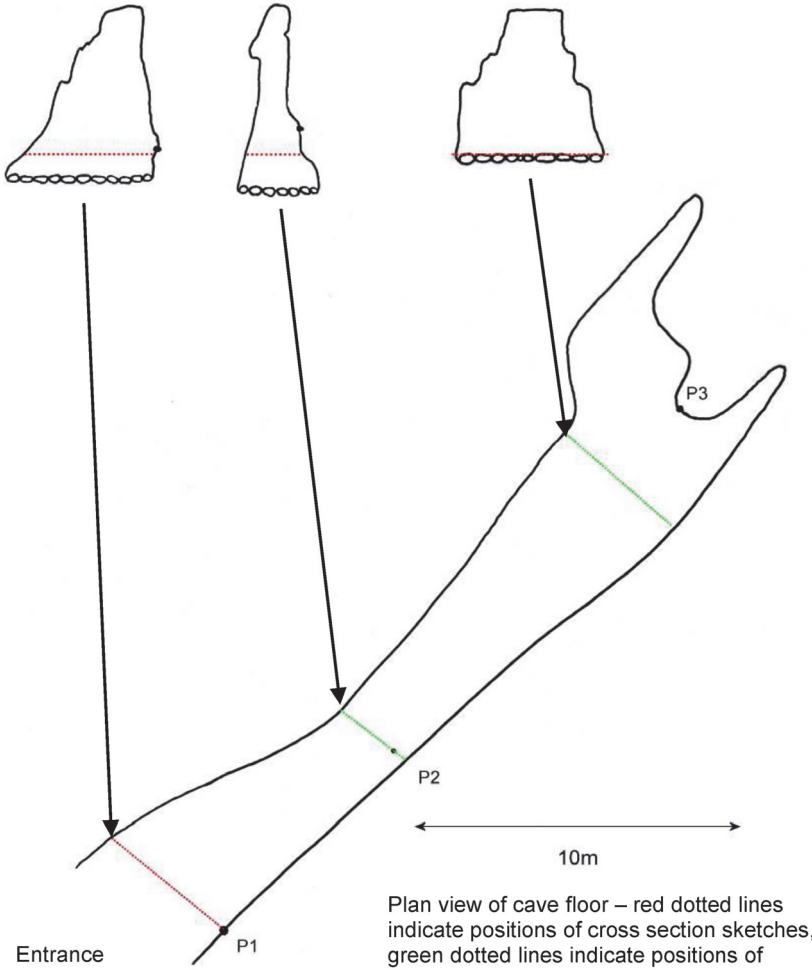
Piton 1

Piton 2

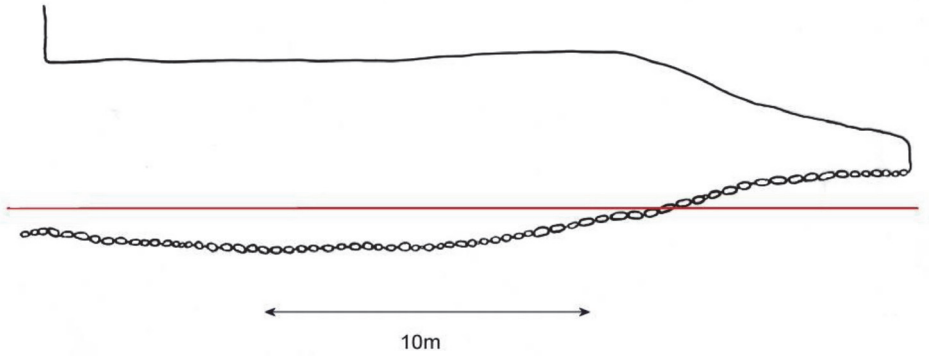


Piton 3

MI08CV04 / Cave near West Ham – Physical survey

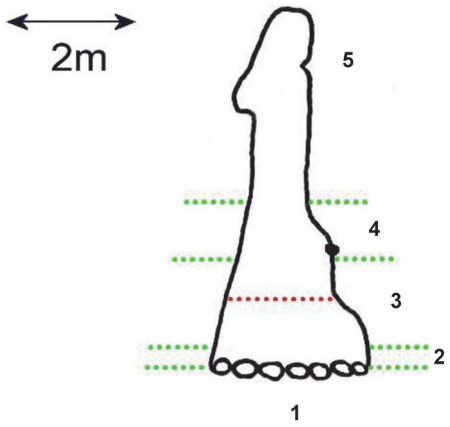


Plan view of cave floor – red dotted lines indicate positions of cross section sketches, green dotted lines indicate positions of biological cross sections



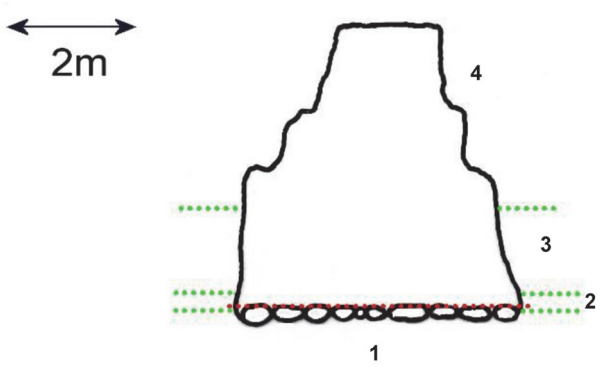
Side elevation - horizontal red line represents chart datum

MI16CV04 / Cave near West Ham – Biological cross section 1 (~8 m from entrance, 7.6 m on tape)



zone	upper limit (ACD)	lower limit (ACD)	Location	Substrate notes	Biological notes	Biotope
1	-1.2	-1.2	Floor	smooth, rounded boulders & cobbles	Boulders with very sparse biota of coralline algal crusts and *Spirorbis tridentatus*.	**IR.FIR.SG.CC.Mo**
2	-0.8	-1.2	Walls near cave floor	Steep to overhanging rock	Scoured steep rock with sparse fauna. Rare *Spirorbis tridentatus*, *Leucosolenia* & *Diplosoma* present.	**IR.FIR.SG.CC.BalPom**
3	0.6	-0.8	Walls below waterline	Steep to overhanging rock	Steep rock with superabundant *Spirorbis tridentatus* and abundant polychaete tube turf.	**IR.FIR.SG.CC.BalPom**
4	1.5	0.6	Walls at waterline	Steep to overhanging rock	Steep rock with abundant *Semibalanus* and *Hildenbrandia*. Frequent *Patella* & *Mytilus*.	**LR.HLR.MusB.Sem**
5	4.5	1.5	Walls above waterline	Steep to overhanging rock	Steep rock with superabundant *Hildenbrandia*. Occasional *Patella* in lower parts of zone.	**LR.FLR.CvOv.VmucHil**

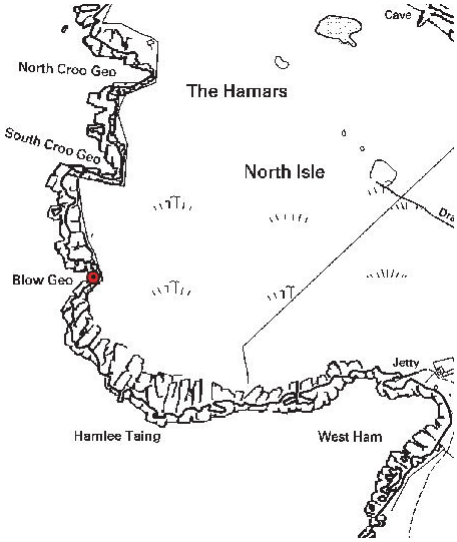
MI16CV04 / Cave near West Ham – Biological cross section 2 (~18 m from entrance, 18 m on tape)



zone	upper limit (ACD)	lower limit (ACD)	Location	Substrate notes	Biological notes	Biotope
1	-0.1	-0.1	Floor	smooth, rounded boulders & cobbles	Boulders with very sparse biota of rare coralline algal crusts and *Spirorbis tridentatus*.	**IR.FIR.SG.CC.Mo**
2	0.2	-0.1	Walls near cave floor	Steep to overhanging rock	Scoured steep rock with sparse fauna. *Spirorbis tridentatus* present (rare).	**IR.FIR.SG.CC.BalPom**
3	1.5	0.2	Walls below waterline	Steep to overhanging rock	Steep rock with abundant *Spirorbis tridentatus* and polychaete tube turf (mostly *Fabricia stellaris*).	**IR.FIR.SG.CC.BalPom**
4	4.5	1.5	Walls above waterline	Steep to overhanging rock	Steep rock with abundant *Hildenbrandia*. Occasional *Patella* in lower parts of zone.	**LR.FLR.CvOv.VmucHil**

Cave relocation sheet

Cave name	Cave at Blow Geo
Site code	MI08CV05
Position of entrance	60.00362°N 1.192517°W
How start point is marked	Relocation piton is in a horizontal crevice at about 2.5 m ACD just below where the cave roof closes over on the SW (right) wall.
Notes on relocation	Refer to photographs.
Access	by boat



IMGP1031.JPG Towards entrance from 60.00367°N 1.19283°W, 109°M

Relocation piton

IMGP1029.JPG Towards entrance from 60.00362°N 1.19242°W, 126°M

IMGP1028.JPG Relocation piton, no fix possible.

Cave datum line relocation information

Cave name	Cave at Blow Geo
Site code	MI08CV05
Position of piton 1	Directly below 2nd relocation piton at a distance of 2.26 m

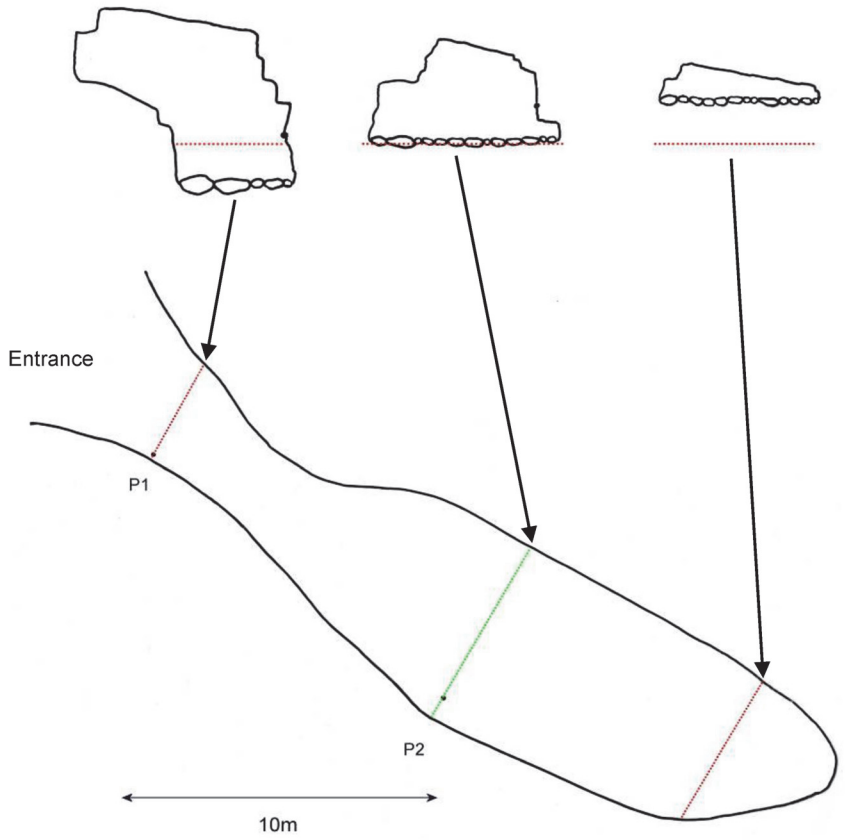
Piton number	Depth of Piton (relative to chart datum)	Distance (m) to next piton	Distance (m) on tape	Bearing (degrees magnetic) to next piton
Piton 1	0.2 ACD	12.1	0	130
Piton 2	1.1 ACD	11.9	12.1	100
Piton 3 (tape placed on boulders)	1.7 ACD	N/A	24.0	N/A

Piton 1

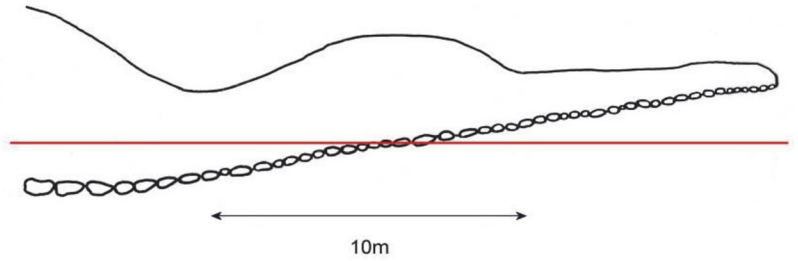
Piton 2

MI08CV05 / Cave at Blow Geo – Physical survey

Passage cross sections – horizontal red dotted lines represent chart datum

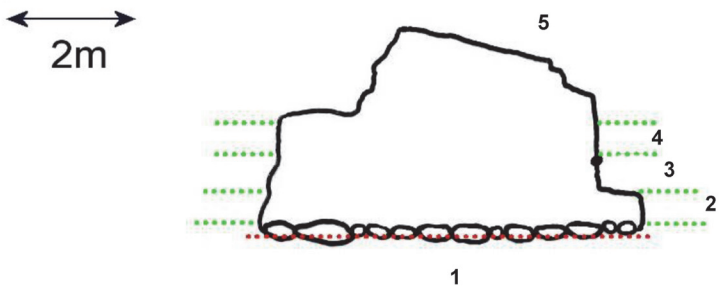


Plan view of cave floor – red dotted lines indicate positions of cross section sketches, green dotted lines indicate positions of biological cross sections



Side elevation - horizontal red line represents chart datum

MI16CV05 / Cave at Blow Geo – Biological cross section 1 (~12 m from entrance, 12.1 m on tape)



zone	upper limit (ACD)	lower limit (ACD)	Location	Substrate notes	Biological notes	Biotope
1	0	0	Floor	Smooth rounded boulders & cobbles with coarse sand infill	Boulders with very sparse biota of barnacles and *Spirorbis tridentatus* (rare).	**IR.FIR.SG.CC.Mo**
2	0.5	0	Right wall below waterline; lower part	Steep to overhanging rock	Steep rock with sparse biota including rare *Spirorbis tridentatus* and polychaete tube turf.	**IR.FIR.SG.CC.BalPom**
3	1.1	0.5	Right wall below waterline; upper part	Steep to overhanging rock	Steep rock with frequent polychaete tube turf and occasional *Spirorbis tridentatus* and frequent *Dynamena pumila*.	**IR.FIR.SG.CC.BalPom**
4	1.6	1.1	Walls at waterline	Steep to overhanging rock	Steep rock with abundant *Semibalanus* and Frequent *Patella*, *Actinia* & *Mytilus*.	**LR.HLR.MusB.Sem**
5	3.1	1.6	Walls above waterline & ceiling	Steep to overhanging rock	Steep rock with common *Hildenbrandia*.	**LR.FLR.CvOv.VmucHil**

Annex 4.1.5 –Cave species abundance data (SACFOR)

MI16CV01 (biological cross section 1)

Taxa	CV01.1.1	CV01.1.2	CV01.1.6	CV01.1.7	CV01.1.8
Hildenbrandia sp.			C	S	
Corallinaceae (pink crusts)	F	F (loc A)			C
Chlorophyta (green crusts)			S		
Bacteria / Fungi (Cave mould)					
Clathrina coriacea					
Leucosolenia complicata					
Leuconia johnstoni					
Oscarella lobularis	O (loc F)	R (loc F)			
Actinia equina					
Urticina felina	P				P
Spirobranchus triqueter	F	F			
Spirorbis (Spirorbis) tridentatus		R (loc F)			
Verruca stroemia	R	P			
Semibalanus balanoides					A
Balanus balanus					
Galathea strigosa		F			
Cancer pagurus	P	P			P
Necora puber		P			
Pagurus sp.		P			
Tectura virginea		P			O
Patella vulgata					F
Steromphala cineraria	P				
Heteranomia squamula	F (loc C)	F (loc C)			
Nassarius incrassatus					
Tonicella sp.	P				
Doris sp.					
Henricia sp.		P			
Asterias rubens		P			P
Echinus esculentus	loc C	P			
Ophiothrix fragilis					
Ophiopholis aculeata	P (loc A)				
Dendrodoa grossularia	P	O			
Botrylloides leachii		P			
Taurulus bubalis		P			

MI16CV01 (biological cross sections 2 & 3)

Taxa	CV01.2.1	CV01.2.2	CV01.2.3	CV01.3.1	CV01.3.2	CV01.3.3
Hildenbrandia sp.			R			P
Corallinaceae (pink crusts)						
Chlorophyta (green crusts)						
Bacteria / Fungi (Cave mould)			A			
Clathrina coriacea	R (loc C)			R (loc O)		
Leucosolenia complicata	R			R		
Leuconia johnstoni	R					
Oscarella lobularis	R (loc C)			P		
Actinia equina				P		
Urticina felina						
Spirobranchus triqueter						
Spirorbis (Spirorbis) tridentatus	O (loc A)	R		R (loc F)		
Verruca stroemia	R	R		R		
Semibalanus balanoides					R	
Balanus balanus				P		
Galathea strigosa						
Cancer pagurus	F					
Necora puber				P		
Pagurus sp.						
Tectura virginea						
Patella vulgata						
Steromphala cineraria	F			F		
Heteranomia squamula	P					
Nassarius incrassatus				P		
Tonicella sp.						
Doris sp.				P		
Henricia sp.						
Asterias rubens						
Echinus esculentus						
Ophiothrix fragilis	P					
Ophiopholis aculeata						
Dendrodoa grossularia	R			R (loc A)		
Botrylloides leachii						
Taurulus bubalis						

MI16CV02 (biological cross section 1)

	CV02.1.1	CV02.1.2	CV02.1.3	CV02.1.4
Verrucaria mucosa				O
Hildenbrandia sp.	O	A	R	S
Chlorophyta (green crusts)				F
Leucosolenia complicata	R (loc O)			
Grantia compressa	P			
Porifera sp 1	R			
Hydrozoa indet				
Actinia equina		F (loc C)	P	
Urticina felina				
Polychaeta (tube turf)	O (loc C)	R	P	
Spirorbis (Spirorbis) tridentatus	R	R		
Polychaeta (faecal casts)				
Semibalanus balanoides			C	
Galathea sp.		P		
Cancer pagurus		P		
Necora puber		P		
Carcinus maenas				
Testudinalia testudinalis		P		
Patella vulgata			F	
Steromphala cineraria	O			
Margarites helicinus	P	P		
Littorina saxatilis			P	
Littorina saxatilis			F	
Mytilus edulis				
Bryozoa (white crust)				
Taurulus bubalis	P			

MI16CV02 (biological cross sections 2 & 3)

	CV02.2.1	CV02.2.2	CV02.2.3	CV02.2.4	CV02.3.1	CV02.3.2
Verrucaria mucosa						
Hildenbrandia sp.			R	C		
Chlorophyta (green crusts)				F		
Leucosolenia complicata	R	R				
Grantia compressa						
Porifera sp 1						
Hydrozoa indet			R			
Actinia equina	F				F	
Urticina felina	P					
Polychaeta (tube turf)	R	R (loc F)	R			R
Spirorbis (Spirorbis) tridentatus	R	R				
Polychaeta (faecal casts)					F	
Semibalanus balanoides			R			
Galathea sp.						
Cancer pagurus	P					
Necora puber	P					P
Carcinus maenas					P	
Testudinalia testudinalis						
Patella vulgata						
Steromphala cineraria		P				
Margarites helicinus	P	O	O			
Littorina saxatilis						
Littorina saxatilis						
Mytilus edulis			P			
Bryozoa (white crust)						R
Taurulus bubalis	P	P				

MI16CV03 (biological cross section 1)

	CV03.1.1	CV03.1.2	CV03.1.3	CV03.1.4	CV03.1.5	CV03.1.6
Hildenbrandia sp.		A	F			
Chlorophyta (green crusts)		F	A			
Clathrina coriacea				R (loc F)		
Leucosolenia complicata				O (loc F)	R	
Leuconia johnstoni				P		
Grantia compressa				P	O	
Oscarella lobularis						
Halichondria (Halichondria) panicea				F (loc)		
Myxilla (Myxilla) incrustans				O		
Porifera (white crust)						
Stelligera rigida				P		
Hymeniacidon kitchingi				P		
Tubularia indivisa				A (loc)		
Sertularia argentea				P		
Hydrozoa indet						
Alcyonium digitatum						
Actinia equina						
Urticina felina						
Metridium dianthus				C (loc)		
Sagartia elegans						
Corynactis viridis						
Polychaeta (tube turf)						
Spirobranchus triqueter					R	
Spirorbis (Spirorbis) tridentatus						R
Polychaeta (faecal casts)						
Verruca stroemia				O	R	
Semibalanus balanoides	S					
Galathea sp.						
Cancer pagurus						C
Necora puber						
Patella vulgata	F					
Steromphala cineraria						
Calliostoma zizyphinum						P
Mytilus edulis	R					
Heteranomia squamula				P		
Hiatella arctica				P		
Crisidia cornuta				P		
Crisia eburnea				F		
Scrupocellaria scruposa				F		
Bicellariella ciliata				P		
Bryozoa (white crust)						
Celleporina caliciformis				P		
Oshurkovia littoralis				C (loc)		
Plagioecia patina				P		
Henricia sp.						P
Asterias rubens						P
Ophiothrix fragilis				P		
Polyclinum aurantium				R		

	CV03.1.1	CV03.1.2	CV03.1.3	CV03.1.4	CV03.1.5	CV03.1.6
Diplosoma listerianum				P		
Lissoclinum perforatum						
Dendrodoa grossularia						
Botryllus schlosseri				R		
Aplidium nordmanni				R		
Chirolophis ascanii						P
Taurulus bubalis						
Pholis gunnellus						

MI16CV03 (biological cross section 2)

	CV03.2.2	CV03.2.3	CV03.2.4
Hildenbrandia sp.			
Chlorophyta (green crusts)			
Clathrina coriacea		R	R (loc F)
Leucosolenia complicata		R	R (loc F)
Leuconia johnstoni		P	
Grantia compressa		A (loc C)	C
Oscarella lobularis			
Halichondria (Halichondria) panicea			R
Myxilla (Myxilla) incrustans			
Porifera (white crust)			
Stelligera rigida			
Hymeniacidon kitchingi			
Tubularia indivisa		R	
Sertularia argentea			
Hydrozoa indet			
Alcyonium digitatum		R	
Actinia equina	P		
Urticina felina			
Metridium dianthus		C (loc)	
Sagartia elegans		C (loc)	
Corynactis viridis		A	
Polychaeta (tube turf)		A	A (loc R)
Spirobranchus triqueter			R
Spirorbis (Spirorbis) tridentatus			F (loc C)
Polychaeta (faecal casts)			
Verruca stroemia			P
Semibalanus balanoides	O		
Galathea sp.			F
Cancer pagurus			C
Necora puber			
Patella vulgata			
Steromphala cineraria			
Calliostoma zizyphinum			
Mytilus edulis	R		
Heteranomia squamula			P
Hiatella arctica			
Crisidia cornuta			

	CV03.2.2	CV03.2.3	CV03.2.4
Crisia eburnea			
Scrupocellaria scruposa			
Bicellariella ciliata			
Bryozoa (white crust)			P
Celleporina caliciformis			
Oshurkovia littoralis			
Plagioecia patina			
Henricia sp.			
Asterias rubens			F
Ophiothrix fragilis			
Polyclinum aurantium			
Diplosoma listerianum			
Lissoclinum perforatum			R
Dendrodoa grossularia			C (loc O)
Botryllus schlosseri			R
Aplidium nordmanni			
Chirolophis ascanii			
Taurulus bubalis		P	
Pholis gunnellus			

MI16CV03 (biological cross section 3)

	CV03.3.2	CV03.3.3	CV03.3.4
Hildenbrandia sp.			
Chlorophyta (green crusts)			
Clathrina coriacea		R	
Leucosolenia complicata		R	
Leuconia johnstoni			
Grantia compressa		F (loc C)	P (loc F)
Oscarella lobularis		R	
Halichondria (Halichondria) panicea			
Myxilla (Myxilla) incrustans			
Porifera (white crust)		R	
Stelligera rigida			
Hymeniacidon kitchingi			
Tubularia indivisa			
Sertularia argentea			
Hydrozoa indet		F (loc A)	
Alcyonium digitatum		R	
Actinia equina	F		
Urticina felina		C (loc)	P
Metridium dianthus		P	
Sagartia elegans		O (loc F)	
Corynactis viridis			
Polychaeta (tube turf)	R	C	O (loc F)
Spirobranchus triqueter		R	
Spirorbis (Spirorbis) tridentatus	R	C	R (loc F)
Polychaeta (faecal casts)			F
Verruca stroemia		P	

	CV03.3.2	CV03.3.3	CV03.3.4
Semibalanus balanoides	R		
Galathea sp.			
Cancer pagurus			P
Necora puber			P
Patella vulgata			
Steromphala cineraria		O	
Calliostoma zizyphinum			
Mytilus edulis	R		
Heteranomia squamula			
Hiatella arctica			
Crisidia cornuta			
Crisia eburnea			
Scrupocellaria scruposa			
Bicellariella ciliata			
Bryozoa (white crust)			
Celleporina caliciformis			
Oshurkovia littoralis			
Plagioecia patina			
Henricia sp.		P	
Asterias rubens			F
Ophiothrix fragilis			
Polyclinum aurantium			
Diplosoma listerianum			
Lissoclinum perforatum			
Dendrodoa grossularia		F	P
Botryllus schlosseri			
Aplidium nordmanni		R	
Chirolophis ascanii			
Taurulus bubalis		P	
Pholis gunnellus			

MI16CV04 (biological cross section 1)

	CV04.1.1	CV04.1.2	CV04.1.3	CV04.1.4	CV04.1.5
Hildenbrandia sp.				A	S
Corallinaceae (pink crusts)	R				
Leucosolenia complicata		R	O (loc C)		
Grantia compressa			C		
Halichondria (Halichondria) panicea			R		
Polychaeta (tube turf)			A		
Spirorbis (Spirorbis) tridentatus	R	R	S		
Semibalanus balanoides				A	
Hyas araneus					
Cancer pagurus					
Patella vulgata				F	O (loc)
Steromphala cineraria		P			
Mytilus edulis				F	
Diplosoma listerianum		R	R		
Taurulus bubalis					

MI16CV04 (biological cross section 2)

	CV04.2.1	CV04.2.2	CV04.2.3	CV04.2.4
Hildenbrandia sp.				A
Corallinaceae (pink crusts)	R			
Leucosolenia complicata			R	
Grantia compressa			F	
Halichondria (Halichondria) panicea			R	
Polychaeta (tube turf)			A	
Spirorbis (Spirorbis) tridentatus	R	R	A	
Semibalanus balanoides				
Hyas araneus			P	
Cancer pagurus	P			
Patella vulgata				O (loc)
Steromphala cineraria	P	P		
Mytilus edulis			R	
Diplosoma listerianum				
Taurulus bubalis	P			

MI16CV05 (biological cross section 1)

	CV05.1.1	CV05.1.2	CV05.1.3	CV05.1.4	CV05.1.5
Hildenbrandia sp.					C
Rhodophyta (red crusts)			O		
Dynamena pumila		O	F		
Actinia equina				O (loc F)	
Urticina felina		P			
Anthozoa indet				R	
Polychaeta (tube turf)		R	F	O	
Serpulidae (*Salmacina dysteri* / *Filograna implexa*)				R	
Spirorbis (Spirorbis) tridentatus	R	R	O		
Semibalanus balanoides	R			A	
Cancer pagurus	F	P			
Necora puber	F				
Patella vulgata		R	F	F	
Mytilus edulis				F	
Bryozoa (crust)			R		

ANNEX 5: SITE ATTRIBUTE TABLES

*Table 5.1. Site attribute table for the **reefs** feature for Mousa SAC, with the results of the 2016 site condition monitoring survey.*

Attribute	Target	Prescription	Result
1.1.1 Extent	1.1.1 No change in extent of littoral rock and inshore sublittoral rock	At 6-yearly intervals (in addition to individual case assessments) review activities that have had the potential to reduce the extent of the reef feature (in consultation with SNH Area Office, relevant authorities and site management groups where applicable) At 6-yearly intervals determine changes in reef extent through a programme of remote video sampling at 120 stations within the following areas identified by the 2003 survey by Posford Haskoning Ltd. (2004): bedrock, boulders and bedrock; cobbles; sand and bedrock. Determine localised changes in reef extent by examination of 5 fixed-position transects, comprising littoral and sublittoral components at North Isle N, Holes of Burro, Scarfi Stack N, West Ham and The Haa (see Harries et al.(2009) for transect positions). Note that following the recommendations in the first site condition monitoring survey (Harries *et al*., 2009) the Holes of Burro transect was replaced by an alternative east coast site with access to the intertidal, and The Haa was replaced by a more representative south coast site. Note also that the number of video sampling stations was reduced from 120 to 100 in 2016. At 18-yearly intervals check the most recent aerial photographs against the baseline littoral data **Note** - Reef extent and the implications of activities should be assessed against Posford Haskoning Ltd. (2004) and Harries et al. (2009).	No human activities have been identified that are likely to have influenced the extent of the feature. No significant change in the extent of reef biotopes along the relocatable reef transects was recorded between 2008 and 2016. There was a slight reduction in the frequency of dropdown video sites exhibiting reef habitats between the 2008 and 2016 surveys (86 in 2016 compared to 89 in 2008). There was also a reduction in the frequency of reef records between the 2003 and the 2016 study, with the same 30 sites studied in both years including 29 reef records in 2003 and 27 in 2016. While locational differences in camera tracking may have contributed in part to an apparent temporal reduction, it is also possible that real change may have taken place at three sites in the form of a reduction in stone density and blanketing of low-profile bedrock. The level of change recorded is considered to be insufficient to imply a global change in reef extent within the SAC. The recorded changes are consistent with natural temporal variation in hydrodynamic conditions.

Attribute	Target	Prescription	Result
1.1.2 Biotope composition of the littoral rock and inshore sublittoral rock	1.1.2 Maintain the variety of biotopes identified for the site, allowing for natural succession/ known cyclical change The following intertidal reef biotopes (or equivalents) must be found on the relocatable transects: LR.HLR.FR.Him LR.HLR.MusB.MytB LR.HLR.MusB.Sem.Sem LR.MLR.BF.FvesB LR.MLR.BF.Fser LR.LLR.F.Fserr.FS LR.FLR.Lic.YG LR.FLR.Lic.Ver.Ver LR.FLR.Lic.Ver.B LR.FLR.Lic.Pra LR.FLR.Rkp.G LR.FLR.Rkp.Cor.Cor The following subtidal reef biotopes (or equivalents) must be found within the SAC (recorded during the remote video sampling and/or on the relocatable transects): <u>Infralittoral biotopes</u> – IR.HIR.KFaR.Ala IR.HIR.KFaR.Ala.Myt IR.HIR.KFaR.FoR IR.HIR.KFaR.LhypR.Ft IR.HIR.KFaR.LhypRVt IR.HIR.KSed IR.HIR.KSed.DesFilR IR.HIR.KSed.LsacSac IR.HIR.KSed.XKScrR IR.MIR.KR.Lhyp.Ft IR.MIR.KR.Lhyp.GzFt	At 6-yearly intervals undertake a Phase II level (Hiscock, 1996) survey of the series of 5 fixed-position transects using standard SNH methodologies At 6-yearly intervals undertake a programme of remote video sampling at 120 stations within the following areas identified in Posford Haskoning Ltd. (2004): bedrock, boulders and bedrock; cobbles; sand and bedrock. Assess the biotope composition against the baseline established in the first SCM event (Harries at al., 2008).	Among the sites examined in both 2008 and 2016, four reef biotopes recorded in 2008 were not identified in 2016 (**IR.HIR.KFaR.FoR** along the reef transects and **IR.HIR.KSed.XKScrR**, **IR.HIR.KSed.Sac** and **CR.MCR.EcCr.FaAlCr.Flu** during the video survey). There was no reason to implicate anthropogenic factors in explaining any of the recorded physical and biological changes underlying the biotope loss at these sites, which were considered to be natural.

Attribute	Target	Prescription	Result
	IR.MIR.KR.Lhyp.GzPk IR.MIR.KR.LhypVt IR.LIR.K.Lsac.Ft Circalittoral biotopes – CR.HCR.XFa CR.MCR.EcCr.FaAlCr CR.MCR.EcCr.Adig CR.MCR.EcCr.AdigVt CR.MCR.EcCr.FaAlCr.Pom CR.MCR.EcCr.FaAlCr.Bri CR.MCR.EcCr.FaAlCr.Flu		

Attribute	Target	Prescription	Result
1.1.3 Distribution of biotopes Spatial arrangement of biotopes at specified locations	1.1.3 Maintain the distribution of intertidal and subtidal reef biotopes, allowing for natural succession/ known cyclical change The following biotopes should be found in the given sequence down the shore on the specified transects: <u>North Isle N</u> LR.FLR.Lic.YG LR.FLR.Lic.Ver.Ver LR.HLR.MusB.Sem.Sem LR.HLR.MusB.MytB IR.HIR.KFaR.Ala.Myt IR.MIR.KR.Lhyp.Ft IR.HIR.KSed.DesFilR IR.HIR.KSed.LsacSac <u>*Holes of Burro</u> LR.FLR.Lic.Ver.B LR.HLR.MusB.MytB IR.HIR.KFaR.Ala.Myt IR.HIR.KFaR.Ala IR.HIR.KFaR.LhypRVt CR.MCR.EcCr.AdigVt CR.MCR.EcCr.FaAlCr.Pom +CR.MCR.EcCr.FaAlCr.Bri <u>Scarfi Stack N</u> LR.FLR.Lic.YG LR.FLR.Lic.Pra LR.FLR.Lic.Ver.B LR.HLR.MusB.Sem.Sem IR.HIR.KFaR.Ala IR.MIR.KR.Lhyp.GzFt IR.MIR.KR.Lhyp.GzFt+ IR.HIR.KSed IR.HIR.KSed.LsacSac IR.HIR.KFaR.FoR <u>West Ham</u>	At 6-yearly intervals undertake a Phase II level (Hiscock, 1996) survey of the 5 fixed-position transects using standard SNH methodologies and compare the vertical biotope zonation patterns with those established through the first SCM event (Harries et al., 2008) At 6-yearly intervals undertake a programme of remote video sampling at 120 stations within the following areas identified in Posford Haskoning Ltd. (2004): bedrock, boulders and bedrock; cobbles; sand and bedrock. Assess the geographic distribution of the specified biotopes against the distribution depicted within the first SCM event (Harries et al., 2008). Note that following the recommendations in the first site condition monitoring survey (Harries *et al*., 2009) the Holes of Burro transect was replaced by an alternative east coast site with access to the intertidal, and The Haa was replaced by a more representative south coast site. Note also that the number of video sampling stations was reduced from 120 to 100 in 2016.	Change in the distribution of biotopes was recorded along all three reef transects studied in 2008 and 2016 and at 38 of the 100 dropdown video sites examined in both years. Temporal differences in camera tracking and variation in natural environmental factors such as hydrodynamism were considered most likely to be responsible for the observed changes, with no indication of anthropogenic causation.

Attribute	Target	Prescription	Result
	LR.FLR.Lic.YG LR.FLR.Lic.Ver.Ver LR.FLR.Lic.Ver.B LR.MLR.BF.FvesB LR.MLR.BF.Fser IR.HIR.KFaR.Ala, IR.HIR.KSed.LsacSac *The Haa LR.FLR.Lic.Pra LR.FLR.Lic.Ver.B LR.HLR.MusB.MytB LR.HLR.MusB.Sem.Sem IR.MIR.KR.LhypVt IR.MIR.KR.Lhyp.Ft IR.HIR.KSed.LsacSac The geographic distribution of the following subtidal reef biotopes (or equivalents) recorded during the remote video sampling should correspond to that given in Harries et al. (2008) - Infralittoral biotopes – IR.HIR.KFaR.Ala IR.HIR.KFaR.LhypR.Ft IR.HIR.KSed IR.HIR.KSed.LsacSac IR.HIR.KSed.Sac IR.HIR.KSed.XKScrR IR.MIR.KR.Lhyp.Ft IR.MIR.KR.Lhyp.GzFt IR.MIR.KR.Lhyp.GzPk Circalittoral biotopes – CR.HCR.XFa CR.MCR.EcCr.FaAlCr CR.MCR.EcCr.FaAlCr.Adig CR.MCR.EcCr.FaAlCr.AdigVt CR.MCR.EcCr.FaAlCr.Bri		

Attribute	Target	Prescription	Result
	CR.MCR.EcCr.FaAlCr.Flu CR.MCR.EcCr.FaAlCr.Pom		
1.1.4 Species composition of representative or notable biotopes	1.1.4 No decline in intertidal and/or subtidal biotope/sub-biotope quality on the monitoring transects due to changes in species composition or loss of notable species allowing for natural succession/ known cyclical change Biotopes for phase II survey to include those listed in section 1.1.3 above. Biotopes to be quadrat surveyed to include: LR.HLR.MusB.MytB LR.HLR.MusB.Sem.Sem	At 6-yearly intervals undertake a Phase II level (Hiscock, 1996) survey of the series of 5 fixed-position transects using standard SNH methodologies and compare the results with the species recorded during the first SCM event (Harries et. al., 2008). At 6-yearly intervals undertake quantitative community composition studies within zones of specified interest on the littoral sections of the transects at North Isle N, Scarfi Stack N and sites representative of the south coast and east coast using the quadrat-sampling techniques described in Harries et al. (2008). Biotopes to be sampled must include those where quadrats were recorded in 2008. Take photographs of all quadrats for comparison with the 2008 survey. Changes in species richness and composition over time to be identified with the aid of appropriate statistical analyses.	MNCR phase 2 surveys along three reef transects and quadrat quantification of the biota at two of these reef sites revealed no temporal decline in species richness between the 2008 and 2016 surveys. The quadrat and transect surveys revealed changes in the abundance of several species, but these were considered to be consistent with natural temporal variation. There was no clear evidence for the loss of any species. Note that due to change in abundance of *Mytilus edulis* and *Porphyra umbilicalis* LR.HLR.MusB.Sem.Sem changed to LR.HLR.MusB.MytB along transect XX07 and hence both quadrat surveys were carried out within this biotope.

References

Harries, D.B., Moore, C.G., Lyndon, A.R. & Mair, J.M. 2009. The establishment of site condition monitoring of the rocky reefs and sea caves of Mousa Special Area of Conservation. *Scottish Natural Heritage Commissioned Report No. 326.*

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Table 5.2. Site attribute table for the sea caves feature for Mousa SAC, with the results of the 2016 site condition monitoring survey.

Attribute	Target	Prescription	Result
1.1.1 Extent of cave(s)	1.1.1 No change in dimensions of a cave, allowing for natural changes that are part of a wider coastal geomorphological management regime.	At 6-yearly intervals (in addition to individual case assessments) review activities that have had the potential to reduce the extent of the cave feature (in consultation with SNH Area Office, relevant authorities and site management groups where applicable) At 6-yearly intervals determine changes in cave extent in 3 caves. Measurements of cave length, depth and visual estimates of passage cross sections to be made in conjunction with biological surveys At 18-yearly intervals visit all caves* and make visual assessment of extent Note - Cave extent and the implications of activities should be assessed against Harries *et al.* (2009).	No human activities have been identified that are likely to have influenced the extent of the known caves. No significant change in the physical extent of the known caves was recorded between 2008 and 2016. CV01, CV02 and CV03 were subject to a repeat physical survey and visual assessment. CV04 and CV05 were subject to a visual assessment. No changes in the dimensions if the caves were recorded.
1.1.2 Number of caves in site	1.1.2 No reduction in the number of caves within a site allowing for natural change.	At 6-yearly intervals (in addition to individual case assessments) review activities that have had the potential to reduce the number of caves (in consultation with SNH Area Office, relevant authorities and site management groups where applicable) At 18-yearly intervals visit all caves recorded in cave inventory and confirm presence Note - Number of caves and the implications of activities should be assessed against Harries *et al*. (2009).	No human activities have been identified that are likely to have reduced the number of known caves. A systematic check of the presence of all caves was not included in the remit of the 2016 survey. However, of the 17 caves known in 2008, 14 were confirmed as present in 2016 (CV1, 3 to 8, 9 & 10, 12 &13, 16 to 18). Level of scrutiny involved full surveys in the case of the monitoring sites and photography of entrances in other cases. No changes in the number of caves were recorded.

1.1.3 Biotope composition of a cave	1.1.3 Maintain the variety of biotopes identified for the cave, allowing for natural succession or known cyclical change. The following biotopes (or equivalents) must be found on the relocatable sections of MI08CV03: LR.FLR.CvOv.GCv LR.FLR.CvOv.VmucHil LR.FLR.CvOv.ScrFa IR.FIR.SG.CrSpAsAn IR.FIR.SG.CC.BalPom IR.FIR.SG.CC.Mo	At 6-yearly intervals conduct a repeat biological survey of MI08CV03 employing comparable methodology to Harries *et al.,* 2009 Assess the biotope composition against the baseline established in the first SCM event (Harries *et al*., 2009).	All six biotopes were confirmed as present within CV03 in 2016. Although some changes in the biota were noted, these changes were not of sufficient magnitude to warrant reassignment of biotopes. The only exception was the intertidal area near the cave entrance where elevated abundance of *Semibalanus balanoides* warranted the reassignment of the previous **LR.FLR.CvOv.ScrFa** biotope to **LR.HLR.MusB.Sem**. This change was also apparent in the entrance areas of the other four surveyed caves and corresponding reassignment of intertidal zones of the outer caves to **LR.HLR.MusB.Sem** was conducted in all cases. Apart from this change noted above, the biotope composition of all the surveyed caves remained unchanged with the exception of certain intertidal and supralittoral zones in CV02 where erroneous abundance estimates of *Hildenbrandia* sp. from 2008 necessitated a review of the biotopes.
1.1.4 Presence of representative/ notable biotopes	1.1.4 Maintain the presence of the specified biotope, allowing for natural succession/known cyclical change. The following biotopes are representative of the site and should be found in CV01, CV02 & CV03: IR.FIR.SG.CC.BalPom IR.FIR.SG.CC.Mo	At 6-yearly intervals conduct repeat biological surveys of MI08CV01, CV02 & CV03 employing comparable methodology to Harries *et al*., 2009 Assess the biotope composition against the baseline established in the first SCM event (Harries *et al*., 2009).	These biotopes were confirmed present at their previous locations in each of the three caves. No change in presence of the specified biotope was recorded.
1.1.5 Species composition of representative or notable biotopes	1.1.5 No decline in biotope quality due to change in species composition or loss of notable species, allowing for natural succession/ known cyclical change.	At 6-yearly intervals conduct a repeat biological survey of MI08CV03 employing comparable methodology to Harries *et al*., 2008	The abundance levels of the three characterising species have remained greater than 'frequent' in at least some areas of the **IR.FIR.SG.CrSpAsAn** biotope within CV03.

Attribute	Target	Prescription	Result
	The biotope IR.FIR.SG.CrSpAsAn within CV03 should include high abundance levels (at least 'frequent') of Tubularia indivisa, Metridium dianthus & Corynactis viridis. No decline in total number of taxa recorded.	Assess the biotope composition against the baseline established in the first SCM event (Harries *et al*., 2009).	Total taxa recorded for the biotope **IR.FIR.SG.CrSpAsAn** within CV03 was 39 in 2008 and 40 in 2016. Total taxa recorded in the 3 fully surveyed caves was as follows: • CV01 (29 taxa in 2008 and 34 taxa in 2016) • CV02 (26 taxa in both 2008 and 2016) • CV03 (54 taxa in 2008 and 56 taxa in 2016) Overall, there is no evidence of a decline in the number of taxa recorded in any of the surveyed caves.
1.1.6 Presence and/or abundance of specified species	1.1.6 Maintain presence and/or abundance of the specified desirable species. Absence of the specified undesirable species (such as an invasive non-native species)	This attribute will not be used for assessment	Not assessed.

References

Harries, D.B., Moore, C.G., Lyndon, A.R. & Mair, J.M. 2009. The establishment of site condition monitoring of the rocky reefs and sea caves of Mousa Special Area of Conservation. *Scottish Natural Heritage Commissioned Report No. 326.*

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