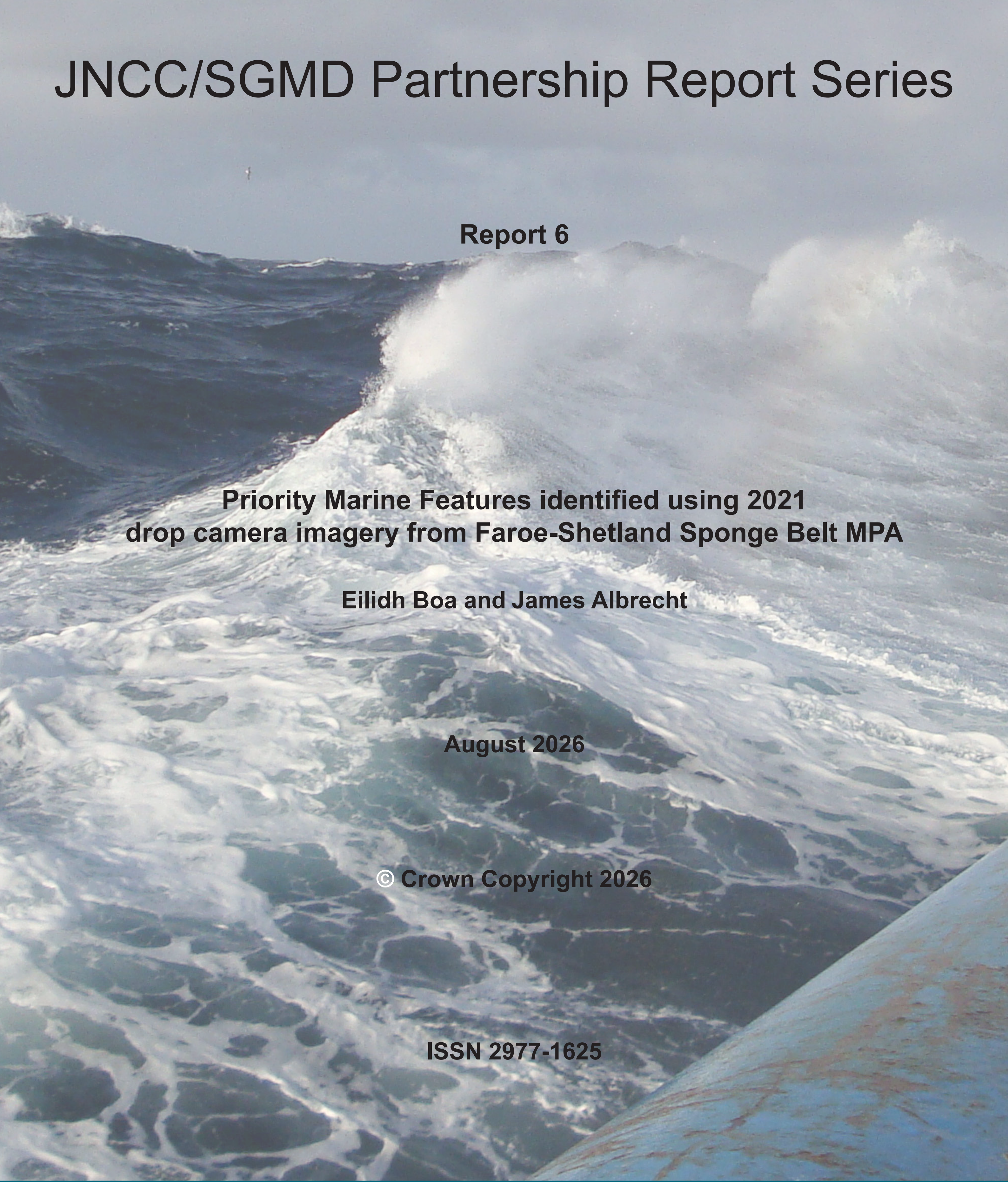

JNCC/SGMD Partnership Report Series

Report 6

Priority Marine Features identified using 2021 drop camera imagery from Faroe-Shetland Sponge Belt MPA

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This document is compliant with JNCC's Evidence Quality Assurance Policy.

Summary

The Joint Nature Conservation Committee and the Marine Directorate of the Scottish Government undertook an offshore seabed survey of Faroe-Shetland Sponge Belt (FSSB) Marine Protected Area on the Marine Research Vessel *Scotia* between the 20 August and 6 September 2021 (survey 1121S).

The aim of this report was to describe the records of Priority Marine Feature (PMF) habitats (deep-sea sponge aggregations, coral gardens, offshore subtidal sands and gravels, offshore deep-sea muds and burrowed mud) using drop camera imagery data collected during this survey. Results from all assessments are outlined in Table 1.

Table 1. Summary of PMF habitats examined and outcomes of analyses.

PMF Habitat	Outcome
Deep-sea sponge aggregations	Of the 182 video segments analysed, a total of 71 were identified as suspected deep-sea sponge aggregations during habitat video analysis. These were then assessed using the criteria outlined by Henry and Roberts (2014a), allowing a confidence score to be assigned to each. 54 segments were assigned a ‘high’ confidence score and 17 a ‘medium’ confidence score. In 72 of the video segments that were not suspected as deep-sea sponge aggregations, biotopes that are associated with deep-sea sponge aggregations were identified as a secondary habitat. These localised areas of sponges in high densities may be associated with iceberg ploughmarks and the segments they were present in were classified as “unverified deep-sea sponge aggregations”. Deep-sea sponge aggregations in FSSB were found to follow the expected depth ranges of the 'sponge belt', with 98% of DSSA identified in the 450, 500 and 550 m depth bands. The density of sponges appeared to 'peak' at a depth of 550 m, which is towards the limit of the expected range of the sponge belt, suggesting it could extend further than previously thought.
Coral gardens	Although coral gardens taxa were observed across FSSB, there was insufficient evidence to suggest that these taxa were the dominant habitat-forming taxa in any of the segments.
Offshore subtidal sands and gravels	Expert analysis of the video footage from FSSB revealed the presence of offshore subtidal sands and gravels at 108 out of 184 video segments.
Offshore deep-sea muds	Expert analysis of the video footage from FSSB revealed the presence of offshore deep-sea muds at 3 out of 184 video segments.
Burrowed mud	As burrows were present at the three segments that were identified as offshore deep-sea muds, an assessment was done to determine whether they could be burrowed mud. Although burrows were present, they were not in high enough densities. As such, these segments were not considered to represent this PMF.
Cold-water coral reefs	No cold water coral reef taxa were observed across the surveyed stations. As such, there was no evidence of the presence of the PMF habitat cold-water coral reefs at FSSB.

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1. Introduction

1.1. Site Overview

Faroe-Shetland Sponge Belt (FSSB) Marine Protected Area (MPA) is in offshore waters on the Scottish side of the Faroe-Shetland Channel, a large rift basin that separates the Scottish and Faroese continental shelves.

The site has an area of 5,278 km^2 and a depth range of around 400 m to 800 m below sea-level. For background information on FSSB see the Site Information Centre (JNCC 2014).

Five different water masses meet in the Faroe-Shetland Channel, which interact with each other and the continental slope to generate ideal conditions for the boreal 'ostur' type of deep-sea sponge aggregations to settle. Iceberg ploughmarks on the upper continental slope (reaching a depth of 450 – 500 m; Masson 2001) may also provide ridges of coarse sediment where sponges can aggregate. Offshore subtidal sands and gravels are also present, supporting a diversity of polychaete worms and a slow-growing bivalve mollusc known as Ocean Quahog (*Arctica islandica*).

There are six designated features of FSSB (Table 2). This report will focus on the deep-sea sponge aggregations and offshore subtidal sands and gravels, which are known to be present at the site. It will also investigate evidence of other previously outlined PMF habitats that may occur in the area, namely coral gardens, offshore deep-sea muds, burrowed mud and cold-water coral reefs. This report will identify where these features are present across FSSB based on the imagery dataset that was obtained in 2021.

The low or limited mobility species, large-scale feature, and geomorphological feature types designated at FSSB are outside the scope of this report.

Table 2. Designated features of FSSB and feature type.

Designated Feature	Feature type
Deep-sea sponge aggregations	Habitat
Offshore subtidal sands and gravels	Habitat
Ocean quahog aggregations	Low or limited mobility species
Continental slope	Large-scale feature
Continental slope channels, iceberg plough marks, prograding wedges and slide deposits representative of the West Shetland Margin paleo-depositional system Key Geodiversity Area	Geomorphological
Sand wave fields and sediment wave fields representative of the West Shetland Margin contourite deposits Key Geodiversity Area	Geomorphological

1.2. Priority Marine Feature Habitats

Priority Marine Feature (PMF) habitats are a list of 26 habitats that are of conservation importance in Scottish waters (Tyler-Walters *et al*. 2016). Two of these, deep-sea sponge aggregations and offshore subtidal sands and gravels, are known to occur at FSSB and are protected features of the MPA. Additional PMF habitats are potentially present across FSSB or are important to consider when confirming the presence of deep-sea sponge aggregations (see section 1.3.1 for more details). These include coral gardens, offshore deep-sea muds, burrowed mud and cold-water coral reefs.

Many of these habitats, or similar habitats, are also considered ICES Vulnerable Marine Ecosystems (VMEs) and are listed as threatened and/or declining habitats by OSPAR (OSPAR 2008). The relationship between the PMF habitats, OSPAR habitats and VMEs are outlined in Table 3.

Table 3. Relationships between PMF habitats, OSPAR habitats and VMEs.

PMF Habitat	Relationship between OSPAR and PMF habitat	OSPAR	Relationship between ICES VME and PMF habitat	ICES VMEs
Deep-sea sponge aggregations	Same	Deep-sea sponge aggregations	Same	Deep-sea sponge aggregations
Offshore subtidal sands and gravel	Not present	N/A	Partially overlaps with	Mud and sand emergent fauna
Coral gardens	Same	Coral gardens	Same	Coral gardens
Offshore deep-sea muds	Not present	N/A	Partially overlaps with	Mud and sand emergent fauna
Burrowed mud	Partially overlaps with	Sea-pens and burrowing megafauna	Partially overlaps with	Sea-pen fields, Mud and sand emergent fauna
Cold-water coral reefs	Same	*Desmophyllum pertusa* reefs	Same	Cold-water coral reefs

1.2.1. Deep-sea sponge aggregations

One of the designated features in FSSB is deep-sea sponge aggregations, which are listed in the OSPAR list of Threatened and/or Declining species and habitats (OSPAR 2008) and are defined by OSPAR as occurring in the deep sea (typically at depths between 250 m and 1,300 m). They are primarily characterised by the presence of structure-forming glass sponges (Hexactinellida) or giant demosponges (Demospongiae) (OSPAR 2010a). Sponge aggregation densities are defined by OSPAR as ranging from 0.5–24 sponges per m² (Henry & Roberts 2014a; OSPAR 2010a). They are biodiversity hotspots, supporting a range of species that are unique to the surrounding seafloor communities. Deep-sea sponge aggregations are found in a wide range of habitats from muddy sediments to rock. In the Faroe-Shetland region, aggregations are often associated with iceberg plough marks, attaching to the hard and coarse substrates associated with the scoured seabed (Marine Scotland 2016).

Sponge tissue is composed of small, spine-like, silica spicules. Spicules from dead sponges form dense mats and can alter seabed characteristics, which in turn provide shelter for a wide range of small animals and elevated habitats for filter feeders (Tyler-Walters *et al.* 2016).

Deep-sea sponges are thought to be slow-growing, and sponge communities are likely to take many years or even decades to recover, if damaged. Physical disturbance is the greatest anthropogenic threat to sponge communities in the deep sea, and it is probable that bottom trawling and increased amounts of sediment in the water significantly damage deep-sea sponge aggregations. Resource exploitation (oil and gas operations) and future bioprospecting also pose potential threats to the survival of sponges (Tyler-Walters *et al*. 2016).

Sponges are historically difficult to identify to species level and enumerate from imagery. Berman *et al*. (2013) highlighted morphological monitoring for sponge assemblages as an effective tool for imagery analysis and monitoring purposes. Consequently, within this report sponge identification is assigned to morphotypes based on descriptions by Berman *et al*. (2013).

Coral species are often found co-occurring with sponges, meaning that it can be challenging to identify if a habitat should be considered a deep-sea sponge aggregation or a coral garden. For the purposes of defining habitats from seabed imagery, it is recommended that if sponges are identified as the dominant species in SIMPER results, this habitat would be considered a deep-sea sponge aggregation. However, if corals are found to be the dominant taxa, this habitat may be considered a coral garden instead (Henry & Roberts 2014a).

1.2.2. Coral Gardens

Like deep-sea sponge aggregations, coral gardens are listed in the OSPAR list of Threatened and/or Declining species and habitats (OSPAR 2008). Although this habitat is not a designated feature of FSSB, soft corals are known to be present throughout the MPA, meaning that coral gardens could potentially be present.

The UK working definition of coral gardens has recently been updated (Cleland *et al*., in press.) and includes offshore coral communities in depths of approximately 200 m and beyond. OSPAR defines coral gardens as a habitat characterised by dense aggregations or colonies of at least one non-reef-forming coral species, although multiple species from a range of taxonomic groups are usually present (OSPAR 2010b). Typical taxa found in coral gardens in UK waters include gorgonians and soft corals (Alcyonacea), sea-pens (Pennatulacea), black corals (Antipatharia), stony corals (Scleractinia) and stony hydroids (Stylasteridae). Reef-forming stony corals such as *Desmophyllum* spp., *Madrepora* spp. and *Solenosmilia* spp. can be present in coral gardens in small densities but are not dominant, while solitary non-reef stony corals such as *Desmophyllum dianthus* and *Caryophyllia* spp. can be found in high densities (Henry & Roberts 2014b). The taxonomic composition of coral gardens varies greatly across UK waters, driven by abiotic factors such as hydrodynamic regimes, substrate type and depth. The UK working definition identifies six sub-types of coral gardens depending on abiotic factors and the corals and associated taxa that are present (Cleland *et al*., in press.).

1.2.3. Offshore subtidal sands and gravels

Offshore subtidal sands and gravels are the most common habitat found in the subtidal waters of Scotland. Offshore subtidal sands and gravels encompass a wide range of broadscale habitats and occur down to depths of 3,000 m (Tyler-Walters *et al*. 2016). This PMF habitat spans a wide range of substrate types including sand and muddy sand, mixed sediment and coarse sediment. In offshore waters, sands and muddy sands support polychaetes (including tube building polychaetes), brittlestars and bivalve molluscs. Medium sands support communities dominated by the Pea Urchin, *Echinocyamus pusillus*, whilst finer sands are characterised by burrowing crustaceans such as amphipods and cumaceans (Marine Scotland 2016).

1.2.4. Offshore deep-sea muds

Offshore deep-sea muds occur at depths ranging from 200 m to 2,500 m and are prevalent in the north and west offshore waters of Scotland, as well as across the rest of UK offshore waters (Tyler-Walters *et al*. 2016). This habitat supports biologically diverse communities, with echinoderms as the most common mobile benthic species observed; primarily sea urchins, brittlestars and sea cucumbers (Tyler-Walters *et al*. 2016). The relatively stable conditions associated with deep mud habitats often lead to the establishment of communities of burrowing megafaunal species where bathyal species may co-occur with coastal species. The burrowing megafaunal species include burrowing crustaceans such as the Norway Lobster, *Nephrops norvegicus*, and *Callianassa subterranea*. The mud habitats in deep water can also support seapen populations and communities with brittlestars, including *Amphiura* spp. (UK BAP 2008).

1.2.5. Burrowed mud

Burrowed mud occurs in a range of depths, from shallow water (10 m) to greater than 500 m depth. This habitat is described as fine sediments in which a variety of burrowing fauna, such as *Nephrops norvegicus*, mud shrimps and burrowing crabs, are found (Tyler-Walters *et al*. 2016). Burrows and mounds are a prominent feature of this habitat and in some cases, burrowed mud can support populations of sea-pens, typically *Virgularia mirabilis* and *Pennatula phosphorea*, although in deeper waters *Kophobelemnon stelliferum* and *Umbellula encrinus* may be recorded. This habitat can also support populations of cerianthid anemones, such as *Pachycerianthus multiplicatus* and the echiuran *Maxmuelleria lankesteri* (Tyler-Walters *et al*. 2016).

1.3. Aims and Objectives

The aim of this report is to describe the records of PMF habitats identified from the drop camera imagery data collected during the 1121S survey of FSSB.

This report will not aim to address the survey monitoring objectives directly, which can be found in the survey plan and survey report (Tangye *et al*. 2022).

The PMF habitats that occur in the deep sea and may be present at the Faroe Shetland Sponge Belt MPA are described in Section 1.2. Deep-sea sponge aggregations and offshore subtidal sands and gravels are designated features of the MPA, and information about these habitats will be used with other data sources to address monitoring objectives in a separate monitoring report.

The remaining PMF habitats are not designated features of the MPA, however, understanding if and where they occur within the MPA is, nonetheless, important information for the management of this MPA.

2. Methods

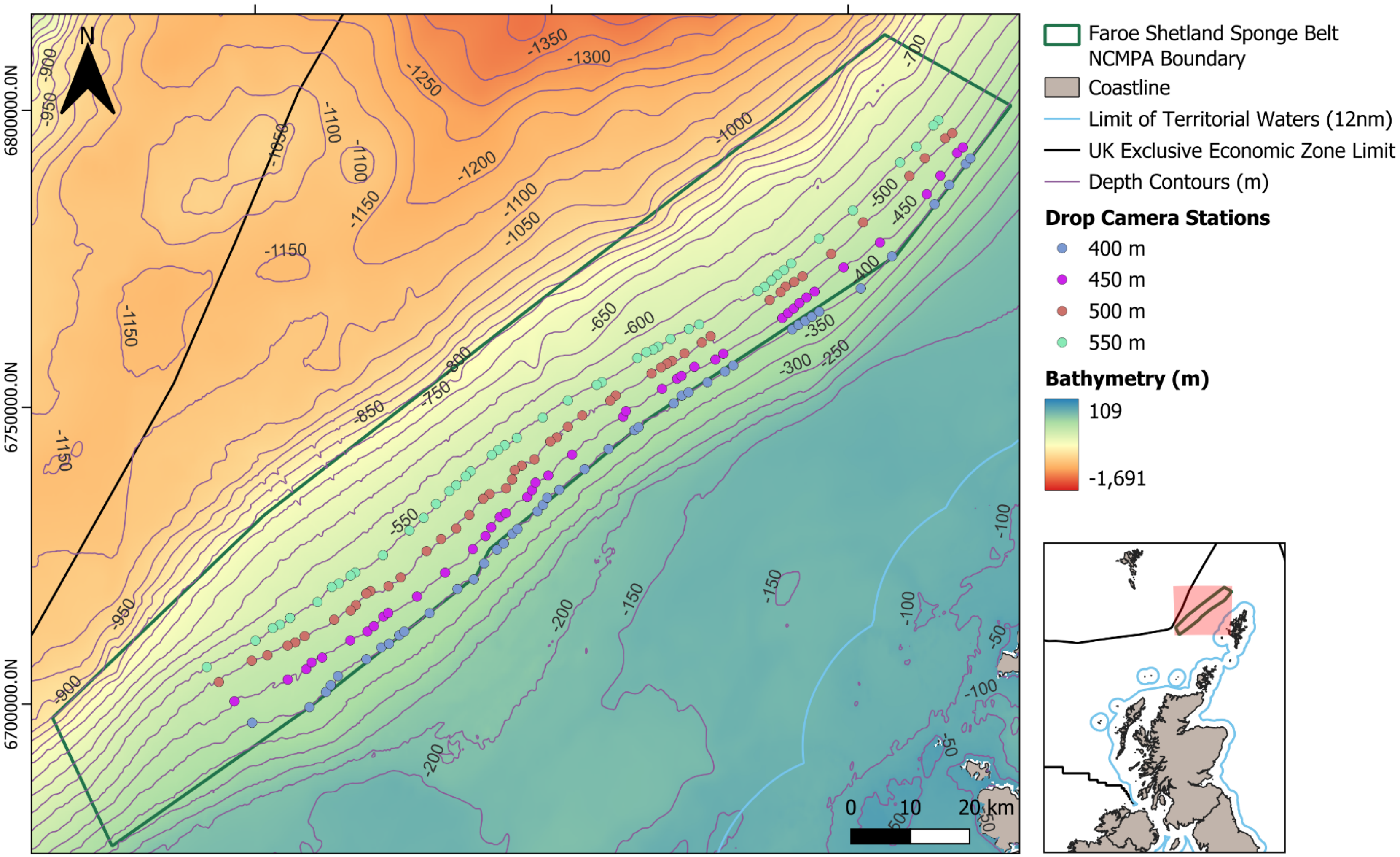
2.1. Sampling, Data Acquisition and Processing

2.1.1. Survey Sample Design

JNCC and the Marine Directorate undertook an MPA monitoring survey of FSSB MPA between 20 August and 6 September 2021 (survey 1121S) on *MRV* Scotia (Tangye *et al*. 2022). 184 stations were successfully sampled with a drop camera across FSSB at four depth contours (400 m, 450 m, 500 m and 550 m; Table 4). Locations of the camera stations sampled at FSSB are shown in Figure 1. All stations were labelled with a unique identifier showing survey code, site code, transect number, depth, sample number, attempt and video segment number (e.g. 1121S_FSSB_T24_D400_S077_A2_S01).

Table 1. Summary of drop camera stations at FSSB.

Target Depth Contour (m)	Number of Transect stations completed
400	43
450	46
500	50
550	45
Total number of stations	184



Projection: WGS 84 / UTM zone 30N (EPSG: 32630); © JNCC 2025; UK Territorial Sea Limit. Contains UKHO data © Crown copyright. All rights reserved. UK Exclusive Economic Zone © Crown copyright, The exact limits of the EEZ are set out in The Exclusive Economic Zone Order 2013; Shoreline © GSHHG 2.2.2. Bathymetry data from EMODnet.

Figure 1. Locations of camera stations by depth sampled at FSSB during survey 1121S.

2.1.2. Imagery Data Analysis

The analysis of video and stills data was carried out by Galathea Marine Consultants Ltd, and an external quality assurance was carried out on 10% of the imagery data by Envision. All videos and stills were annotated using the annotation software BIIGLE 2.0 (Langenkämper *et al*. 2017; Zurowietz & Nattkemper 2021). In total, 184 videos were analysed by the contractor, and 7120 stills from 182 video tows were analysed, with approximately 40 images per tow. The stills from two video tows were not analysed, meaning that these video tows were not included in the deep-sea sponge aggregations and coral gardens habitat assessments (outlined in section 2.2). These tows were not identified as potential deep-sea sponge aggregations during video analysis.

Video tows were segmented into areas of continuous broadscale seabed habitat type greater than or equal to 5 m along transect distance using the Marine Habitat Classification of Britain and Ireland (v 22.04) and Scottish Priority Marine Features (Habitats) label trees in BIIGLE. Biotopes were also assigned to segments, up to level six of the Marine Habitat Classification of Britain and Ireland hierarchy and in accordance with Parry (2019). Each video segment was assigned an image quality score following the NMBAQC image quality categories (Turner *et al*. 2016) and if a segment was given a score of zero, no further analysis was undertaken. In total, 184 video tows were analysed, with four identified as having a significant change in habitat along the tow. These tows were split into segments according to the change in habitat, giving a total of 193 video segments analysed across the 184 videos.

Each still was assigned an image quality score following the NMBAQC image quality categories (Turner *et al*. 2016). If a still image was given a score of ‘very poor’ and/or ‘substrate’, no taxonomic identification was carried out for that still image. For the remaining images, epifauna were identified and enumerated based on the SMarTaR-ID framework (Howell *et al*. 2019) with Operational Taxonomic Units (OTUs) from Howell and Davies (2010) and the CATAMI morphological classification scheme (Althaus *et al*. 2015). For taxa which did not have an existing OTU number, temporary project-specific OTUs were assigned with the prefix ‘FSC’. Solitary, erect and massive species were tagged using point annotations to provide count data, while encrusting/turf taxa were tagged with polygons to provide percentage cover data.

Additionally, image substrate type was noted, and the area of seabed captured in each image was calculated using scaling lasers.

During imagery analysis, two biotopes were identified that could not be matched to any existing biotopes in the Marine Habitat Classification of Britain and Ireland (JNCC 2022). For the purposes of this report, the biotopes M.AAUB.Co.[UrcCom.CidUrc] and M.AAUB.Mx.[UrcCom.CidUrc] have been included and have been submitted for consideration to be included as a new biotope.

2.1.3. Data Preparation and Truncation

The datasets were examined and truncated to remove any spurious entries and ensure an accurate representation of the faunal communities observed. Details of this truncation are as follows:

- Records of fish and mobile species were removed.
- Records of ‘eggs’ were removed.
- Records of unidentifiable fauna were removed.

- Records of anthropogenic impacts were removed.

- The OSPAR definition of deep-sea sponge aggregations does not include encrusting sponges (OSPAR 2010). The Scottish PMF habitat description lists encrusting sponges as potential deep-sea sponge aggregation taxa. However, the definition also states that the habitat is characterised by an increase in habitat complexity in the areas they are present (Tyler-Walters *et al*. 2016). Encrusting sponges do not provide increased habitat complexity to the same extent as other sponge morphologies, so records of these taxa were removed.

Following truncation, only images of an area of seabed between 0.5 and 2.5 m^2 were retained (mean area covered = 1.5 m^2 ± 0.01). The area of seabed captured by stills in each video segment was summed to calculate a 'total viewable area' of each segment (Appendix 1). Any segments with a total area covered of less than 20 m^2 were removed. 20 m^2 was selected as the minimum area covered to provide the highest coverage whilst including the highest number of video segments in the analysis. The resulting dataset consisted of 6235 images from 182 video segments.

2.2. PMF habitat assessments

2.2.1. Deep-sea sponge aggregations

Drop-down video tows were analysed to identify the main habitat types observed along the transects, with any changes in habitat noted. Habitat changes were defined as a change in substrate type where tow length is greater than 5 m covering an area equal to or greater than 25 m^2 (Turner *et al*. 2016). Suspected deep-sea sponge aggregations were allocated using expert judgement during the habitat analysis of the video footage. Video segments in which the PMF habitat deep-sea sponge aggregations, or biotopes that are associated with this habitat were identified as the primary habitat, were provisionally recorded as "suspected deep-sea sponge aggregations", pending verification as explained below. This initial identification of deep-sea sponge aggregations was based on the definition from Benson and Sotheran (2018): 'Erect, structure-forming sponges were observed at 1% or more of the percentage cover of the entire video tow'.

Abundance data from analysed stills from the video segments were then used to verify the presence of the habitat using three criteria: density, habitat and ecological function, as detailed in Henry and Roberts (2014a). The use of these criteria also allowed a confidence score to be assigned to each record, relating to how likely the record was a deep-sea sponge aggregation according to the OSPAR definition (OSPAR 2010).

The methods used to assess each of the criteria included:

- **Density:** The density of sponges was calculated by dividing the sum of sponge counts over a video tow or segment by the total viewable area covered. For massive sponges, any stations with a density of greater than 0.5 per m^2 were considered to meet the OSPAR criteria for deep-sea sponge aggregations (OSPAR 2010). This definition does not include a threshold for other sponge morphotypes (such as 'cup-like' or 'erect'). Instead, the SACFOR scale was used to assess whether these sponge morphotypes were present in high enough densities, as suggested by Henry and Roberts (2014a). Sponge morphotypes were split by size class identified during imagery analysis and were subsequently scored based on their density. A score of "F" ("Frequent") or higher on the SACFOR scale was considered to meet the density criteria for sponge morphotypes other than massive (Hiscock 1996).

- **Habitat:** This criterion was met if it could be confirmed that the record of potential deep-sea sponge aggregations was characterised by sponges or that it could **not** be described as any other habitat forming assemblage such as corals, sea-pens, cerianthid anemones or *Lanice* polychaetes (Henry & Roberts 2014a). This was done using SIMPER analysis (for details, see section 2.3.1) to identify the characterising taxa within the assemblage. If the taxa identified by SIMPER analysis included both sponge species and another habitat-forming species, evidence that sponges characterised the habitat **more strongly** than the other species had to be provided for the habitat criterion to be met.

- **Ecological function:** Deep-sea sponge aggregations are known to play an important functional role in the ecosystems in which they are present. For example, they provide habitats for fauna such as echinoderms (particularly ophiuroids), crustaceans, hydroids, attached polychaetes and fish (OSPAR 2010). For the ecological function criterion to be met, SIMPER analysis had to identify the characterising taxa of the assemblage to be fauna that are typically associated with deep-sea sponge aggregations as outlined by OSPAR (2010).

2.2.2. Coral Gardens

All video transects and segments were also assessed for the presence of coral gardens, using three criteria: density, biotope and ecological function as detailed in Cleland *et al*. (in press.). The use of these criteria also allowed a confidence score to be assigned to each record, relating to how likely the record was a coral garden according to the OSPAR definition (OSPAR 2010).

The methods used to assess each of the criteria included:

- **Density:** The density of coral gardens taxa was calculated by dividing the sum of coral taxa counts over a video segment by the total viewable area covered. This criterion included three stages of assessment:

    - Show that coral gardens taxa were more dominant than other habitat-forming megafauna by comparing the density of coral gardens taxa with sponge taxa density.

    - Test whether other assemblages were characterised by coral gardens taxa with SIMPER analysis.

    - Using the SACFOR scale, identify where coral gardens taxa occur in densities considered "frequent" or above.

- **Biotope:** This criterion was met if it could be shown that the biotopes present in areas in which potential coral gardens were identified did not resemble anything other than coral gardens biotopes. This was done by comparing the assigned biotopes of stations, characteristic species, depth and substrate type with existing coral gardens biotopes to determine whether an assemblage ‘matches’ a coral gardens biotope. If it could also be a Deep-sea sponge aggregation, sufficient evidence that corals are the dominant species and not sponges must be provided for a coral garden to be present.

- **Ecological Function:** This criterion was met if it could be shown that the potential coral gardens serve an ecological function such as providing a habitat to other taxa. SIMPER analysis results must identify characteristic taxa that are commonly associated with coral gardens as outline by OSPAR (2010) and Cleland *et al*. (in press.). Another ecological function that coral gardens can serve is as a fish spawning ground, which can be assessed by examining observations of egg cases. If any are found to be associated with the coral taxa, this suggests that the area could be a fish spawning ground.

2.2.3. Other PMF Habitats

During video analysis, PMF habitats were noted using expert judgement. This information was then used to determine the presence and distribution of offshore subtidal sands and gravels, offshore deep-sea muds and cold-water coral reefs.

Stations identified as offshore deep-sea muds were then assessed for the presence of burrowed mud. All burrows were annotated in still images, meaning that the density of burrows could be calculated to give the number of burrows per m^2 at a station, however burrow size was not estimated. To apply the SACFOR scale to these values (as outlined in Robson 2014), the size class ‘1-3 cm’ was used for all burrows. This conservative approach was best to avoid over-estimating the density of the burrows. Guidelines suggest that areas with burrows that are at least “F” or “Frequent” on the SACFOR scale could be burrowed mud.

2.3. Numerical and Statistical Analyses

2.3.1. Epifaunal Community Analysis

The FSSB epifaunal dataset was analysed using PRIMER v7 (Clarke & Gorley 2015). Solitary and colonial communities were combined to gain a holistic view of the epifaunal communities across FSSB. The dataset was then standardised, ensuring the total number of individuals for each taxon was equally weighted on a relative scale of 100 across each station. This method enabled the combination of two enumeration techniques to understand the relative structure and composition of both communities. The dataset was examined using shade plots before applying a fourth root transformation to downweigh numerically dominant taxa. From this dataset, a resemblance matrix was created using Bray-Curtis similarity, which was then subject to the multivariate analyses listed in Table 5.

Patterns and structure in the data were investigated using hierarchical agglomerative clustering, initially aided by the SIMPROF routine. However, the SIMPROF routine identified 38 groups in the dataset, which was determined to be too high a number to perform further analyses on. Instead, cluster groups were identified by creating a factor that grouped the segments with at least 60 % similarity with each other. This resulted in the identification of 12 cluster groups, two of which were comprised of one video segment.

SIMPER analysis was then used to identify the characteristic taxa of the biological assemblages observed at the segments in each group. These results were used to assess the necessary criteria for deep-sea sponge aggregations and coral gardens habitats.

Table 5. Epifaunal multivariate analysis.

Multivariate analysis	Application
Similarity profiles (SIMPROF)	To determine if the dataset has a structure distinct from that derived by random permutation.
Hierarchical agglomerative clustering	Used in conjunction with SIMPROF to look for clustering of stations in the dataset.
Similarity percentages (SIMPER)	To investigate the characterising taxa of each SIMPROF group identified in cluster analysis as well as the taxa driving the differences between the groups.

3. Results

3.1. Deep-Sea Sponge Aggregations

A total of 45 sponge OTUs (excluding encrusting sponges) were observed across FSSB, covering eight CATAMI classes (Table 6). Appendix 2 provides a reference collection of these sponges. The most frequently occurring sponge CATAMI class was massive sponges, followed by erect. Cup-like sponges were the least common morphotype across FSSB.

Table 6. Sponge CATAMI Classes observed across FSSB MPA.

CATAMI Class Category	CATAMI Class Description
Cup-like	Tubes and chimneys
	Cup/goblet
Erect forms	Branching
	Laminar
	Stalked
Massive forms	Balls
	Simple
	Massive forms

In total, 71 segments were identified as a suspected deep-sea sponge aggregation record (Appendix 3). To verify the expert's opinion, these segments were analysed using the criteria outlined by Henry and Roberts (2014a), as detailed in section 2.2.1.

111 segments were not identified as suspected deep-sea sponge aggregations during video analysis. Prior to the verification of deep-sea sponge records in FSSB, an examination of the sponge density in all video segments was completed as a data-exploration exercise (Appendix 4). This showed that in 99 of the 111 segments, sponge density exceeded one or more of the density threshold values described in Section 2.2.1 (Figure 2). Although these segments passed the threshold value, it was deemed by expert analysts that they did not resemble deep-sea sponge aggregations due to the small size of the massive sponges present or very sparsely distributed large erect sponges that were present. These segments were not included in further assessments.

The mean temperatures recorded at segments identified as suspected deep-sea sponge aggregations ranged from -0.15 °C to 9.13 °C, with a mean of 6.35 °C, while mean depth ranged from 401 m to 553 m with a mean of 478 m.

3.1.1. Density

Sponge density was found to increase with depth for all sponge morphotypes between 400 and 550 m depth (Figure 2). Sponge densities peaked at 550 m depth for all sponge morphotypes apart from the largest erect sponges (> 15 cm), which peaked at 500 m depth.

41 of the 71 segments had a massive sponge density of greater than 0.5 per m^2, therefore meeting the requirements of the density criterion.

The "cup-like" and "erect" morphotypes were assessed using the SACFOR scale, with the appropriate size class applied (Hiscock 1996). For cup-like sponges, eight segments had a

SACFOR score of “F” or above and all these segments also had a massive sponge density of greater than 0.5 per m^2. For small erect sponges (size class 1–3 cm), no segments had a SACFOR score of “F” or above. Larger erect sponges (size class 3–15 cm) were scored “F” or above at 46 segments, 10 of which had low densities of massive sponges (less than the 0.5 per m^2 threshold). Erect sponges (size class > 15 cm) were scored “F” or above at 67 segments, 29 of which had low densities of massive sponges. The full results for the SACFOR assessments can be found in Appendix 4.

By combining the results of the different sponge morphotypes, it was deemed that all suspected deep-sea sponge aggregations met the requirements to pass the density criterion (a total of 71 segments), with high densities of massive, cup-like or large erect sponges, or a combination of sponge morphotypes.

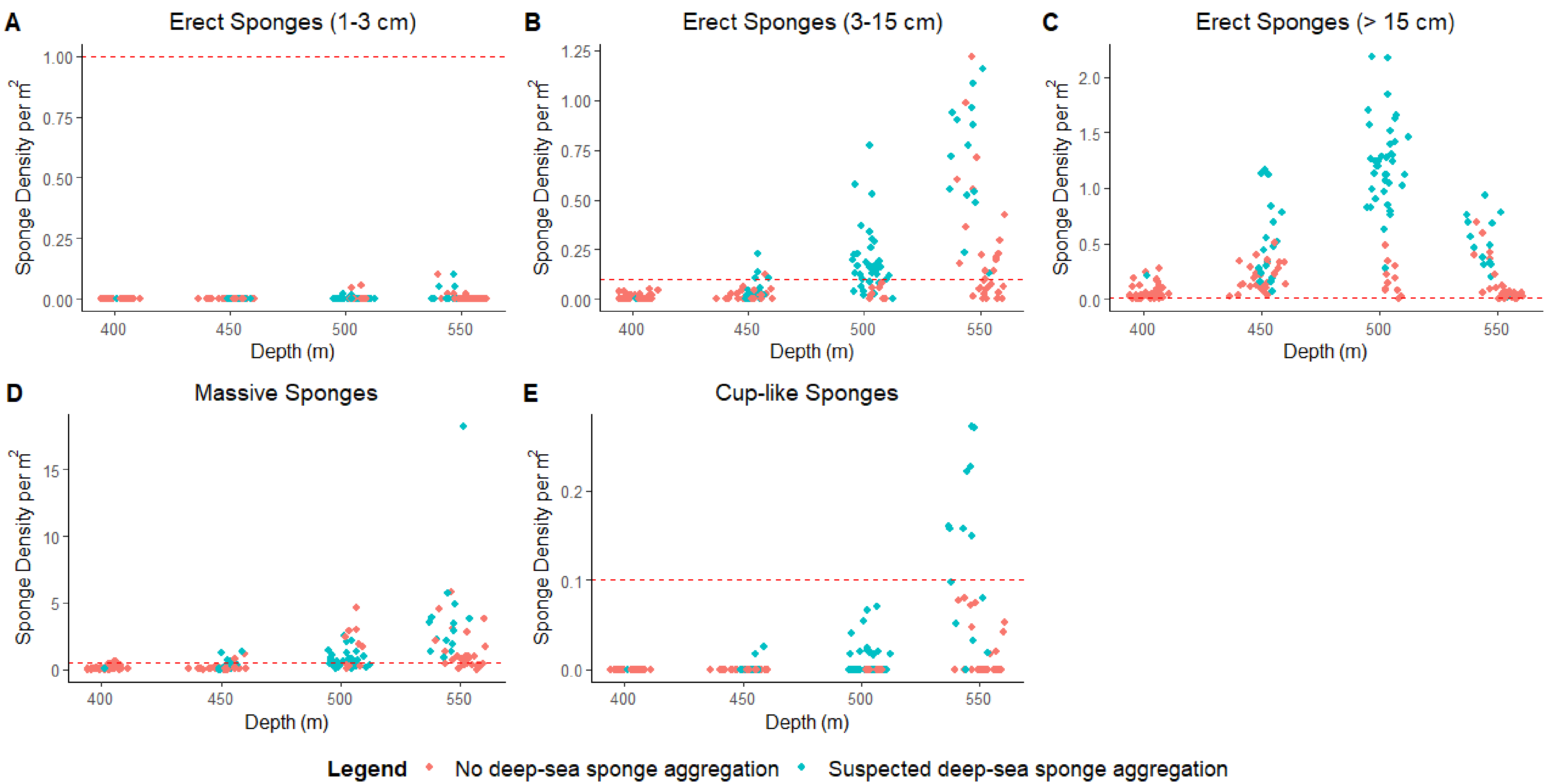


Figure 2. Sponge morphotype density across depths in FSSB. The red dotted line shows the density threshold value for each sponge morphotype (e.g. 0.5 m^2 for massive sponges) and the density associated with a “Frequent” score for the appropriate size class on the SACFOR scale (Hiscock 1996).

3.1.2. Habitat

Suspected deep-sea sponge aggregation records were also assessed with the habitat criterion using the results from the SIMPER analysis detailed in Section 2.3.2.

A total of 12 cluster groups were included in the SIMPER analysis, however two of these cluster groups (c and f) contained only one video segment. As such, the characterising taxa for these segments could not be examined.

The 71 segments identified as suspected deep-sea sponge aggregations were present in six cluster groups (a, e, h, i, j and l) and the SIMPER analysis results were examined for these. Four cluster groups (b, d, g and k) did not have any of the suspected deep-sea sponge aggregations present in them, so the SIMPER results for these clusters were not examined.

In cluster group a, no sponge taxa were listed in the characterising taxa. As such, the 17 segments in these groups did **not** pass the habitat criterion.

All other suspected deep-sea sponge aggregations were present in cluster groups e, h, i, j and l. These cluster groups had a range of between three and 11 sponge OTUs identified within their characterising taxa (Table 7). Most of the sponge OTUs identified in SIMPER analysis were ‘massive’ morphologies, suggesting that any deep-sea sponge aggregations present are likely to be ‘ostur’ type, which have been observed previously in the area (OSPAR 2010).

In cluster group e, sponges were the only habitat-forming taxa identified in the SIMPER analysis. As such, the seven segments identified as suspected deep-sea sponge aggregations in these cluster groups passed the habitat criterion.

In cluster groups h, i, j and l, coral gardens taxa such as *Caryophyllia*, *Pliobothrus* or Nephtheidae were identified in the characterising taxa (Table 7). Further investigation was required to provide evidence that sponges were the dominant taxa in these cluster groups. The SIMPER results for these cluster groups showed that sponge taxa contributed more to the similarity of the cluster groups than coral gardens taxa. This, in combination with the fact that more sponge taxa were identified as characteristic than coral gardens taxa, suggests that sponges were the dominant habitat-forming taxa in these cluster groups, meaning that segments in these cluster groups passed the habitat criterion.

Overall, a total of 54 segments passed the habitat criterion.

Table 7. Sponge and coral taxa identified as characteristic of cluster groups in SIMPER analysis.

Cluster Group	Sponges in Characterising Taxa	Corals in Characterising Taxa
a	NA	NA
b	NA	NA
c	< 2 samples	< 2 samples
d	Porifera_OTU392_ Massive	NA
e	Porifera_UNID_Massive Porifera_FSC95_ Massive Porifera_OTU422b_Erect	NA
f	< 2 samples	< 2 samples
g	Porifera_FSC95_Massive Porifera_FSC84_Massive	NA
h	Porifera_OTU75_ Massive Porifera_OTU422_Erect Porifera_UNID_Massive	*Caryophyllia*_OTU37
i	Porifera_OTU422_Erect Porifera_OTU181_Erect Porifera_UNID_Massive Porifera_OTU5_Massive Porifera_FSC81_Erect	*Pliobothrus*_OTU207 *Caryophyllia* _OTU37
j	Porifera_FSC95_Massive Porifera_OTU422_Erect Porifera_OTU81_Erect Porifera_UNID_Massive Porifera_OTU75_Massive Porifera_FSC87_Massive Porifera_OTU422b_Erect Porifera_FSC86_Massive Porifera_OTU1156_Massive Porifera_FSC83_Erect Porifera_FSC78_Cuplike	Nephtheidae_FSC39
k	Porifera_OTU387_Massive Porifera_FSC84_ Massive Porifera_OTU602_Massive	Nephtheidae_FSC39
l	Porifera_OTU387_Massive Porifera_OTU422_Erect Porifera_FSC84_ Massive	Nephtheidae_FSC39 *Caryophyllia* _OTU37

3.1.3. Ecological Function

Extensive sponge growth in the Faroe-Shetland region has previously been associated with the presence of Galatheoidea squat lobsters, *Cidaris cidaris,* Asteroidea including cushion stars *Ceramaster* spp., brittlestars Ophiuroidea, Sabellidae polychaetes and brachiopods (Bett & Axelsson 2000; Axelsson 2003; Bett & Jacobs 2007). The SIMPER results were examined to determine whether the assemblages observed were associated with these taxa.

The characterising taxa of all cluster groups identified across FSSB included many of the taxa typically associated with deep-sea sponge aggregations. For example, a range of brittle stars (Ophiuroidea), brachiopods, serpulid worms, the pencil urchin *Cidaris cidaris,* the squat lobster *Munida sarsi* were among the characterising taxa of all cluster groups, including those that did not contain any sponge taxa (Appendix 5). As a result, all 71 segments identified as a suspected deep-sea sponge aggregation passed the ecological function criterion.

3.1.4. Confidence Assessment

Following the assessment of the suspected deep-sea sponge aggregations records against the relevant criteria, a 'confidence' score was assigned to each. This was done by awarding a 'tick' to a record for every criterion it met the requirements of, with a maximum of 3 ticks available. A total of three ticks indicated a 'high' confidence level, meaning that there was strong evidence to support that this record is a deep-sea sponge aggregation under the OSPAR definition. Two ticks indicated a 'medium' confidence. If a station received a zero or one tick, this indicated that a Deep-sea sponge aggregation was identified in this area with 'low' confidence.

Suspected deep-sea sponge aggregations were observed across the whole of FSSB, with varying degrees of confidence. A total of 54 segments were assigned a 'high' confidence score, largely located in the 500 – 550 m depth bands, and 17 were assigned a 'medium' confidence score, largely located in the 450 m depth band (Figure 3, Appendix 3).

In 72 of the video segments that were not suspected deep-sea sponge aggregations, biotopes that are associated with deep-sea sponge aggregations were identified as a secondary habitat (meaning that they occur as a mosaic of a biotope associated with deep-sea sponge aggregations and the primary habitat). Expert opinion did not deem these video segments to resemble deep-sea sponge aggregations, meaning that they were not assessed. Nevertheless, localised areas of sponges in high densities occurred throughout these segments, possibly associated with iceberg ploughmarks (Figure 3). For this reason, these video segments have been identified as 'unverified deep-sea sponge aggregation biotopes'.

Three of the video segments that were excluded for analysis due to the low area of seabed captured in their stills were identified as having a primary biotope that is associated with deep-sea sponge aggregations. Additionally, the two videos that didn't have their stills analysed had secondary biotopes associated with deep-sea sponge aggregations. These were also identified as 'unverified deep-sea sponge aggregation biotopes'.

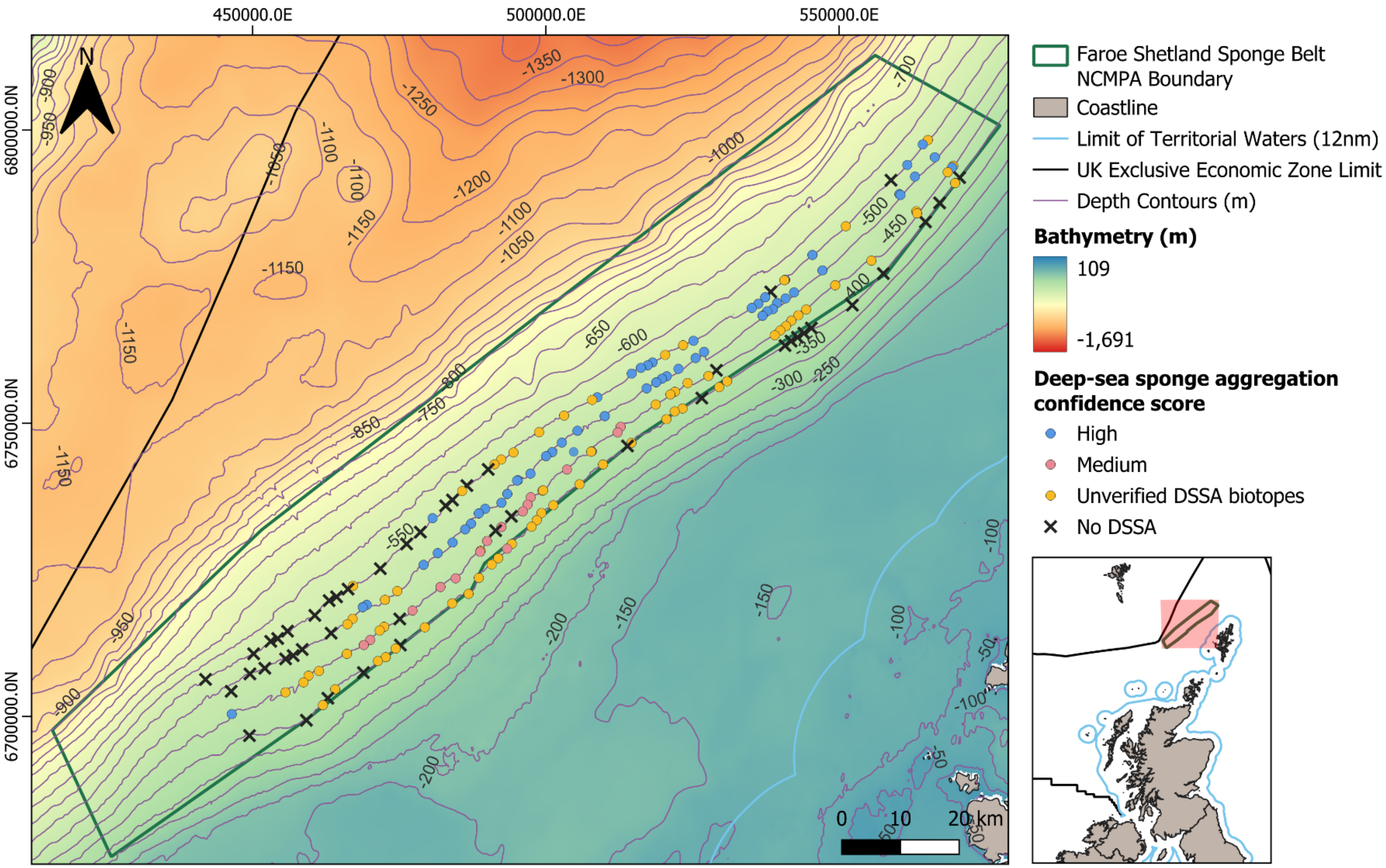


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Figure 3. Map showing the Deep-sea sponge aggregation (DSSA) confidence scores assigned to stations sampled across FSSB MPA.

3.2. Coral Gardens

In addition to sponges, a total of eight coral gardens taxa were also identified across FSSB. This included cup corals (*Caryophyllia*), lace corals (*Pliobothrus* and Stylasyteridae), octocorals (*Drifa* and Nephtheidae) and three seapen OTUs (Pennatuloidea). The most observed coral gardens taxon was the lace coral *Pliobothrus*, followed by the cup coral *Caryophyllia* and octocoral Nephtheidae.

During the habitat analysis of the video footage, the PMF habitat coral gardens was not identified. However, as coral gardens taxa were present across FSSB, it was decided that an assessment of all video segments should be carried out to confirm that this was the case using a quantitative approach.

3.2.1. Density

The density of coral gardens taxa at each segment was calculated for all coral gardens' taxa combined. These values were used to determine whether the segment passed the density criteria for coral gardens.

The **first step** of the density criterion was to test whether there was a higher density of coral gardens taxa than other habitat-forming taxa (in this case, sponge taxa). When the densities of all coral gardens taxa and all sponges were compared, a total of 14 segments had a higher density of coral gardens taxa than sponge taxa.

The **second step** of the density criterion is testing whether coral gardens taxa were characteristic of the assemblages they were present in. This was done using SIMPER analysis, detailed in section 2.3.2, which revealed that coral gardens taxa were listed in the characteristic taxa of five cluster groups (Table 7). However, in the previous section, it was determined that the sponge taxa present were more dominant than the coral gardens taxa in these groups. Therefore, SIMPER analysis showed that, although coral gardens taxa were characteristic of five cluster groups, sponges were the dominant habitat-forming taxa.

The **final step** of the density criterion was to compare the densities of coral gardens taxa with the SACFOR scale. When the densities of all coral gardens' taxa were compared to values outlined in the SACFOR scale (using size class 1–3 cm for all; Hiscock 1996). Ten segments were ranked as "F" or "Frequent" on the SACFOR scale. Two of these segments (segment codes 1121S_FSSB_T27_D450_S163_A1_S02, and 1121S_FSSB_T31_D450_S160_A1_S01) had a higher density of coral gardens taxa than sponge taxa. When the densities of the most common coral gardens taxa were examined separately using the SACFOR scale, these segments had *Pliobothrus* present in densities equivalent to "F" or "frequent", while *Caryophyllia* and Nepthedidae were present in lower densities.

The guidance outlines that video segments must pass all three steps to meet the requirements of the density criterion (Cleland *et al*., in press). Although 14 segments had higher densities of coral gardens taxa than sponge taxa, two of which had a density of "F" on the SACFOR scale, it was deemed that sponges were the dominant taxa across these segments. As such, none of the segments passed the coral gardens density criterion.

Although there were no segments that passed the density criterion, the 14 segments that had a higher density of coral gardens taxa than sponge taxa were assessed with the biotopes and ecological function criteria. This analysis was carried out to confirm that these segments **did not** resemble a coral gardens habitat.

3.2.2. Biotopes

As previously mentioned, the most observed coral gardens taxon was the lace coral *Pliobothrus*, followed by the cup coral *Caryophyllia*. The presence of these taxa suggests that, should the coral garden habitat be present, it would be identified as the coral gardens sub-type lace coral garden. In the coral gardens guidance (Cleland *et al*., in press), lace coral gardens are described to be dominated by stylasterid corals such as *Pliobothrus*, often found with taxa such as cup corals (*Caryophyllia*) as well as *Callogorgia verticillata* and *Madrepora oculata* colonies. This sub-type of coral garden has been identified in a depth range of 471–811 m, with coarse/rocky underlying substrate.

When the underlying substrate and other environmental parameters were examined (Table 8), six of the segments had coarse sediment while the remaining segment substrate was rock. This means that all the potential coral gardens segments had the correct type of underlying sediment to support a coral gardens habitat. Furthermore, the average temperature of segments ranged from 7.85 °C to 8.73 °C and average seabed depth ranged from 398 m to 453 m. The underlying substrate, average temperature and depth of the segments were a match for a lace coral garden.

The biotopes assigned to the 14 segments that had a higher density of coral taxa than sponge taxa are outlined in Table 8. The deep-sea sponge aggregation biotopes (M.AAUB.Co.DeeSpo and M.AAUB.Ro.DeeSpo) were observed at four of the 14 segments. However, these biotopes are not listed as potential coral gardens biotopes for lace coral gardens (Cleland *et al*., in press). The coral taxa found in the highest densities in all 14 segments were the lace coral *Pliobothrus*, with some cup corals (*Caryophyllia*), although these taxa were not identified to be characteristic of the communities in SIMPER analysis (Appendix 5).

After an examination of the segment biotopes, substrate type, depth and characterising taxa, it was decided that, should a coral garden habitat be present, it would most likely resemble a lace coral garden. However, it was not possible to prove that these segments did not resemble another habitat such as a deep-sea sponge aggregation. As such, the 14 segments did not pass the biotopes criterion.

Table 8. Average environmental parameter values and biotopes for potential coral gardens segments.

Cluster Group	Segment	Temperature (°C)	Depth (m)	Habitat Code
a	1121S_FSSB_T24_D400_S077_A2_S01	8.13	403	M.AAUB.Co.[UrcCom.CidUrc]
	1121S_FSSB_T24_D450_S165_A1_S01	8.73	453	M.AAUB.Co.DeeSpo
	1121S_FSSB_T27_D400_S075_A1_S01	8.08	401	M.AAUB.Co.[UrcCom.CidUrc]
	1121S_FSSB_T27_D450_S163_A1_S02	8.69	450	M.AAUB.Ro.DeeSpo
	1121S_FSSB_T28_D400_S074_A1_S01	8.02	396	M.AAUB.Co.[UrcCom.CidUrc]
	1121S_FSSB_T29_D450_S161_A1_S01	8.73	449	M.AAUB.Co.DeeSpo

Cluster Group	Segment	Temperature (°C)	Depth (m)	Habitat Code
a	1121S_FSSB_T31_D450_S160_A1_S01	8.70	455	M.AAUB.Co.DeeSpo
	1121S_FSSB_T32_D400_S071_A1_S01	8.13	402	M.AAUB.Co.[UrcCom.CidUrc]
	1121S_FSSB_T37_D400_S066_A1_S01	8.34	408	M.AAUB.Co.[UrcCom.CidUrc]
	1121S_FSSB_T41_D400_S063_A1_S01	8.72	407	M.AAUB.Co.[UrcCom.CidUrc]
	1121S_FSSB_T42_D400_S062_A1_S01	8.66	406	M.AAUB.Co.[UrcCom.CidUrc]
	1121S_FSSB_T44_D450_S148_A1_S01	7.91	453	M.AAUB.Co.[UrcCom.CidUrc]
b	1121S_FSSB_T14_D400_S085_A1_S01	7.85	398	M.AAUB.Co.[UrcCom.CidUrc]

3.2.3. Ecological Function

As the lace coral gardens sub-type was identified as most likely to be present in FSSB, the associated taxa previously recorded in this sub-type were used to assess the ecological function criterion. Previous records showed associated fauna to include cerianthids, the holothurians *Parastichopus tremulus* and *Psolus* spp., encrusting and lobed sponges, and pagurid hermit crabs (Cleland *et al*., in press).

Of the 14 segments that were assessed, one was assigned to cluster group b, and the remaining segments were assigned to cluster group a. SIMPER analysis results for these groups showed no matches with the taxa previously recorded to be associated with lace coral gardens.

Any images with records of eggs were inspected to identify whether these co-occurred with the corals, to examine whether they were potentially acting as a fish spawning ground. However, this was not the case.

Following an assessment of biotopes and ecological function, it was determined that the 14 segments that had higher densities of coral gardens taxa than sponges were **not** considered to be the coral gardens PMF habitat.

3.3. Other PMF Habitats

Expert analysis of the video footage from FSSB revealed the presence of the PMF habitats other than deep-sea sponge aggregation and coral gardens.

- **Offshore subtidal sands and gravels** were identified in 108 video segments.
- **Offshore deep-sea muds** were identified in three video segments.

Offshore subtidal sands and gravels were largely observed in 400 – 450 m depth, with some observations in deeper waters towards the south end of FSSB, while all offshore deep-sea muds were observed at around 550 m depth (the deepest depth contour sampled in this dataset, Figure 4).

Burrows were observed in the video segments in which offshore deep-sea muds were identified. To determine whether these video segments could be considered the PMF habitat “burrowed mud”, an assessment was carried out using the SACFOR scale, assigning all burrows the size category of 1-3 cm. Any segments with a burrow density of “F” or above on the SACFOR scale (at least 1 burrow per m^2) would be considered burrowed mud.

The three segments that were identified as offshore deep-sea muds had a burrows density ranging from 0.324 to 0.863 per m^2 which were “O” or “Occasional” on the SACFOR scale (Table 9). Therefore, although burrows were present in areas of offshore deep-sea mud, they were **not** considered to be burrowed mud.

Table 9. Burrows assessment results.

Segment	Burrows density (per m^2)	SACFOR Score
1121S_FSSB_T14_D550_S111_A1_S01	0.863	O
1121S_FSSB_T38_D550_S132_A1_S01	0.324	O
1121S_FSSB_T44_D550_S137_A1_S01	0.511	O

No cold-water coral reef taxa were observed across the surveyed stations. As such, there was no evidence of the presence of the PMF habitat cold-water coral reefs at FSSB.

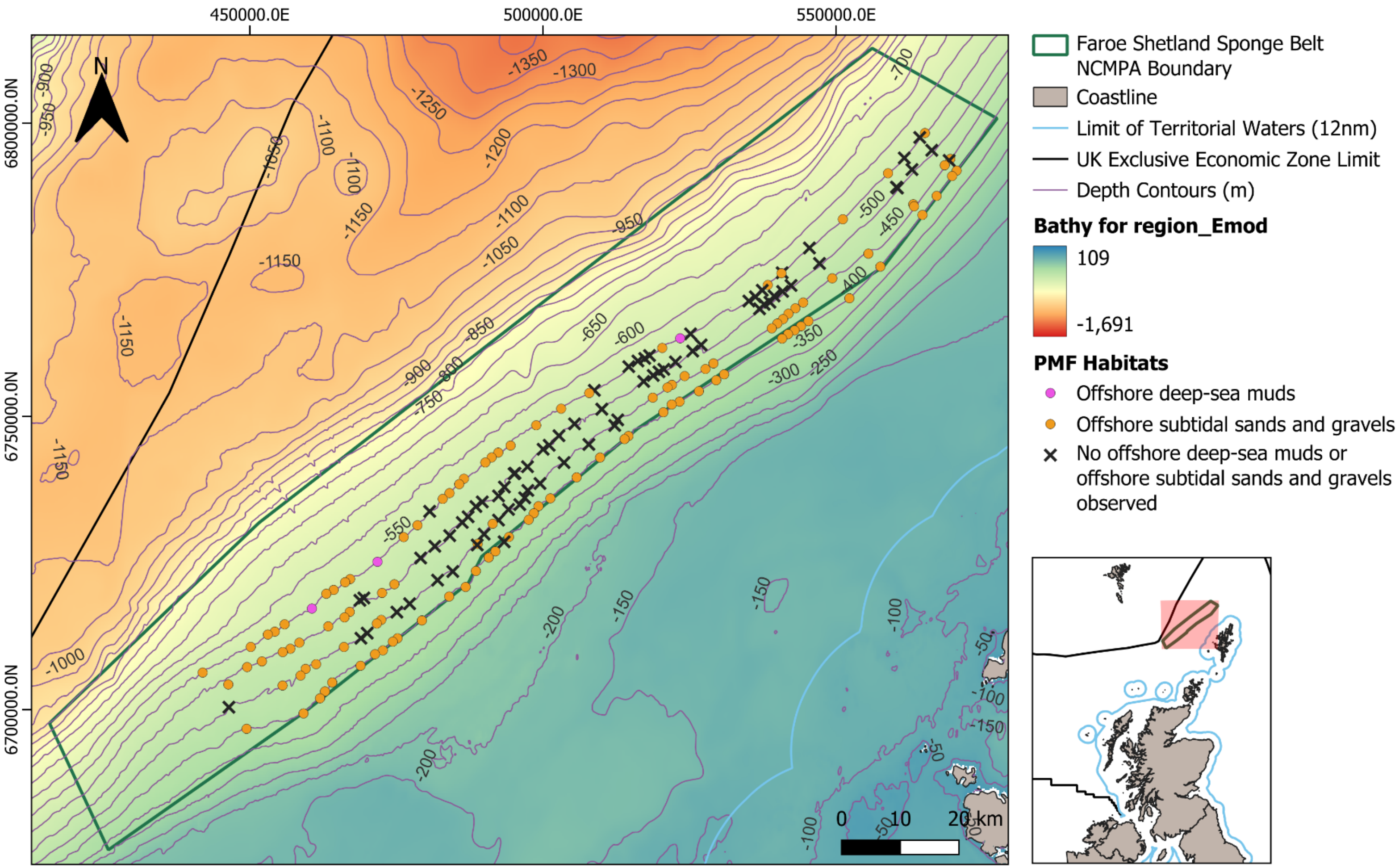

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Figure 4. Map of PMF habitats present across FSSB MPA.

4. Discussion

This report aimed to describe the records of PMF habitats identified from the drop camera imagery data collected during the 1121S survey of FSSB. FSSB is designated for deep-sea sponge aggregations and offshore subtidal sands and gravels, however the data was also examined for the presence of coral gardens, offshore deep-sea muds, burrowed mud and cold-water coral reefs.

4.1. Deep-sea sponge aggregations

Sponge densities recorded from drop camera still images collected from FSSB peaked at 500 m – 550 m depth (Figure 2). Deep-sea sponge aggregations were identified with high or medium confidence at all depth bands surveyed, however the 450, 500, and 550 m depth bands contained 98% of stations where sponge aggregations were identified. Confidence scores varied spatially and with depth. For example, segments with high confidence scores in the 550 m depth band were located mainly in the north of the site, moving up to the 500 m depth band further south until there is an area of medium confidence segments in the 450 m depth band (Figure 3). These findings are in line with previous studies that have found a 'sponge belt' in the Faroe-Shetland Channel to occur at depths of around 500 m (Henry & Roberts 2014a). Although sponge densities appeared to 'peak' at 550 m depth in the current survey, it is not possible to tell whether this is where the sponge belt ends. Due to time constraints during survey 1121S, the 600 m depth band was not surveyed as was originally planned. Future surveys of FSSB should prioritise obtaining data from these deeper stations to identify whether the sponge belt extends beyond the depths investigated in this report, and to confirm the depth at which the sponge belt ends.

Iceberg ploughmarks are known to occur in FSSB and have been observed at depths of up to 450 m, with few observed at 500 m in the wider Faroe Shetland Channel area (Masson 2001). These glacial seabed features have resulted in patches of boulders and cobbles, providing sponges with hard substrate to attach to, leading to isolated patches of sponges in high densities (Axelsson 2003). To understand the true extent and distribution of deep-sea sponge aggregations in FSSB, future surveys should target these areas of iceberg ploughmarks, using acoustic techniques to identify their locations. The use of a Remotely Operated Vehicle (ROV) to obtain imagery data in FSSB will enable the collection of high-quality images with more precision, meaning that specific areas of iceberg ploughmarks can be targeted with ease. The current Henry and Roberts guidance (2014) does not give details on the functional importance of these isolated patches of sponges associated with iceberg ploughmarks. It is recommended that future updates to the guidance should include further information on these and how they should be assessed against the deep-sea sponge aggregation criteria. The assessments of deep-sea sponge aggregations undertaken in this report were based on imagery from a towed drop frame camera system. The small areas of seabed observed during each tow were not sufficient to determine the absence of patchily distributed sponge aggregations that may be associated with iceberg ploughmarks. Therefore, the 67 stations where potential sponge biotopes occur as a secondary habitat have been labelled as "unverified DSSA biotopes". In these areas, more information is required to confirm the absence of deep-sea sponge aggregations, such as better mapping of the locations of iceberg ploughmarks throughout FSSB.

There were some cases where video segments that had not been identified as suspected deep-sea sponge aggregations exceeded the density threshold values outlined in Henry and Roberts (2014a). Examination of these videos revealed that this discrepancy was due to the presence of many massive sponges that were small in size, meaning that although the densities were above the threshold value, the sponges present were not representative of a deep-sea sponge aggregation. There were also cases where a small number of large erect sponges were annotated in the videos, meaning that when compared to the SACFOR scale using the correct size class (> 15 cm) these transects appeared to meet the threshold for "F" or above, despite not resembling a deep-sea sponge aggregation when the video was examined. It is recommended that future amendments to the Henry and Roberts (2014) guidance should review the threshold density values used for each sponge morphology and provide further information on the minimum size that sponges should meet to be considered a deep-sea sponge aggregation.

The identification of habitats from imagery data based on expert opinion is subjective. Application of the verification process for deep-sea sponge aggregations, as used in the current report, allows a semi-quantitative method to be used in identifying deep-sea sponge aggregations. Identifying sponge taxa from imagery data is challenging; to identify taxa to species level, a physical sample is required to allow inspection of the sponge spicules under a microscope. Future surveys of FSSB could consider the use of a ROV, which would not only allow for higher resolution images to be captured, but for specimen samples to be taken alongside them, meaning that species could be identified with high confidence. If specimen samples of sponges are taken, species identification could be carried out through DNA barcoding, providing a cost-effective and high confidence method of species identification. Additionally, recent studies have found that sponges are 'natural eDNA samplers' as they passively collect the DNA of other organisms, such as fish, through the process of filter feeding (Mariani *et al*. 2019). The extraction and analysis of the DNA present in sponge specimens may provide an effective method to understand other species and communities in the area (Brodnicke *et al*. 2023), which would assist in our assessment of the ecological function criterion for deep-sea sponge aggregations.

There were some limitations to the ecological function criterion used to assess the presence of deep-sea sponge aggregations. It was difficult to assess the ecological function of the sponge aggregations purely from results of SIMPER analysis. In the future, further analyses can be done on the 2021 FSSB imagery dataset to improve our understanding of the ecological function that deep-sea sponge aggregations in FSSB provide. For example, a comparison of univariate diversity indices from inside and outside deep-sea sponge aggregations would allow a better understanding of whether these habitats lead to an increase in biodiversity in the areas that they are present. Sponges are known to provide a habitat for fish at multiple life stages (Klitgaard 1995; Bett & Rice 1992; Miller *et al.* 2012). Although drop-cameras are not the best way to monitor fish communities, the inclusion of fish species observed using the drop-camera in the current survey in analyses may provide an insight into whether the deep-sea sponge aggregations in FSSB are being used as a habitat for fish. Deep-sea sponge aggregations also play an important role in nutrient cycling in the areas they are present (Bart *et al*. 2021; Hanz *et al*. 2022). The deployment of technology such as aquatic eddy covariance systems across FSSB will allow measurements of respiration to be made (Coogan & Long 2023), enhancing our understanding of how deep-sea sponge aggregations contribute to local nutrient cycling.

4.2. Coral Gardens

Although coral gardens taxa were observed across FSSB, there was not sufficient evidence to suggest that these taxa were the dominant habitat-forming taxa at any of the segments. Deep-sea sponge aggregations and coral gardens taxa have been found to co-occur (Henry & Roberts 2014a), so providing a definitive answer on which habitat is present can be difficult. In this case, the data suggests that the PMF habitat coral gardens was not present in the surveyed areas, but deep-sea sponge aggregations were.

However, it is possible for deep-sea sponge aggregations to experience a shift in community composition that may favour coral gardens taxa in the future. As such, future surveys of FSSB should continue to investigate the presence of coral gardens and monitor any changes in community composition that may occur. Although not observed in the current survey, it is possible for coral gardens and deep-sea sponge aggregations to occur as a mosaic habitat (ICES 2020). The guidance on both coral gardens and deep-sea sponge aggregations do not take this into account in their assessment criteria. It is recommended that such guidance should be developed to advise on the best way to carry out confidence assessments of mosaic habitats of coral gardens/deep-sea sponge aggregations.

4.3. Other PMF Habitats

Other PMF habitats were identified across FSSB, including offshore subtidal sands and gravel and offshore deep-sea muds.

The sediments in FSSB have previously been described as split between distinct depth zones, with the sediments found in shallower areas (between 300 m and 600 m depth) characterised by higher proportions of cobbles and boulders, and sediments found below 600 m depth characterised by finer sands and muddy sand. This report provides evidence to support that this is the case, although mud sediments were only identified at three stations. As the stations surveyed were not deeper than 550 m, it is likely that the current survey did not sample deep enough waters to give an accurate representation of the distribution of muddy sediments within the MPA. To address this, future surveys of FSSB should prioritise obtaining data from larger depths to accurately identify the extent of offshore deep-sea muds.

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Appendix 1

Table outlining the total area covered by each video segment and whether the video segment was included in analyses in this report. This was calculated by summing the field of view for all images in a segment.

Video Segment	Total Area (m^2)	Included in report analyses
1121S_FSSB_T01_D400_S097_A1_S01	47.5	Yes
1121S_FSSB_T01_D450_S186_A1_S01	42.2	Yes
1121S_FSSB_T01_D500_S005_A2_S01	51.1	Yes
1121S_FSSB_T01_D550_S098_A1_S01	41.8	Yes
1121S_FSSB_T02_D400_S096_A1_S01	49.7	Yes
1121S_FSSB_T02_D450_S185_A1_S01	30.0	Yes
1121S_FSSB_T02_D500_S006_A1_S01	52.0	Yes
1121S_FSSB_T02_D550_S099_A1_S01	39.6	Yes
1121S_FSSB_T03_D400_S095_A1_S01	54.5	Yes
1121S_FSSB_T03_D450_S184_A1_S01	36.5	Yes
1121S_FSSB_T03_D500_S007_A1_S01	52.5	Yes
1121S_FSSB_T03_D550_S100_A1_S01	50.1	Yes
1121S_FSSB_T04_D400_S094_A1_S01	48.5	Yes
1121S_FSSB_T04_D450_S183_A1_S01	47.5	Yes
1121S_FSSB_T04_D500_S008_A1_S01	51.9	Yes
1121S_FSSB_T04_D550_S101_A1_S01	43.4	Yes
1121S_FSSB_T05_D400_S093_A1_S01	53.0	Yes
1121S_FSSB_T05_D450_S182_A2_S01	44.8	Yes
1121S_FSSB_T05_D500_S009_A1_S01	49.0	Yes
1121S_FSSB_T05_D550_S102_A1_S01	45.6	Yes
1121S_FSSB_T06_D400_S092_A1_S01	38.6	Yes
1121S_FSSB_T06_D450_S181_A2_S01	41.7	Yes
1121S_FSSB_T06_D500_S010_A1_S01	61.5	Yes
1121S_FSSB_T06_D550_S103_A1_S01	40.0	Yes
1121S_FSSB_T07_D450_S180_A1_S01	46.4	Yes
1121S_FSSB_T07_D500_S011_A1_S01	64.1	Yes
1121S_FSSB_T07_D550_S104_A1_S01	38.9	Yes
1121S_FSSB_T08_D400_S091_A1_S01	51.8	Yes
1121S_FSSB_T08_D450_S179_A1_S01	42.7	Yes
1121S_FSSB_T08_D500_S012_A1_S01	56.9	Yes

Video Segment	Total Area (m^2)	Included in report analyses
1121S_FSSB_T08_D550_S105_A1_S01	39.9	Yes
1121S_FSSB_T09_D400_S090_A1_S01	44.3	Yes
1121S_FSSB_T09_D450_S178_A2_S01	43.0	Yes
1121S_FSSB_T09_D500_S013_A1_S01	56.4	Yes
1121S_FSSB_T09_D550_S106_A1_S01	38.9	Yes
1121S_FSSB_T10_D400_S089_A1_S01	32.0	Yes
1121S_FSSB_T10_D450_S177_A1_S01	42.5	Yes
1121S_FSSB_T10_D500_S014_A1_S01	57.6	Yes
1121S_FSSB_T10_D550_S107_A1_S01	40.6	Yes
1121S_FSSB_T11_D400_S088_A1_S01	52.4	Yes
1121S_FSSB_T11_D450_S176_A1_S01	38.5	Yes
1121S_FSSB_T11_D500_S015_A1_S01	54.9	Yes
1121S_FSSB_T11_D550_S108_A1_S01	44.7	Yes
1121S_FSSB_T12_D400_S087_A1_S01	39.9	Yes
1121S_FSSB_T12_D450_S175_A1_S01	43.1	Yes
1121S_FSSB_T12_D500_S016_A1_S01	52.9	Yes
1121S_FSSB_T12_D550_S109_A1_S01	43.4	Yes
1121S_FSSB_T13_D400_S086_A1_S01	46.9	Yes
1121S_FSSB_T13_D450_S174_A1_S01	31.4	Yes
1121S_FSSB_T13_D500_S017_A1_S01	58.3	Yes
1121S_FSSB_T13_D550_S110_A1_S01	50.9	Yes
1121S_FSSB_T14_D400_S085_A1_S01	51.4	Yes
1121S_FSSB_T14_D450_S173_A1_S01	46.3	Yes
1121S_FSSB_T14_D500_S018_A1_S01	54.7	Yes
1121S_FSSB_T14_D550_S111_A1_S01	49.8	Yes
1121S_FSSB_T15_D400_S084_A1_S01	50.2	Yes
1121S_FSSB_T15_D450_S172_A1_S01	51.1	Yes
1121S_FSSB_T15_D500_S019_A1_S01	64.6	Yes
1121S_FSSB_T15_D550_S112_A1_S01	53.3	Yes
1121S_FSSB_T16_D450_S171_A1_S01	47.2	Yes
1121S_FSSB_T16_D500_S020_A1_S01	50.9	Yes
1121S_FSSB_T16_D550_S113_A1_S01	48.0	Yes
1121S_FSSB_T17_D400_S083_A1_S01	53.4	Yes
1121S_FSSB_T17_D450_S170_A1_S01	46.6	Yes

Video Segment	Total Area (m^2)	Included in report analyses
1121S_FSSB_T17_D500_S021_A1_S01	47.5	Yes
1121S_FSSB_T17_D550_S114_A1_S01	51.5	Yes
1121S_FSSB_T18_D400_S082_A1_S01	50.8	Yes
1121S_FSSB_T18_D500_S022_A1_S01	56.6	Yes
1121S_FSSB_T18_D550_S115_A1_S01	61.3	Yes
1121S_FSSB_T19_D400_S081_A1_S01	55.5	Yes
1121S_FSSB_T19_D450_S169_A1_S01	50.7	Yes
1121S_FSSB_T19_D500_S023_A1_S01	57.2	Yes
1121S_FSSB_T19_D550_S116_A1_S01	51.6	Yes
1121S_FSSB_T20_D400_S080_A1_S01	47.0	Yes
1121S_FSSB_T20_D450_S168_A1_S01	47.3	Yes
1121S_FSSB_T20_D500_S024_A1_S01	55.3	Yes
1121S_FSSB_T20_D550_S117_A1_S01	63.4	Yes
1121S_FSSB_T21_D400_S079_A1_S01	40.4	Yes
1121S_FSSB_T21_D450_S167_A1_S01	43.4	Yes
1121S_FSSB_T21_D500_S025_A1_S01	57.9	Yes
1121S_FSSB_T21_D550_S118_A1_S01	64.4	Yes
1121S_FSSB_T22_D400_S078_A1_S01	48.4	Yes
1121S_FSSB_T22_D450_S166_A1_S02	13.0	No
1121S_FSSB_T22_D450_S166_A1_S03	27.4	Yes
1121S_FSSB_T22_D450_S166_A1_S04	4.0	No
1121S_FSSB_T22_D500_S026_A1_S01	58.4	Yes
1121S_FSSB_T22_D550_S119_A1_S01	60.6	Yes
1121S_FSSB_T23_D500_S027_A1_S01	60.9	Yes
1121S_FSSB_T24_D400_S077_A2_S01	42.5	Yes
1121S_FSSB_T24_D450_S165_A1_S01	31.8	Yes
1121S_FSSB_T24_D500_S028_A1_S01	61.1	Yes
1121S_FSSB_T24_D550_S120_A1_S01	59.9	Yes
1121S_FSSB_T25_D500_S029_A1_S01	48.8	Yes
1121S_FSSB_T26_D400_S076_A1_S01	42.8	Yes
1121S_FSSB_T26_D450_S164_A1_S01	2.6	No
1121S_FSSB_T26_D450_S164_A1_S02	5.5	No
1121S_FSSB_T26_D450_S164_A1_S03	6.6	No
1121S_FSSB_T26_D450_S164_A1_S04	4.6	No

Video Segment	Total Area (m^2)	Included in report analyses
1121S_FSSB_T26_D450_S164_A1_S05	28.6	Yes
1121S_FSSB_T26_D500_S030_A1_S01	57.0	Yes
1121S_FSSB_T26_D550_S121_A1_S01	54.2	Yes
1121S_FSSB_T27_D400_S075_A1_S01	41.0	Yes
1121S_FSSB_T27_D450_S163_A1_S01	5.4	No
1121S_FSSB_T27_D450_S163_A1_S02	44.1	Yes
1121S_FSSB_T27_D500_S031_A1_S01	54.4	Yes
1121S_FSSB_T27_D550_S122_A1_S01	52.9	Yes
1121S_FSSB_T28_D400_S074_A1_S01	37.2	Yes
1121S_FSSB_T28_D450_S162_A1_S01	50.2	Yes
1121S_FSSB_T28_D500_S032_A1_S01	37.3	Yes
1121S_FSSB_T28_D550_S123_A1_S01	50.0	Yes
1121S_FSSB_T29_D400_S073_A1_S01	53.2	Yes
1121S_FSSB_T29_D450_S161_A1_S01	55.2	Yes
1121S_FSSB_T29_D500_S033_A1_S01	42.4	Yes
1121S_FSSB_T29_D550_S124_A1_S01	52.3	Yes
1121S_FSSB_T30_D500_S034_A1_S01	42.1	Yes
1121S_FSSB_T31_D400_S072_A1_S01	45.6	Yes
1121S_FSSB_T31_D450_S160_A1_S01	54.6	Yes
1121S_FSSB_T31_D500_S035_A1_S01	47.0	Yes
1121S_FSSB_T31_D550_S125_A1_S01	50.7	Yes
1121S_FSSB_T32_D400_S071_A1_S01	43.0	Yes
1121S_FSSB_T32_D450_S159_A1_S01	52.7	Yes
1121S_FSSB_T32_D500_S036_A1_S01	47.2	Yes
1121S_FSSB_T32_D550_S126_A1_S01	50.0	Yes
1121S_FSSB_T33_D400_S070_A1_S01	49.8	Yes
1121S_FSSB_T33_D450_S158_A1_S01	59.2	Yes
1121S_FSSB_T33_D500_S037_A1_S01	48.5	Yes
1121S_FSSB_T33_D550_S127_A1_S01	37.8	Yes
1121S_FSSB_T34_D400_S069_A1_S01	40.2	Yes
1121S_FSSB_T34_D450_S157_A1_S01	46.5	Yes
1121S_FSSB_T34_D500_S038_A1_S01	49.1	Yes
1121S_FSSB_T34_D550_S128_A1_S01	47.7	Yes
1121S_FSSB_T35_D400_S068_A1_S01	57.3	Yes

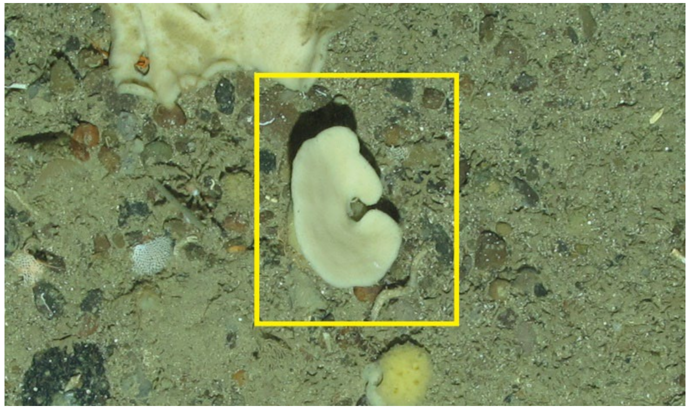
Video Segment	Total Area (m^2)	Included in report analyses
1121S_FSSB_T35_D450_S156_A1_S01	38.6	Yes
1121S_FSSB_T35_D500_S039_A1_S01	46.1	Yes
1121S_FSSB_T35_D550_S129_A1_S01	52.8	Yes
1121S_FSSB_T36_D400_S067_A1_S01	49.8	Yes
1121S_FSSB_T36_D450_S155_A1_S01	39.7	Yes
1121S_FSSB_T36_D500_S040_A1_S01	48.7	Yes
1121S_FSSB_T36_D550_S130_A1_S01	52.4	Yes
1121S_FSSB_T37_D400_S066_A1_S01	50.7	Yes
1121S_FSSB_T37_D450_S154_A1_S01	43.7	Yes
1121S_FSSB_T37_D500_S041_A1_S01	49.7	Yes
1121S_FSSB_T37_D550_S131_A1_S01	49.4	Yes
1121S_FSSB_T38_D400_S065_A1_S01	49.5	Yes
1121S_FSSB_T38_D450_S153_A1_S01	38.8	Yes
1121S_FSSB_T38_D450_S153_A1_S02	5.4	No
1121S_FSSB_T38_D500_S042_A1_S01	51.1	Yes
1121S_FSSB_T38_D550_S132_A1_S01	49.3	Yes
1121S_FSSB_T39_D500_S043_A1_S01	52.4	Yes
1121S_FSSB_T40_D400_S064_A1_S01	58.2	Yes
1121S_FSSB_T40_D450_S152_A1_S01	42.2	Yes
1121S_FSSB_T40_D500_S044_A1_S01	56.7	Yes
1121S_FSSB_T40_D550_S133_A1_S01	44.8	Yes
1121S_FSSB_T41_D400_S063_A1_S01	57.9	Yes
1121S_FSSB_T41_D450_S151_A1_S01	40.3	Yes
1121S_FSSB_T41_D500_S045_A1_S01	46.5	Yes
1121S_FSSB_T41_D550_S134_A1_S01	47.9	Yes
1121S_FSSB_T42_D400_S062_A1_S01	57.4	Yes
1121S_FSSB_T42_D450_S150_A1_S01	39.0	Yes
1121S_FSSB_T42_D500_S046_A1_S01	49.4	Yes
1121S_FSSB_T42_D550_S135_A1_S01	35.9	Yes
1121S_FSSB_T43_D400_S061_A1_S01	56.2	Yes
1121S_FSSB_T43_D450_S149_A1_S01	50.3	Yes
1121S_FSSB_T43_D500_S047_A1_S01	44.5	Yes
1121S_FSSB_T43_D550_S136_A1_S01	40.4	Yes
1121S_FSSB_T44_D400_S060_A1_S01	55.7	Yes

Video Segment	Total Area (m^2)	Included in report analyses
1121S_FSSB_T44_D450_S148_A1_S01	51.3	Yes
1121S_FSSB_T44_D500_S048_A1_S01	42.4	Yes
1121S_FSSB_T44_D550_S137_A1_S01	39.1	Yes
1121S_FSSB_T45_D400_S059_A1_S01	47.2	Yes
1121S_FSSB_T45_D450_S147_A1_S01	53.3	Yes
1121S_FSSB_T45_D500_S049_A1_S01	36.1	Yes
1121S_FSSB_T45_D550_S138_A1_S01	37.8	Yes
1121S_FSSB_T46_D400_S058_A1_S01	51.8	Yes
1121S_FSSB_T46_D450_S146_A1_S01	41.6	Yes
1121S_FSSB_T46_D500_S050_A1_S01	36.3	Yes
1121S_FSSB_T46_D550_S139_A1_S01	29.6	Yes
1121S_FSSB_T47_D400_S057_A1_S01	57.5	Yes
1121S_FSSB_T47_D450_S145_A1_S01	45.7	Yes
1121S_FSSB_T47_D500_S051_A1_S01	36.7	Yes
1121S_FSSB_T47_D550_S140_A1_S01	33.7	Yes
1121S_FSSB_T48_D400_S056_A1_S01	55.6	Yes
1121S_FSSB_T48_D450_S144_A2_S01	34.6	Yes
1121S_FSSB_T48_D500_S052_A1_S01	35.3	Yes
1121S_FSSB_T48_D550_S141_A1_S01	27.6	Yes
1121S_FSSB_T49_D500_S053_A1_S01	35.8	Yes
1121S_FSSB_T50_D400_S055_A1_S01	53.7	Yes
1121S_FSSB_T50_D450_S143_A1_S01	38.3	Yes
1121S_FSSB_T50_D500_S054_A2_S01	33.1	Yes
1121S_FSSB_T50_D550_S142_A1_S01	21.1	Yes

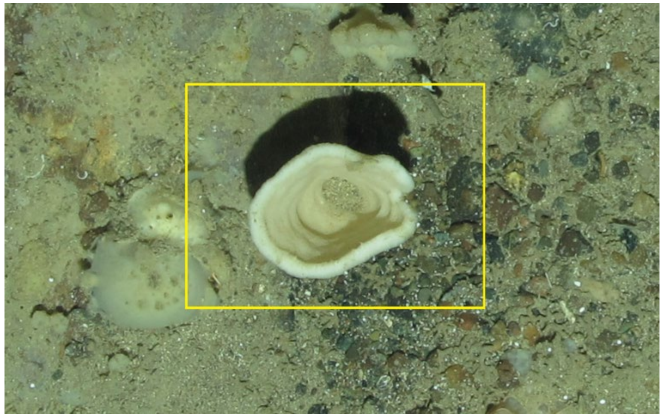
Appendix 2

Reference collection for cup-like, erect and massive sponge morphotypes and OTUs annotated in the 1121S FSSB still imagery analysis.

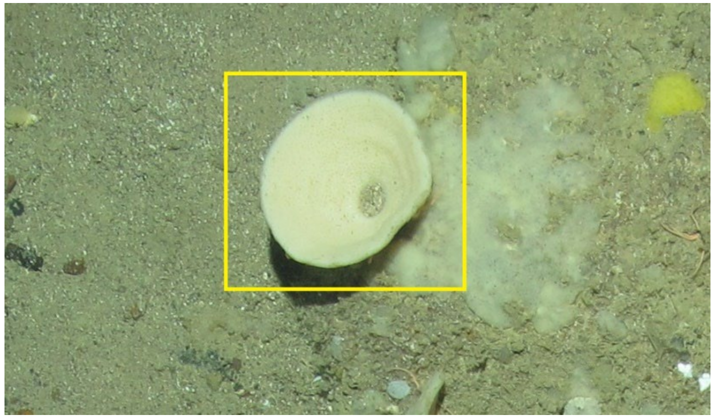
Cup-Like Sponges



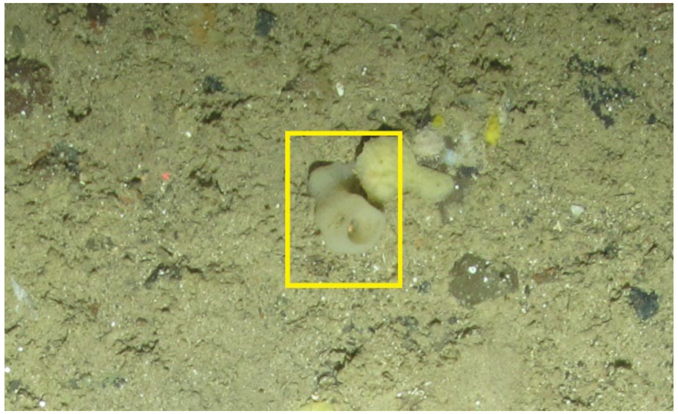
FSC078



OTU124



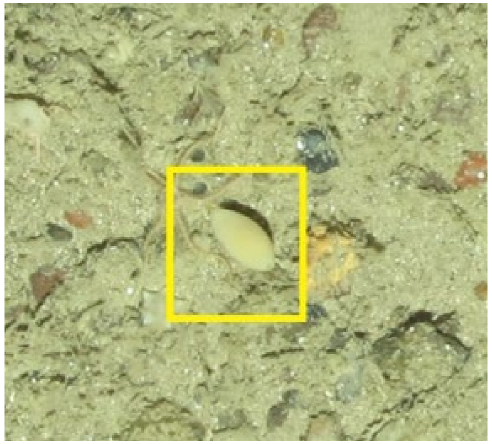
OTU403 *Axinella Infundibuliformis*



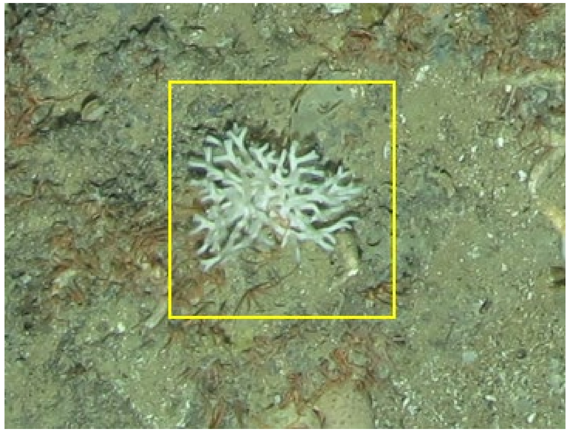
FSC082

Erect Sponges

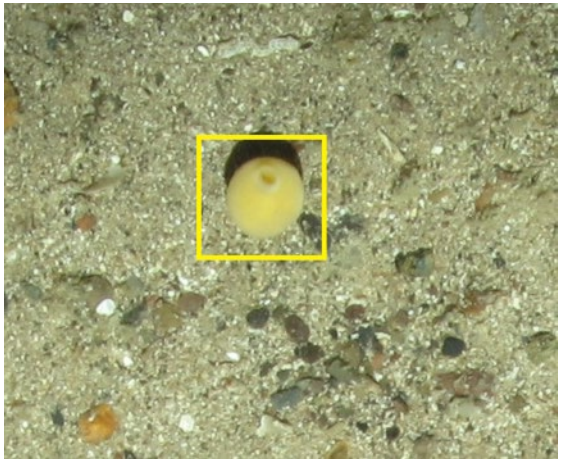
FSC079



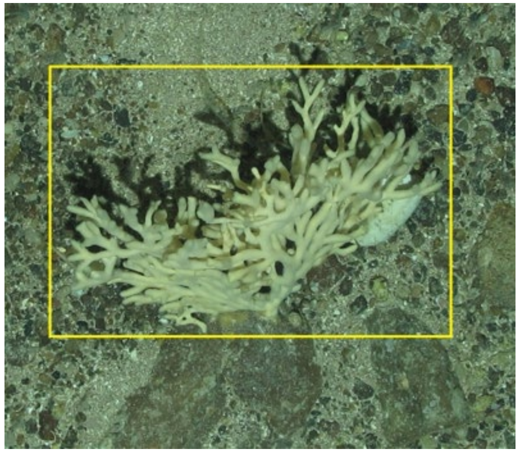
FSC80



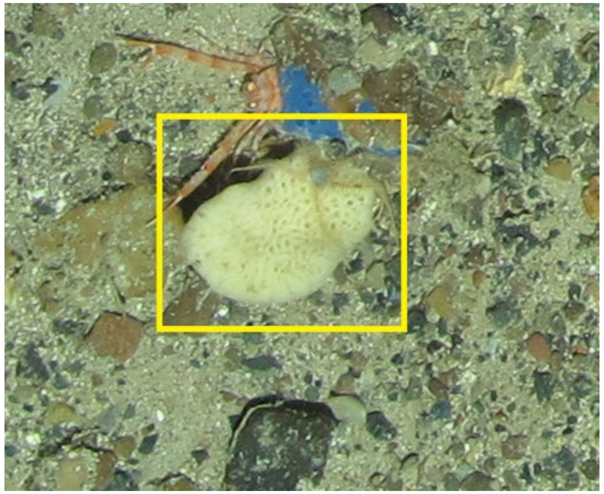
FSC81



OTU387

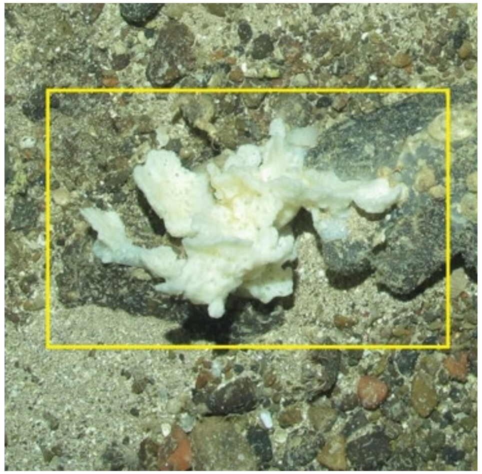


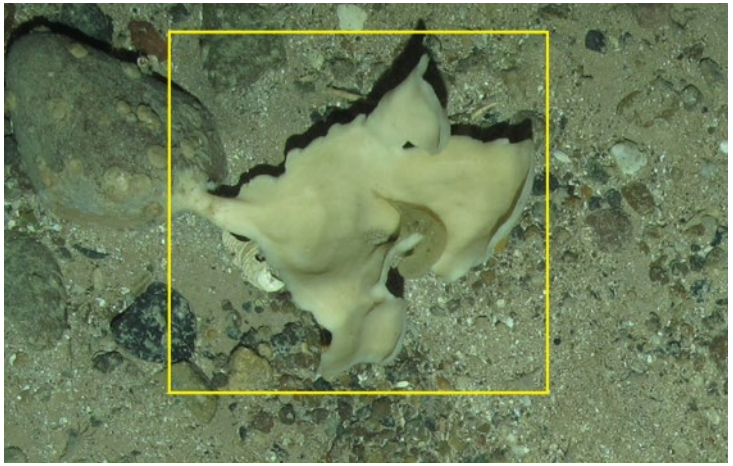
OTU281

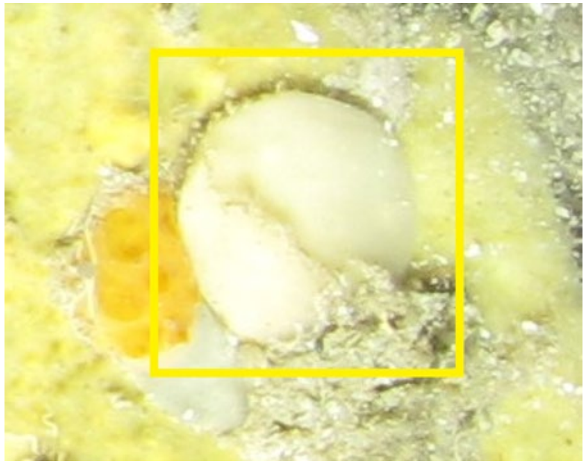


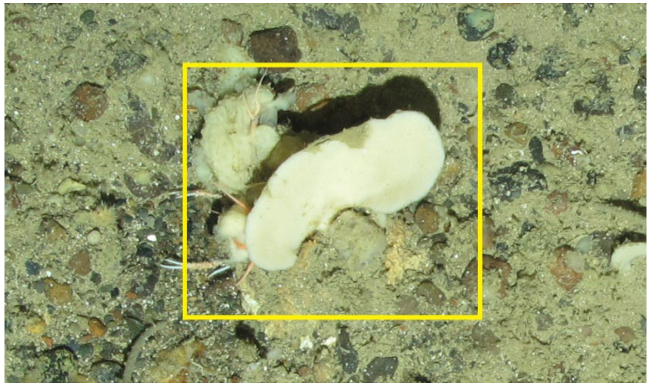
OTU181

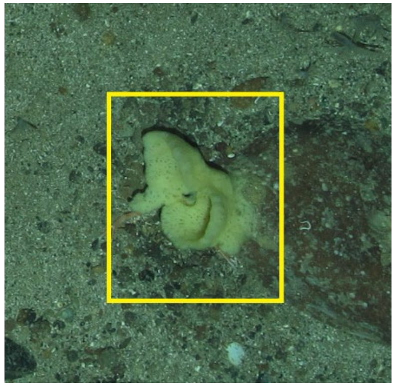
Erect Sponges

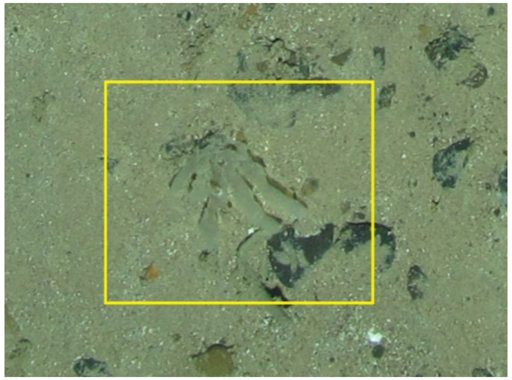

OTU409


OTU422

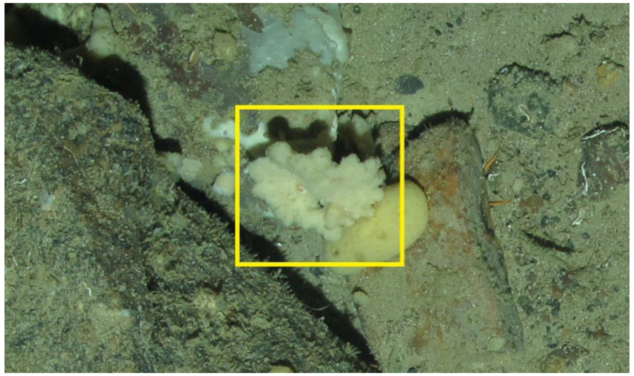

OTU590


FSC083


OTU611

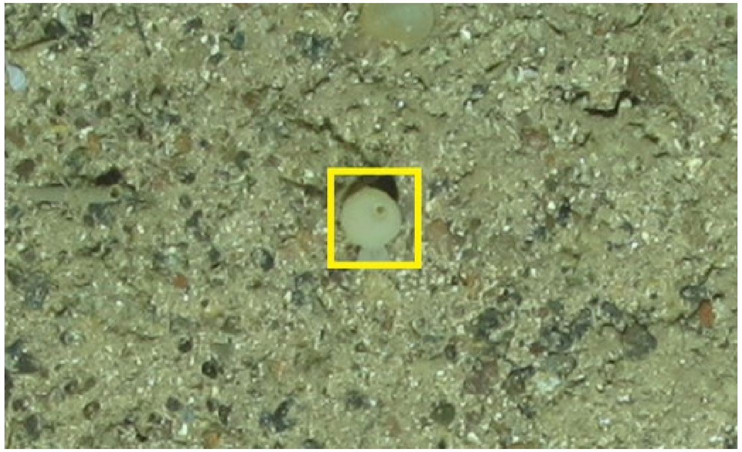

OTU1091

Erect Sponges

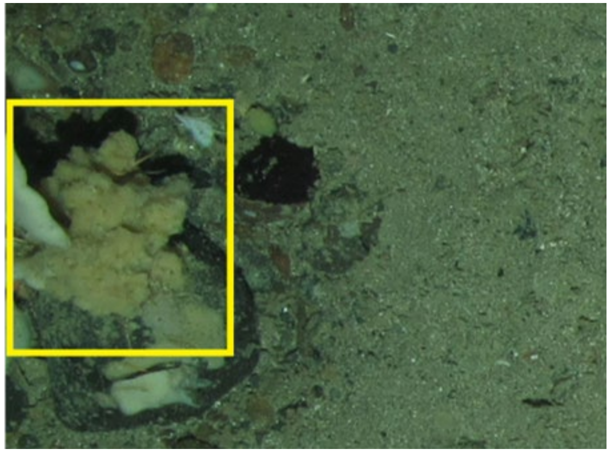


OTU81

Massive Sponges



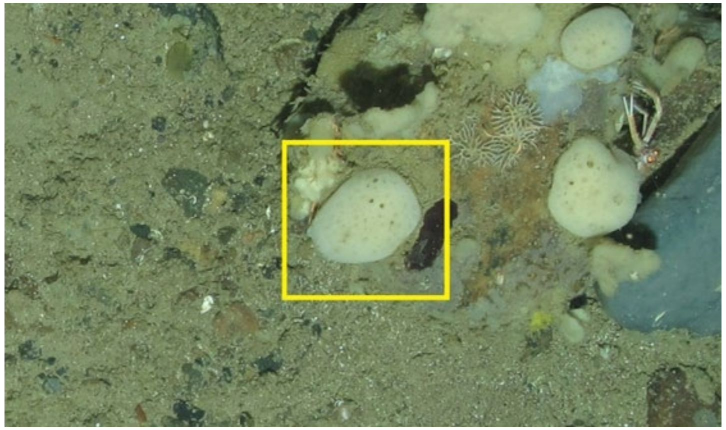
FSC84



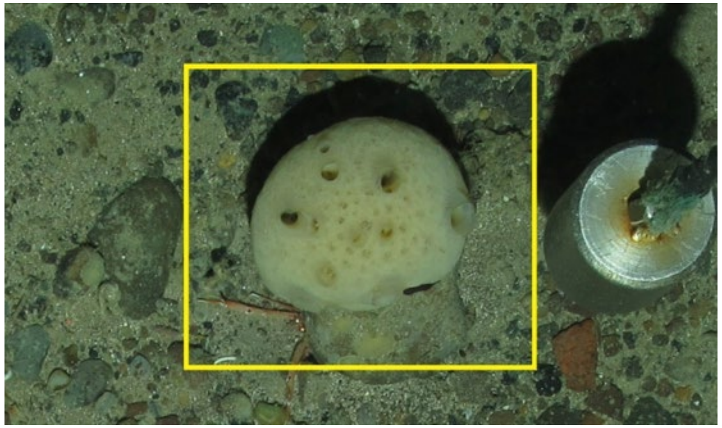
FSC85

FSC86

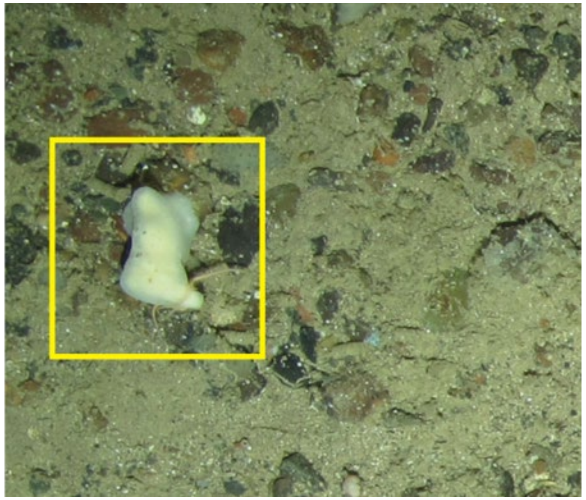
Massive Sponges (continued)



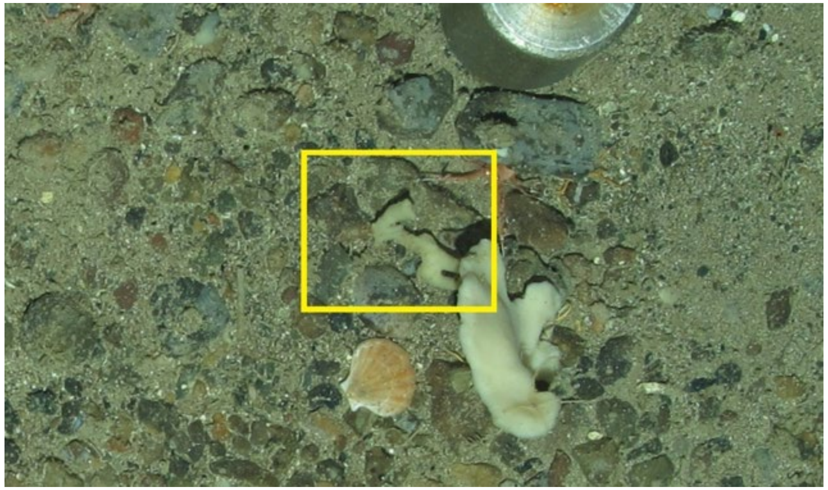
FSC87



FSC88

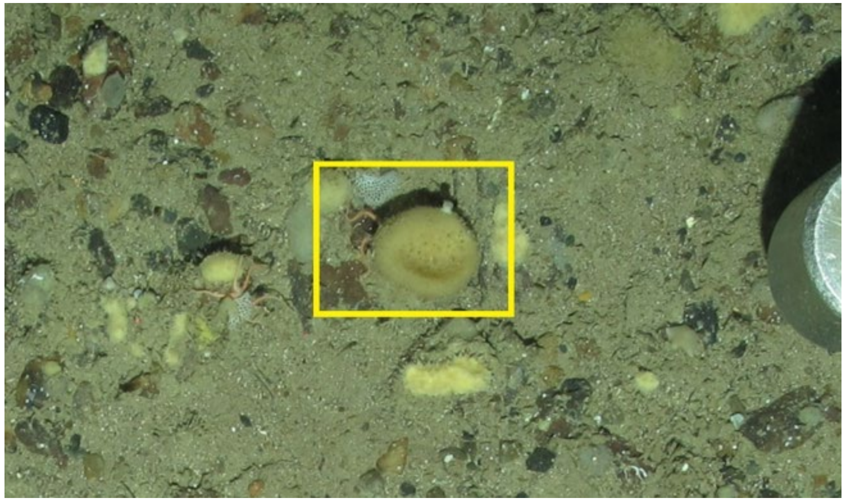


FSC89



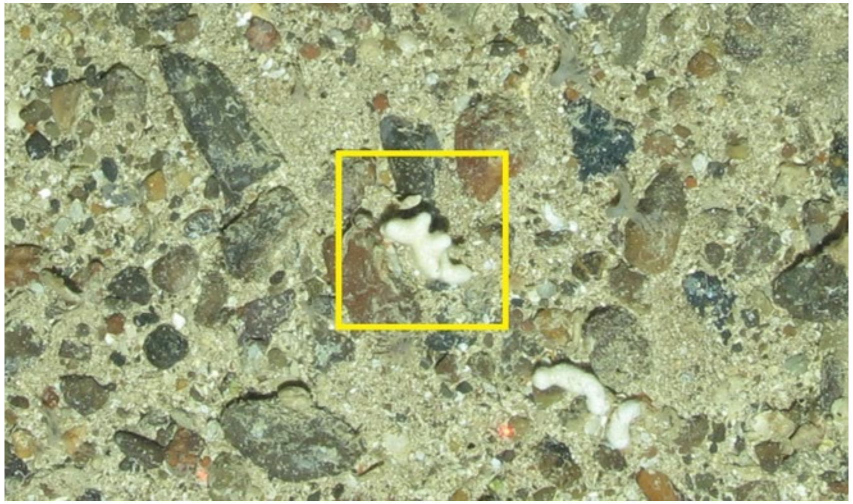
FSC90

Massive Sponges (continued)

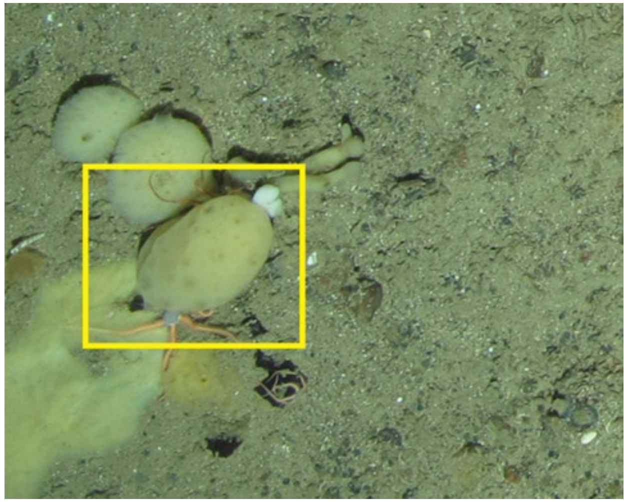


FSC91

FSC92

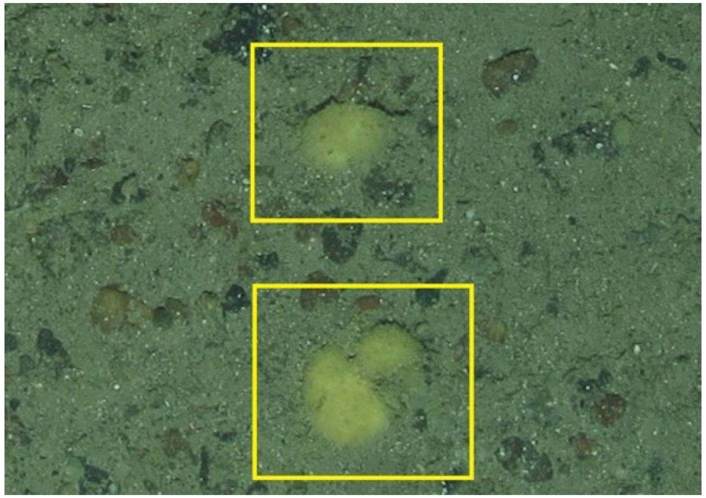


FSC93

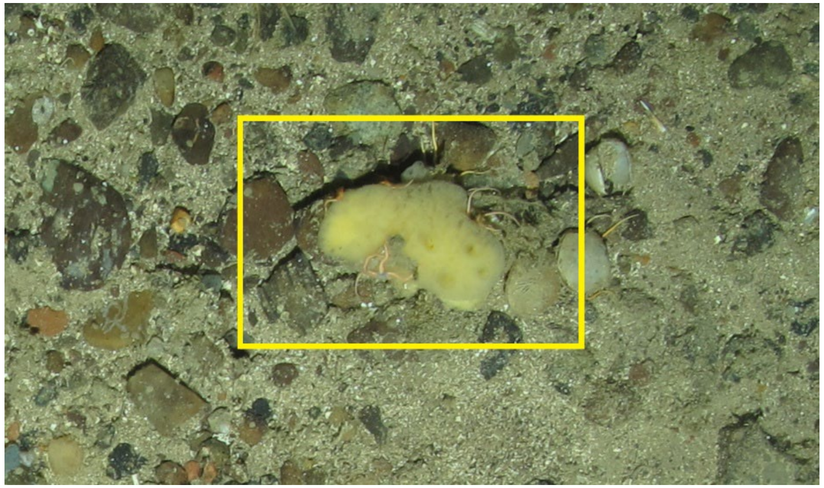


FSC94

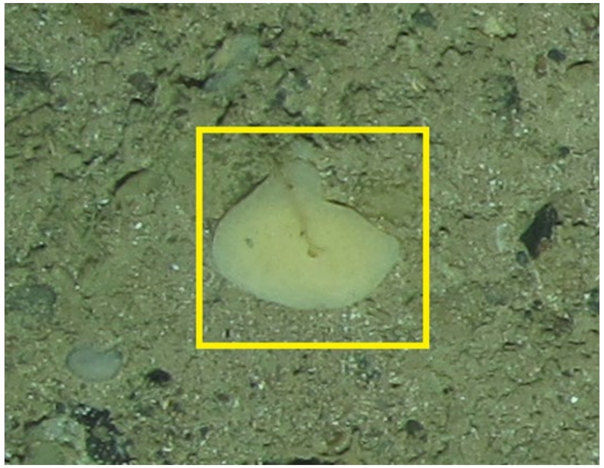
Massive Sponges (continued)



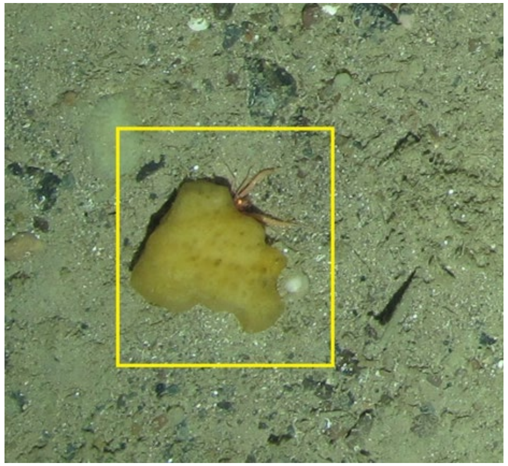
FSC95



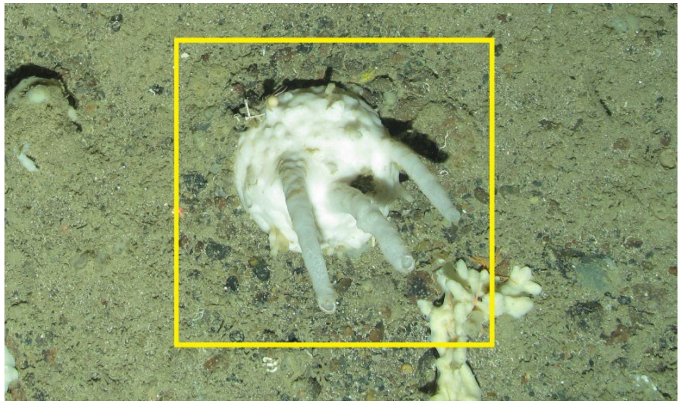
OTU5



OTU75

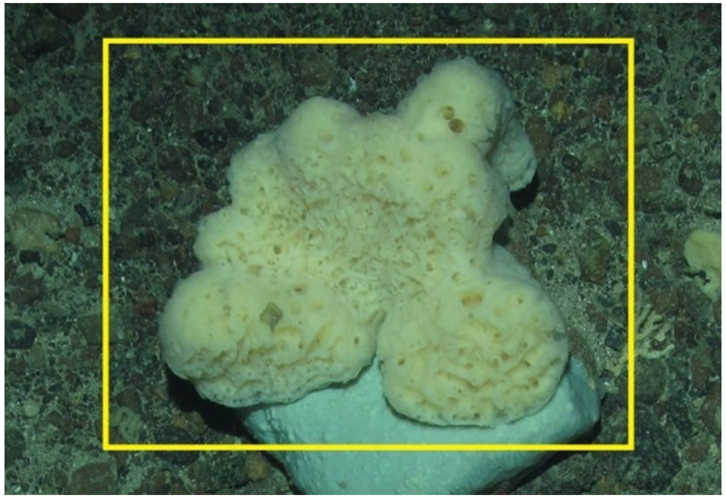


OTU76

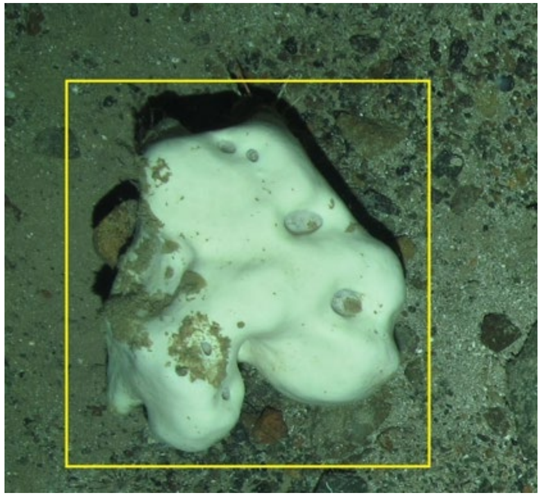


OTU79

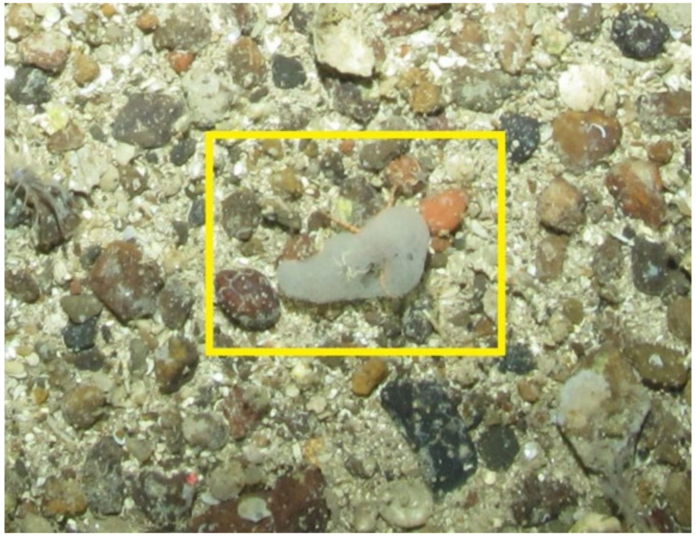
Massive Sponges (continued)



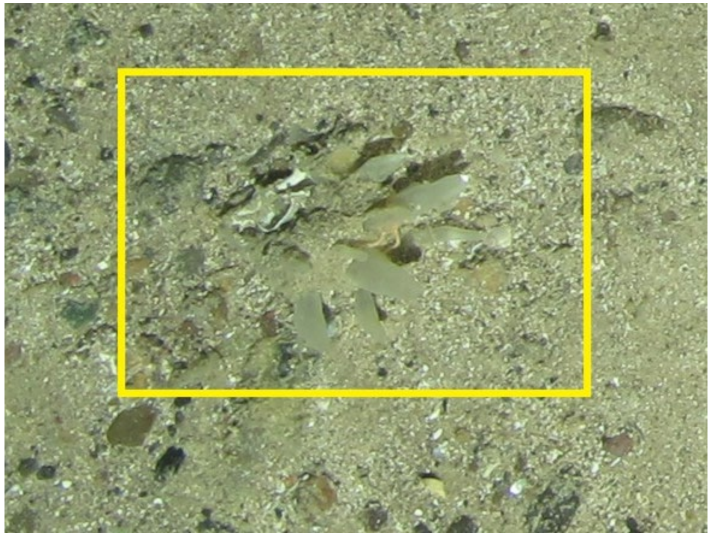
OTU171f



OTU196 *Geodia barretti*

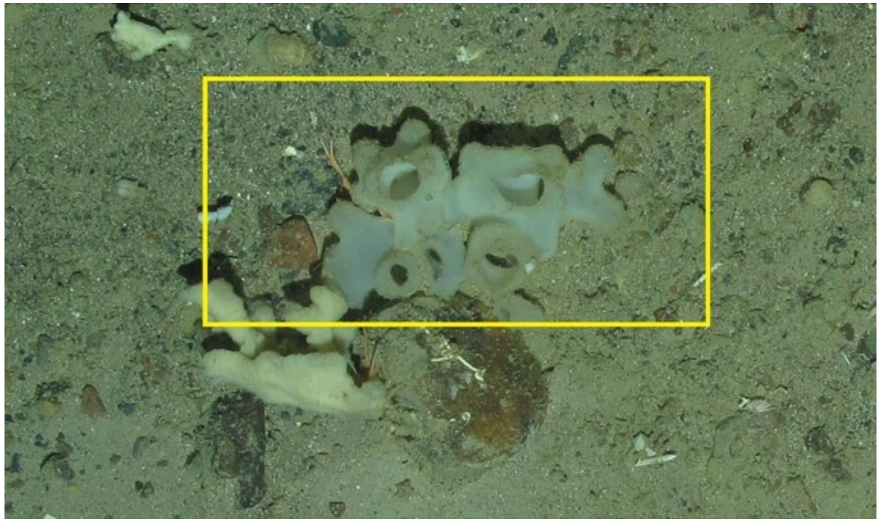


OTU392

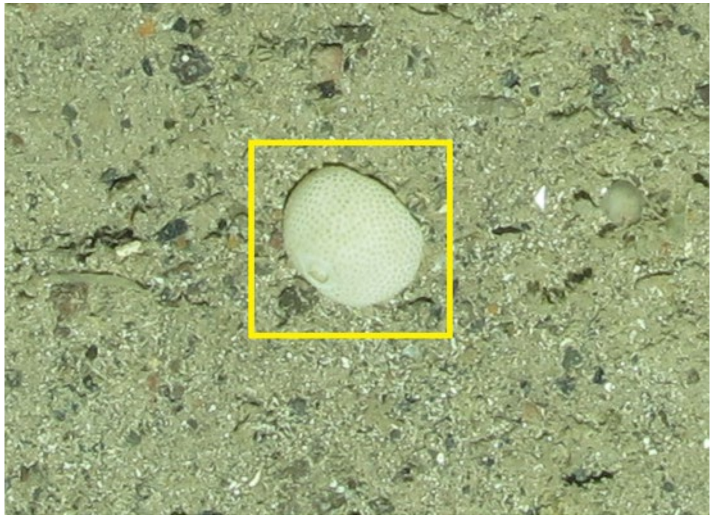


OTU602

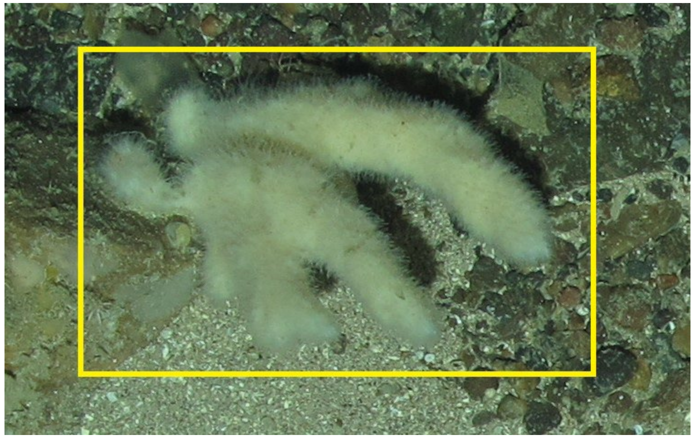
Massive Sponges (continued)



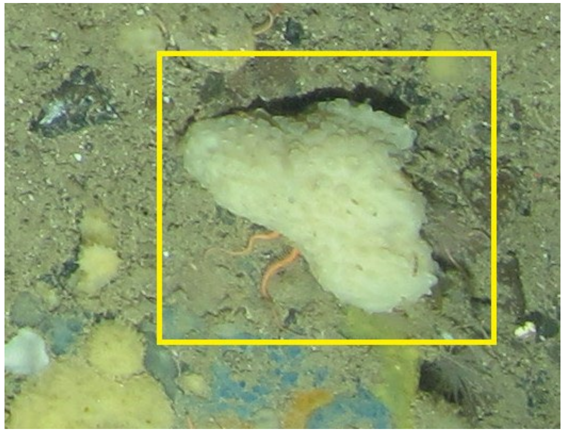
OTU650



OTU1156

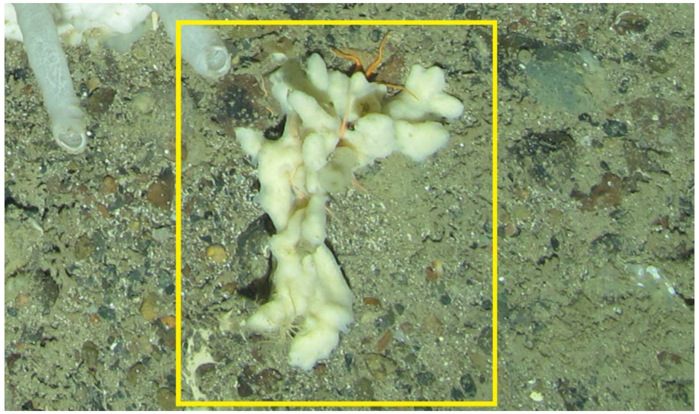


OTU232

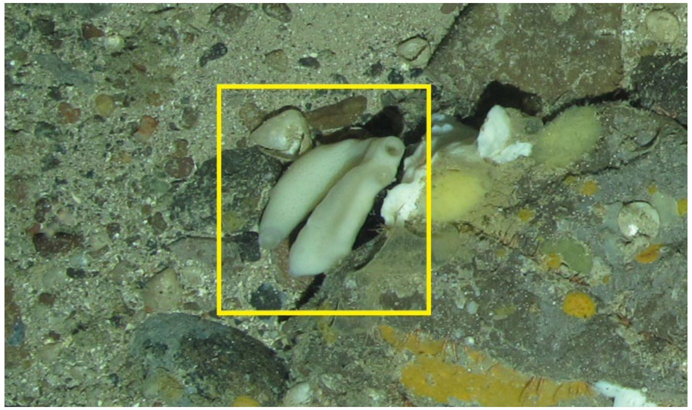


OTU407

Massive Sponges (continued)



OTU418



OTU425

Appendix 3

Verification of suspected deep-sea sponge aggregations (DSSA) across FSSB, applying the criteria and confidence assessment outlined by Henry and Roberts (2014). The rationale for including video segments in this assessment are outline and ticks indicate the number of criteria that each video segment met.

Video Segment	Rationale for being included in DSSA confidence assessment		Density	Habitat	Function	DSSA Confidence
	Primary Biotope	PMF Habitat				
1121S_FSSB_T01_D500_S005_A2_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T02_D500_S006_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T02_D550_S099_A1_S01	M.AAUB.Mx.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T03_D500_S007_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T03_D550_S100_A1_S01	M.AAUB.Mx.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T04_D500_S008_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T05_D500_S009_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T06_D500_S010_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T06_D550_S103_A1_S01	M.AAUB.Mx.SpaEnc	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T07_D500_S011_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T07_D550_S104_A1_S01	M.AAUB.Mx.SpaEnc	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T08_D500_S012_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T09_D500_S013_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T10_D500_S014_A3_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High

Video Segment	Rationale for being included in DSSA confidence assessment		Density	Habitat	Function	DSSA Confidence
	Primary Biotope	PMF Habitat				
1121S_FSSB_T10_D550_S107_A1_S01	M.AAUB.Mx.SpaEnc	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T11_D500_S015_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T11_D550_S108_A1_S01	M.AAUB.Mx.SpaEnc	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T12_D500_S016_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T12_D550_S109_A1_S01	M.AAUB.Mx.SpaEnc	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T13_D500_S017_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T13_D550_S110_A1_S01	M.AAUB.Mx.SpaEnc	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T14_D500_S018_A1_S01	M.AAUB.Co.[UrcCom.CidUrc]	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T15_D500_S019_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T16_D500_S020_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T16_D550_S113_A1_S01	M.AAUB.Mx.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T17_D500_S021_A1_S01	M.AAUB.Co.[UrcCom.CidUrc]	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T17_D550_S114_A1_S01	M.AAUB.Mx.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T18_D500_S022_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T18_D550_S115_A1_S01	M.AAUB.Mx.SpaEnc	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T19_D500_S023_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T19_D550_S116_A1_S01	M.AAUB.Mx.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High

Video Segment	Rationale for being included in DSSA confidence assessment		Density	Habitat	Function	DSSA Confidence
	Primary Biotope	PMF Habitat				
1121S_FSSB_T20_D450_S168_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	×	✓	Medium
1121S_FSSB_T20_D500_S024_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T20_D550_S117_A1_S01	M.AAUB.Mx.SpaEnc	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T21_D450_S167_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	×	✓	Medium
1121S_FSSB_T21_D500_S025_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T22_D450_S166_A1_S03	M.AAUB.Ro.DeeSpo	Deep-sea sponge aggregations	✓	×	✓	Medium
1121S_FSSB_T22_D500_S026_A1_S01	M.AAUB.Mx.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T24_D450_S165_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	×	✓	Medium
1121S_FSSB_T24_D500_S028_A1_S01	M.AAUB.Mx.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T25_D500_S029_A1_S01	M.AAUB.Co.[UrcCom.CidUrc]	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T26_D450_S164_A1_S05	M.AAUB.Ro.DeeSpo	Deep-sea sponge aggregations	✓	×	✓	Medium
1121S_FSSB_T26_D500_S030_A1_S01	M.AAUB.Co.[UrcCom.CidUrc]	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T27_D450_S163_A1_S02	M.AAUB.Ro.DeeSpo	Deep-sea sponge aggregations	✓	×	✓	Medium
1121S_FSSB_T27_D500_S031_A1_S01	M.AAUB.Mx.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T28_D450_S162_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	×	✓	Medium
1121S_FSSB_T28_D500_S032_A1_S01	M.AAUB.Mx.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T29_D450_S161_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	×	✓	Medium

Video Segment	Rationale for being included in DSSA confidence assessment		Density	Habitat	Function	DSSA Confidence
	Primary Biotope	PMF Habitat				
1121S_FSSB_T29_D500_S033_A1_S01	M.AAUB.Mx.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T30_D500_S034_A1_S01	M.AAUB.Mx.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T31_D450_S160_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	×	✓	Medium
1121S_FSSB_T31_D500_S035_A1_S01	M.AAUB.Mx.[UrcCom.CidUrc]	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T32_D400_S071_A1_S01	M.AAUB.Co.[UrcCom.CidUrc]	Deep-sea sponge aggregations	✓	×	✓	Medium
1121S_FSSB_T32_D500_S036_A1_S01	M.AAUB.Mx.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T33_D450_S158_A1_S01	M.AAUB.Co.[UrcCom.CidUrc]	Deep-sea sponge aggregations	✓	×	✓	Medium
1121S_FSSB_T33_D500_S037_A1_S01	M.AAUB.Mx.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T34_D500_S038_A1_S01	M.AAUB.Mx.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T35_D450_S156_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	×	✓	Medium
1121S_FSSB_T35_D500_S039_A1_S01	M.AAUB.Mx.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T35_D550_S129_A1_S01	M.AAUB.Mx.SpaEnc	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T36_D450_S155_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	×	✓	Medium
1121S_FSSB_T36_D500_S040_A1_S01	M.AAUB.Mx.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T37_D450_S154_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	×	✓	Medium
1121S_FSSB_T37_D500_S041_A1_S01	M.AAUB.Mx.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T38_D450_S153_A1_S01	M.AAUB.Ro.DeeSpo	Deep-sea sponge aggregations	✓	×	✓	Medium

Video Segment	Rationale for being included in DSSA confidence assessment		Density	Habitat	Function	DSSA Confidence
	Primary Biotope	PMF Habitat				
1121S_FSSB_T40_D500_S044_A1_S01	M.AAUB.Mx.SpaEnc	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T41_D500_S045_A1_S01	M.AAUB.Mx.SpaEnc	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T42_D450_S150_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	×	✓	Medium
1121S_FSSB_T43_D450_S149_A1_S01	M.AAUB.Ro.DeeSpo	Deep-sea sponge aggregations	✓	×	✓	Medium
1121S_FSSB_T50_D450_S143_A1_S01	M.AAUB.Co.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High
1121S_FSSB_T23_D500_S027_A1_S01	M.AAUB.Mx.DeeSpo	Deep-sea sponge aggregations	✓	✓	✓	High

Appendix 4

Results of density assessment for all sponge morphologies. Size classes used for this assessment are outlined in brackets. Sponge density results from initial data exploration are also included, grouped by whether segment sponge density exceeded one or more of the density thresholds outlined in section 2.2.1.

DSSA

Video segment	Massive sponge density	Cup sponge density	SACFOR score	Erect sponge density (1–3 cm)	SACFOR score	Erect sponge density (3–15 cm)	SACFOR score	Erect sponge density (> 15 cm)	SACFOR score
1121S_FSSB_T01_D500_S005_A2_S01	1.39	0.00	no	0.00	no	0.20	F	0.82	C
1121S_FSSB_T02_D500_S006_A1_S01	2.13	0.02	O	0.00	no	0.14	F	1.52	A
1121S_FSSB_T02_D550_S099_A1_S01	1.36	0.23	F	0.10	O	0.96	F	0.48	C
1121S_FSSB_T03_D500_S007_A1_S01	0.67	0.02	O	0.00	no	0.13	F	1.85	A
1121S_FSSB_T03_D550_S100_A1_S01	18.21	0.08	O	0.00	no	1.16	C	0.78	C
1121S_FSSB_T04_D500_S008_A1_S01	0.77	0.00	no	0.00	no	0.29	F	1.39	A
1121S_FSSB_T05_D500_S009_A1_S01	0.71	0.02	O	0.00	no	0.16	F	1.65	A
1121S_FSSB_T06_D500_S010_A1_S01	1.07	0.00	no	0.00	no	0.13	F	0.83	C
1121S_FSSB_T06_D550_S103_A1_S01	3.40	0.15	F	0.05	R	0.88	F	0.20	C

Video segment	Massive sponge density	Cup sponge density	SACFOR score	Erect sponge density (1–3 cm)	SACFOR score	Erect sponge density (3–15 cm)	SACFOR score	Erect sponge density (> 15 cm)	SACFOR score
1121S_FSSB_T07_D500_S011_A1_S01	0.75	0.00	no	0.00	no	0.16	F	1.04	A
1121S_FSSB_T07_D550_S104_A1_S01	2.29	0.05	O	0.05	R	0.90	F	0.46	C
1121S_FSSB_T08_D500_S012_A1_S01	1.37	0.07	O	0.00	no	0.19	F	1.62	A
1121S_FSSB_T09_D500_S013_A1_S01	0.34	0.02	O	0.00	no	0.00	no	1.46	A
1121S_FSSB_T10_D500_S014_A1_S01	0.66	0.00	no	0.00	no	0.14	F	0.83	C
1121S_FSSB_T10_D550_S107_A1_S01	3.94	0.10	O	0.00	no	0.94	F	0.57	C
1121S_FSSB_T11_D500_S015_A1_S01	0.56	0.02	O	0.00	no	0.13	F	1.29	A
1121S_FSSB_T11_D550_S108_A1_S01	1.34	0.16	F	0.00	no	0.72	F	0.69	C
1121S_FSSB_T12_D500_S016_A1_S01	0.79	0.00	no	0.00	no	0.06	O	2.17	A
1121S_FSSB_T12_D550_S109_A1_S01	3.55	0.16	F	0.00	no	0.55	F	0.76	C
1121S_FSSB_T13_D500_S017_A1_S01	0.19	0.00	no	0.00	no	0.12	F	1.11	A
1121S_FSSB_T13_D550_S110_A1_S01	0.86	0.16	F	0.00	no	0.24	F	0.37	C

Video segment	Massive sponge density	Cup sponge density	SACFOR score	Erect sponge density (1–3 cm)	SACFOR score	Erect sponge density (3–15 cm)	SACFOR score	Erect sponge density (> 15 cm)	SACFOR score
1121S_FSSB_T14_D500_S018_A1_S01	0.09	0.00	no	0.00	no	0.15	F	0.79	C
1121S_FSSB_T15_D500_S019_A1_S01	0.06	0.00	no	0.00	no	0.12	F	1.13	A
1121S_FSSB_T16_D500_S020_A1_S01	0.16	0.00	no	0.02	R	0.10	O	1.20	A
1121S_FSSB_T16_D550_S113_A1_S01	2.19	0.00	no	0.00	no	0.52	F	0.31	C
1121S_FSSB_T17_D500_S021_A1_S01	0.21	0.00	no	0.00	no	0.17	F	0.99	no
1121S_FSSB_T17_D550_S114_A1_S01	1.86	0.27	F	0.00	no	1.09	C	0.33	C
1121S_FSSB_T18_D500_S022_A1_S01	0.34	0.00	no	0.00	no	0.02	O	1.20	A
1121S_FSSB_T18_D550_S115_A1_S01	2.91	0.03	O	0.00	no	0.54	F	0.31	C
1121S_FSSB_T19_D500_S023_A1_S01	0.61	0.00	no	0.00	no	0.23	F	2.18	A
1121S_FSSB_T19_D550_S116_A1_S01	4.90	0.27	F	0.00	no	0.49	F	0.68	C
1121S_FSSB_T20_D450_S168_A1_S01	0.53	0.00	no	0.00	no	0.02	O	0.19	C
1121S_FSSB_T20_D500_S024_A1_S01	0.42	0.00	no	0.00	no	0.04	O	1.70	A

Video segment	Massive sponge density	Cup sponge density	SACFOR score	Erect sponge density (1–3 cm)	SACFOR score	Erect sponge density (3–15 cm)	SACFOR score	Erect sponge density (> 15 cm)	SACFOR score
1121S_FSSB_T20_D550_S117_A1_S01	5.76	0.22	F	0.00	no	0.77	F	0.93	no
1121S_FSSB_T21_D450_S167_A1_S01	0.05	0.00	no	0.00	no	0.05	O	0.07	F
1121S_FSSB_T21_D500_S025_A1_S01	0.67	0.02	O	0.00	no	0.22	F	1.57	A
1121S_FSSB_T22_D450_S166_A1_S03	0.40	0.00	no	0.00	no	0.00	no	0.47	C
1121S_FSSB_T22_D500_S026_A1_S01	0.57	0.00	no	0.00	no	0.17	F	1.30	A
1121S_FSSB_T23_D500_S027_A1_S01	1.30	0.07	O	0.00	no	0.77	F	1.12	A
1121S_FSSB_T24_D450_S165_A1_S01	0.35	0.00	no	0.00	no	0.03	O	0.35	C
1121S_FSSB_T24_D500_S028_A1_S01	0.26	0.02	O	0.00	no	0.15	F	1.24	A
1121S_FSSB_T25_D500_S029_A1_S01	0.98	0.00	no	0.00	no	0.10	F	1.02	A
1121S_FSSB_T26_D450_S164_A1_S05	0.73	0.00	no	0.00	no	0.11	F	1.12	A
1121S_FSSB_T26_D500_S030_A1_S01	0.54	0.00	no	0.00	no	0.16	F	0.97	no
1121S_FSSB_T27_D450_S163_A1_S02	1.25	0.00	no	0.00	no	0.05	O	1.13	A

Video segment	Massive sponge density	Cup sponge density	SACFOR score	Erect sponge density (1–3 cm)	SACFOR score	Erect sponge density (3–15 cm)	SACFOR score	Erect sponge density (> 15 cm)	SACFOR score
1121S_FSSB_T27_D500_S031_A1_S01	0.63	0.00	no	0.00	no	0.37	F	0.90	no
1121S_FSSB_T28_D450_S162_A1_S01	0.06	0.00	no	0.00	no	0.02	O	0.16	C
1121S_FSSB_T28_D500_S032_A1_S01	0.62	0.05	O	0.00	no	0.19	F	1.29	A
1121S_FSSB_T29_D450_S161_A1_S01	0.00	0.00	no	0.00	no	0.00	no	0.27	C
1121S_FSSB_T29_D500_S033_A1_S01	0.26	0.00	no	0.00	no	0.02	O	0.75	C
1121S_FSSB_T30_D500_S034_A1_S01	0.14	0.02	O	0.00	no	0.26	F	1.12	A
1121S_FSSB_T31_D450_S160_A1_S01	0.22	0.02	O	0.00	no	0.06	O	0.70	C
1121S_FSSB_T31_D500_S035_A1_S01	0.45	0.02	O	0.00	no	0.34	F	1.06	A
1121S_FSSB_T32_D400_S071_A1_S01	0.02	0.00	no	0.00	no	0.00	no	0.21	C
1121S_FSSB_T32_D500_S036_A1_S01	0.15	0.02	O	0.00	no	0.53	F	1.27	A
1121S_FSSB_T33_D450_S158_A1_S01	0.02	0.00	no	0.00	no	0.00	no	0.24	C
1121S_FSSB_T33_D500_S037_A1_S01	0.89	0.04	O	0.00	no	0.58	F	1.26	A

Video segment	Massive sponge density	Cup sponge density	SACFOR score	Erect sponge density (1–3 cm)	SACFOR score	Erect sponge density (3–15 cm)	SACFOR score	Erect sponge density (> 15 cm)	SACFOR score
1121S_FSSB_T34_D500_S038_A1_S01	0.29	0.02	O	0.00	no	0.04	O	1.24	A
1121S_FSSB_T35_D450_S156_A1_S01	0.13	0.00	no	0.00	no	0.00	no	0.44	C
1121S_FSSB_T35_D500_S039_A1_S01	0.54	0.00	no	0.00	no	0.07	O	1.24	A
1121S_FSSB_T35_D550_S129_A1_S01	3.80	0.02	O	0.00	no	0.13	F	0.02	F
1121S_FSSB_T36_D450_S155_A1_S01	0.05	0.00	no	0.00	no	0.03	O	0.55	C
1121S_FSSB_T36_D500_S040_A1_S01	0.29	0.00	no	0.00	no	0.08	O	1.42	A
1121S_FSSB_T37_D450_S154_A1_S01	0.02	0.00	no	0.00	no	0.02	O	0.30	C
1121S_FSSB_T37_D500_S041_A1_S01	0.38	0.02	O	0.00	no	0.30	F	0.84	C
1121S_FSSB_T38_D450_S153_A1_S01	0.15	0.00	no	0.00	no	0.03	O	1.16	A
1121S_FSSB_T40_D500_S044_A1_S01	2.08	0.00	no	0.02	R	0.09	O	0.28	C
1121S_FSSB_T41_D500_S045_A1_S01	2.49	0.00	no	0.00	no	0.17	F	0.62	C
1121S_FSSB_T42_D450_S150_A1_S01	0.05	0.00	no	0.00	no	0.23	F	0.15	C

Video segment	Massive sponge density	Cup sponge density	SACFOR score	Erect sponge density (1–3 cm)	SACFOR score	Erect sponge density (3–15 cm)	SACFOR score	Erect sponge density (> 15 cm)	SACFOR score
1121S_FSSB_T43_D450_S149_A1_S01	0.34	0.00	no	0.00	no	0.02	O	0.52	C
1121S_FSSB_T50_D450_S143_A1_S01	1.36	0.03	O	0.00	no	0.10	F	0.78	C

Not suspected deep-sea sponge aggregations and no density thresholds exceeded

Video segment	Massive sponge density	Cup sponge density	SACFOR score	Erect sponge density (1–3 cm)	SACFOR score	Erect sponge density (3–15 cm)	SACFOR score	Erect sponge density (> 15 cm)	SACFOR score
1121S_FSSB_T06_D400_S092_A1_S01	0.03	0.00	no	0.00	no	0.00	no	0.00	no
1121S_FSSB_T11_D400_S088_A1_S01	0.10	0.00	no	0.00	no	0.00	no	0.00	no
1121S_FSSB_T12_D400_S087_A1_S01	0.03	0.00	no	0.00	no	0.00	no	0.00	no
1121S_FSSB_T13_D400_S086_A1_S01	0.15	0.00	no	0.00	no	0.00	no	0.00	no
1121S_FSSB_T14_D400_S085_A1_S01	0.04	0.00	no	0.00	no	0.00	no	0.00	no
1121S_FSSB_T15_D400_S084_A1_S01	0.00	0.00	no	0.00	no	0.00	no	0.00	no
1121S_FSSB_T36_D400_S067_A1_S01	0.44	0.00	no	0.00	no	0.02	O	0.00	no

Video segment	Massive sponge density	Cup sponge density	SACFOR score	Erect sponge density (1–3 cm)	SACFOR score	Erect sponge density (3–15 cm)	SACFOR score	Erect sponge density (> 15 cm)	SACFOR score
1121S_FSSB_T44_D400_S060_A1_S01	0.14	0.00	no	0.00	no	0.00	no	0.00	no
1121S_FSSB_T46_D550_S139_A1_S01	0.34	0.00	no	0.00	no	0.00	no	0.00	no
1121S_FSSB_T47_D400_S057_A1_S01	0.21	0.00	no	0.00	no	0.02	O	0.00	no
1121S_FSSB_T47_D550_S140_A1_S01	0.33	0.00	no	0.00	no	0.03	O	0.00	no
1121S_FSSB_T49_D500_S053_A1_S01	0.22	0.00	no	0.00	no	0.00	no	0.00	no

Not suspected deep-sea sponge aggregations but density threshold met in one or more sponge morphologies

Video segment	Massive sponge density	Cup sponge density	SACFOR score	Erect sponge density (1–3 cm)	SACFOR score	Erect sponge density (3–15 cm)	SACFOR score	Erect sponge density (> 15 cm)	SACFOR score
1121S_FSSB_T01_D400_S097_A1_S01	0.13	0.00	no	0.00	no	0.00	no	0.02	F
1121S_FSSB_T01_D450_S186_A1_S01	0.17	0.00	no	0.00	no	0.00	no	0.21	C
1121S_FSSB_T01_D550_S098_A1_S01	5.80	0.07	O	0.02	R	1.22	C	0.10	F
1121S_FSSB_T02_D400_S096_A1_S01	0.08	0.00	no	0.00	no	0.00	no	0.12	C

Video segment	Massive sponge density	Cup sponge density	SACFOR score	Erect sponge density (1–3 cm)	SACFOR score	Erect sponge density (3–15 cm)	SACFOR score	Erect sponge density (> 15 cm)	SACFOR score
1121S_FSSB_T02_D450_S185_A1_S01	0.10	0.00	no	0.00	no	0.00	no	0.13	C
1121S_FSSB_T03_D400_S095_A1_S01	0.07	0.00	no	0.00	no	0.02	O	0.04	F
1121S_FSSB_T03_D450_S184_A1_S01	0.08	0.00	no	0.00	no	0.03	O	0.33	C
1121S_FSSB_T04_D400_S094_A1_S01	0.06	0.00	no	0.00	no	0.04	O	0.02	F
1121S_FSSB_T04_D450_S183_A1_S01	0.11	0.00	no	0.00	no	0.13	F	0.27	C
1121S_FSSB_T04_D550_S101_A1_S01	3.08	0.00	no	0.00	no	0.55	F	0.37	C
1121S_FSSB_T05_D400_S093_A1_S01	0.00	0.00	no	0.00	no	0.00	no	0.04	F
1121S_FSSB_T05_D450_S182_A2_S01	0.07	0.00	no	0.00	no	0.00	no	0.29	C
1121S_FSSB_T05_D550_S102_A1_S01	1.34	0.00	no	0.02	R	0.99	F	0.59	C
1121S_FSSB_T06_D450_S181_A2_S01	0.05	0.00	no	0.00	no	0.00	no	0.12	C
1121S_FSSB_T07_D450_S180_A1_S01	0.11	0.00	no	0.00	no	0.00	no	0.13	C
1121S_FSSB_T08_D400_S091_A1_S01	0.06	0.00	no	0.00	no	0.04	O	0.02	F

Video segment	Massive sponge density	Cup sponge density	SACFOR score	Erect sponge density (1–3 cm)	SACFOR score	Erect sponge density (3–15 cm)	SACFOR score	Erect sponge density (> 15 cm)	SACFOR score
1121S_FSSB_T08_D450_S179_A1_S01	0.12	0.00	no	0.00	no	0.05	O	0.19	C
1121S_FSSB_T08_D550_S105_A1_S01	2.15	0.00	no	0.10	O	0.60	F	0.40	C
1121S_FSSB_T09_D400_S090_A1_S01	0.07	0.00	no	0.00	no	0.02	O	0.02	F
1121S_FSSB_T09_D450_S178_A2_S01	0.02	0.00	no	0.00	no	0.00	no	0.09	F
1121S_FSSB_T09_D550_S106_A1_S01	4.50	0.08	O	0.00	no	0.18	F	0.69	C
1121S_FSSB_T10_D400_S089_A1_S01	0.00	0.00	no	0.00	no	0.00	no	0.03	F
1121S_FSSB_T10_D450_S177_A1_S01	0.05	0.00	no	0.00	no	0.02	O	0.12	C
1121S_FSSB_T11_D450_S176_A1_S01	0.00	0.00	no	0.00	no	0.03	O	0.13	C
1121S_FSSB_T12_D450_S175_A1_S01	0.05	0.00	no	0.00	no	0.00	no	0.35	C
1121S_FSSB_T13_D450_S174_A1_S01	0.03	0.00	no	0.00	no	0.00	no	0.03	F
1121S_FSSB_T14_D450_S173_A1_S01	0.04	0.00	no	0.00	no	0.00	no	0.02	F
1121S_FSSB_T14_D550_S111_A1_S01	0.42	0.08	O	0.00	no	0.36	F	0.06	F

Video segment	Massive sponge density	Cup sponge density	SACFOR score	Erect sponge density (1–3 cm)	SACFOR score	Erect sponge density (3–15 cm)	SACFOR score	Erect sponge density (> 15 cm)	SACFOR score
1121S_FSSB_T15_D450_S172_A1_S01	0.02	0.00	no	0.00	no	0.00	no	0.10	F
1121S_FSSB_T15_D550_S112_A1_S01	0.94	0.08	O	0.00	no	0.71	F	0.23	C
1121S_FSSB_T16_D450_S171_A1_S01	0.00	0.00	no	0.00	no	0.00	no	0.06	F
1121S_FSSB_T17_D400_S083_A1_S01	0.02	0.00	no	0.00	no	0.02	O	0.06	F
1121S_FSSB_T17_D450_S170_A1_S01	0.04	0.00	no	0.00	no	0.06	O	0.24	C
1121S_FSSB_T18_D400_S082_A1_S01	0.02	0.00	no	0.00	no	0.02	O	0.02	F
1121S_FSSB_T19_D400_S081_A1_S01	0.13	0.00	no	0.00	no	0.02	O	0.02	F
1121S_FSSB_T19_D450_S169_A1_S01	0.22	0.00	no	0.00	no	0.00	no	0.39	C
1121S_FSSB_T20_D400_S080_A1_S01	0.13	0.00	no	0.00	no	0.00	no	0.04	F
1121S_FSSB_T21_D400_S079_A1_S01	0.07	0.00	no	0.00	no	0.00	no	0.02	F
1121S_FSSB_T21_D550_S118_A1_S01	0.70	0.05	O	0.00	no	0.02	O	0.42	C
1121S_FSSB_T22_D400_S078_A1_S01	0.58	0.00	no	0.00	no	0.00	no	0.17	C

Video segment	Massive sponge density	Cup sponge density	SACFOR score	Erect sponge density (1–3 cm)	SACFOR score	Erect sponge density (3–15 cm)	SACFOR score	Erect sponge density (> 15 cm)	SACFOR score
1121S_FSSB_T22_D550_S119_A1_S01	0.96	0.00	no	0.00	no	0.10	O	0.12	C
1121S_FSSB_T24_D400_S077_A2_S01	0.00	0.00	no	0.00	no	0.02	O	0.02	F
1121S_FSSB_T24_D550_S120_A1_S01	0.03	0.00	no	0.00	no	0.05	O	0.10	C
1121S_FSSB_T26_D400_S076_A1_S01	0.07	0.00	no	0.00	no	0.05	O	0.05	F
1121S_FSSB_T26_D550_S121_A1_S01	0.31	0.02	O	0.00	no	0.07	O	0.07	F
1121S_FSSB_T27_D400_S075_A1_S01	0.07	0.00	no	0.00	no	0.00	no	0.24	C
1121S_FSSB_T27_D550_S122_A1_S01	0.19	0.00	no	0.00	no	0.23	F	0.04	F
1121S_FSSB_T28_D400_S074_A1_S01	0.08	0.00	no	0.00	no	0.00	no	0.19	C
1121S_FSSB_T28_D550_S123_A1_S01	0.24	0.02	O	0.00	no	0.20	F	0.06	F
1121S_FSSB_T29_D400_S073_A1_S01	0.02	0.00	no	0.00	no	0.00	no	0.02	F
1121S_FSSB_T29_D550_S124_A1_S01	0.00	0.00	no	0.00	no	0.21	F	0.06	F
1121S_FSSB_T31_D400_S072_A1_S01	0.04	0.00	no	0.00	no	0.00	no	0.11	C

Video segment	Massive sponge density	Cup sponge density	SACFOR score	Erect sponge density (1–3 cm)	SACFOR score	Erect sponge density (3–15 cm)	SACFOR score	Erect sponge density (> 15 cm)	SACFOR score
1121S_FSSB_T31_D550_S125_A1_S01	0.22	0.00	no	0.00	no	0.30	F	0.04	F
1121S_FSSB_T32_D450_S159_A1_S01	0.02	0.00	no	0.00	no	0.02	O	0.04	F
1121S_FSSB_T32_D550_S126_A1_S01	1.00	0.00	no	0.00	no	0.14	F	0.02	F
1121S_FSSB_T33_D400_S070_A1_S01	0.10	0.00	no	0.00	no	0.02	O	0.10	C
1121S_FSSB_T33_D550_S127_A1_S01	1.67	0.05	O	0.00	no	0.42	F	0.03	F
1121S_FSSB_T34_D400_S069_A1_S01	0.05	0.00	no	0.00	no	0.00	no	0.12	C
1121S_FSSB_T34_D450_S157_A1_S01	0.06	0.00	no	0.00	no	0.00	no	0.32	C
1121S_FSSB_T34_D550_S128_A1_S01	3.84	0.04	O	0.00	no	0.06	O	0.06	F
1121S_FSSB_T35_D400_S068_A1_S01	0.35	0.00	no	0.00	no	0.00	no	0.28	C
1121S_FSSB_T36_D550_S130_A1_S01	0.80	0.00	no	0.00	no	0.06	O	0.00	no
1121S_FSSB_T37_D400_S066_A1_S01	0.04	0.00	no	0.00	no	0.00	no	0.02	F
1121S_FSSB_T37_D550_S131_A1_S01	0.36	0.00	no	0.02	R	0.14	F	0.12	C

Video segment	Massive sponge density	Cup sponge density	SACFOR score	Erect sponge density (1–3 cm)	SACFOR score	Erect sponge density (3–15 cm)	SACFOR score	Erect sponge density (> 15 cm)	SACFOR score
1121S_FSSB_T38_D400_S065_A1_S01	0.65	0.00	no	0.00	no	0.00	no	0.18	C
1121S_FSSB_T38_D500_S042_A1_S01	0.04	0.00	no	0.00	no	0.00	no	0.49	C
1121S_FSSB_T38_D550_S132_A1_S01	0.34	0.00	no	0.00	no	0.00	no	0.02	F
1121S_FSSB_T39_D500_S043_A1_S01	0.21	0.00	no	0.00	no	0.06	O	0.34	C
1121S_FSSB_T40_D400_S064_A1_S01	0.12	0.00	no	0.00	no	0.05	O	0.05	F
1121S_FSSB_T40_D450_S152_A1_S01	0.05	0.00	no	0.00	no	0.05	O	0.14	C
1121S_FSSB_T40_D550_S133_A1_S01	0.78	0.00	no	0.00	no	0.22	F	0.00	no
1121S_FSSB_T41_D400_S063_A1_S01	0.02	0.00	no	0.00	no	0.00	no	0.03	F
1121S_FSSB_T41_D450_S151_A1_S01	0.02	0.00	no	0.00	no	0.00	no	0.12	C
1121S_FSSB_T41_D550_S134_A1_S01	0.86	0.00	no	0.00	no	0.06	O	0.04	F
1121S_FSSB_T42_D400_S062_A1_S01	0.03	0.00	no	0.00	no	0.00	no	0.07	F
1121S_FSSB_T42_D500_S046_A1_S01	0.28	0.00	no	0.00	no	0.02	O	0.22	C

Video segment	Massive sponge density	Cup sponge density	SACFOR score	Erect sponge density (1–3 cm)	SACFOR score	Erect sponge density (3–15 cm)	SACFOR score	Erect sponge density (> 15 cm)	SACFOR score
1121S_FSSB_T42_D550_S135_A1_S01	0.95	0.00	no	0.00	no	0.06	O	0.03	F
1121S_FSSB_T43_D400_S061_A1_S01	0.37	0.00	no	0.00	no	0.00	no	0.16	C
1121S_FSSB_T43_D500_S047_A1_S01	0.34	0.00	no	0.04	R	0.00	no	0.09	F
1121S_FSSB_T43_D550_S136_A1_S01	2.80	0.00	no	0.00	no	0.05	O	0.00	no
1121S_FSSB_T44_D450_S148_A1_S01	0.02	0.00	no	0.00	no	0.00	no	0.35	C
1121S_FSSB_T44_D500_S048_A1_S01	2.93	0.00	no	0.00	no	0.02	O	0.14	C
1121S_FSSB_T44_D550_S137_A1_S01	0.36	0.00	no	0.00	no	0.03	O	0.03	F
1121S_FSSB_T45_D400_S059_A1_S01	0.59	0.00	no	0.00	no	0.00	no	0.02	F
1121S_FSSB_T45_D450_S147_A1_S01	0.19	0.00	no	0.00	no	0.02	O	0.51	C
1121S_FSSB_T45_D500_S049_A1_S01	4.60	0.00	no	0.06	R	0.06	O	0.19	C
1121S_FSSB_T45_D550_S138_A1_S01	0.48	0.00	no	0.00	no	0.00	no	0.03	F
1121S_FSSB_T46_D400_S058_A1_S01	0.37	0.00	no	0.00	no	0.02	O	0.04	F

Video segment	Massive sponge density	Cup sponge density	SACFOR score	Erect sponge density (1–3 cm)	SACFOR score	Erect sponge density (3–15 cm)	SACFOR score	Erect sponge density (> 15 cm)	SACFOR score
1121S_FSSB_T46_D450_S146_A1_S01	1.13	0.00	no	0.00	no	0.05	O	0.34	C
1121S_FSSB_T46_D500_S050_A1_S01	2.98	0.00	no	0.00	no	0.06	O	0.30	C
1121S_FSSB_T47_D450_S145_A1_S01	0.09	0.00	no	0.00	no	0.00	no	0.22	C
1121S_FSSB_T47_D500_S051_A1_S01	1.85	0.00	no	0.00	no	0.08	O	0.08	F
1121S_FSSB_T48_D400_S056_A1_S01	0.31	0.00	no	0.00	no	0.00	no	0.09	F
1121S_FSSB_T48_D450_S144_A2_S01	0.84	0.00	no	0.00	no	0.00	no	0.23	C
1121S_FSSB_T48_D500_S052_A1_S01	2.41	0.00	no	0.00	no	0.00	no	0.08	F
1121S_FSSB_T48_D550_S141_A1_S01	0.43	0.00	no	0.00	no	0.00	no	0.07	F
1121S_FSSB_T50_D400_S055_A1_S01	0.45	0.00	no	0.00	no	0.00	no	0.02	F
1121S_FSSB_T50_D500_S054_A2_S01	1.75	0.00	no	0.00	no	0.00	no	0.03	F
1121S_FSSB_T50_D550_S142_A1_S01	0.52	0.00	no	0.00	no	0.10	O	0.05	F

Appendix 5

Full list of characterising taxa identified during SIMPER analysis for the 12 cluster groups across FSSB.

Cluster Group	Taxa
A	Halcampa_OTU3 Halcampa_OTU126 Serpulidae_OTU106 Anomiidae_OTU32 Serpulidae_OTU228 Chaetopteridae_OTU247 Cidaris cidaris_OTU211 Ophiactis balli_OTU246 Gastropoda_FSC65 Munida sarsi_OTU200 Brachiopoda_OTU34 Serpulidae_OTU275 Polychaeta_FSC3 Ophiuroidea_FSC57
B	Halcampa_OTU3 Serpulidae_OTU106 Anomiidae_OTU32 Serpulidae_OTU228 Munida sarsi_OTU200 Polychaeta_OTU362 Ophiactis balli_OTU246 Ophiuroidea_OTU26 Cidaris cidaris_OTU211 Pandalidae_FSC12 Gastropoda_FSC65 Serpulidae_OTU275
C	< 2 SAMPLES

Cluster Group	Taxa
D	Decapoda_FSC11 Ophiuroidea_FSC58 Ophiuroidea_OTU26 Pycnogonida_OTU161 Ophiuroidea_OTU70 Boreonymphon_OTU130 Polyplacophora_OTU33 Munida sarsi_OTU200 Actiniaria_FSC34 Paguridae_OTU205 Ascidiacea_FSC22 Brachiopoda_OTU34 Gastropoda_FSC65 Porifera_OTU392_Massive
E	Ophiuroidea_FSC58 Ophiactis abyssicola_OTU100 Serpulidae_OTU106 Polyplacophora_OTU33 Ophiuroidea_OTU26 Ophiuroidea_OTU70 Polychaeta_OTU913 Reteporella_OTU204 Decapoda_FSC11 Serpulidae_OTU228 Pycnogonida_OTU161 Gastropoda_FSC65 Ascidiacea_FSC22 Ophiuroidea_OTU60 Ophiuroidea_FSC55 Boreonymphon_OTU130 Porifera_UNID_Massive Porifera_FSC95_Massive Actiniaria_FSC33 Paguridae_OTU205 Brachiopoda_OTU34 Porifera_OTU422b_Erect
F	< 2 SAMPLES

Cluster Group	Taxa
G	Ophiuroidea_FSC58 Ophiuroidea_OTU26 Decapoda_FSC11 Polyplacophora_OTU33 Ophiuroidea_OTU70 Ophiactis abyssicola_OTU100 Pycnogonida_OTU161 Boreonymphon_OTU130 Thalassometra lusitanica_OTU131 Ophiuroidea_FSC55 Actiniaria_FSC34 Reteporella_OTU204 Munida sarsi_OTU200 Gastropoda_FSC65 Epimeria (Epimeria) loricata_OTU393 Actiniaria_FSC33 Echinus_OTU194 Porifera_FSC95_Massive Porifera_FSC84_Massive
H	Serpulidae_OTU106 Halcampa_OTU3 Serpulidae_OTU228 Gastropoda_FSC65 Munida sarsi_OTU200 Porifera_OTU75_Massive Brachiopoda_OTU34 Cidaris cidaris_OTU211 Ophiactis balli_OTU246 Anomiidae_OTU32 Serpulidae_OTU275 Ophiuroidea_FSC57 Porifera_OTU422_Erect Thalassometra lusitanica_OTU131 Polychaeta_FSC3 Chaetopteridae_OTU247 Porifera_UNID_Massive Ophiuroidea_FSC55 Caryophyllia_OTU37 Henricia_OTU208

Cluster Group	Taxa
I	Munida sarsi_OTU200 Ophiactis abyssicola_OTU100 Ophiuroidea_OTU376 Serpulidae_OTU106 Porifera_OTU422_Erect Serpulidae_OTU228 Polyplacophora_OTU33 Ophiuroidea_OTU329 Brachiopoda_OTU34 Gastropoda_FSC65 Cidaris cidaris_OTU211 Pliobothrus_OTU207 Chaetopteridae_OTU247 Pandalus borealis_OTU57 Porifera_OTU181_Erect Pycnogonida_OTU161 Porifera_UNID_Massive Parastichopus tremulus_OTU266 Anomiidae_OTU32 Caryophyllia_OTU37 Serpulidae_OTU275 Echinus_OTU194 Porifera_OTU5_Massive Annelida_FSC5 Decapoda_FSC11 Halcampa_OTU3 Ophiuroidea_FSC57 Paguridae_OTU205 Porifera_FSC81_Erect Ophiuroidea_OTU26

Cluster Group	Taxa
J	Serpulidae_OTU106 Ophiactis abyssicola_OTU100 Polychaeta_OTU913 Reteporella_OTU204 Munida sarsi_OTU200 Polyplacophora_OTU33 Gastropoda_FSC65 Porifera_FSC95_Massive Porifera_OTU422_Erect Porifera_OTU81_Erect Decapoda_FSC11 Serpulidae_OTU228 Porifera_UNID_Massive Pycnogonida_OTU161 Ophiuroidea_OTU376 Echinus_OTU194 Ascidiacea_OTU8 Porifera_OTU75_Massive Porifera_FSC87_Massive Velatida_OTU199 Ascidiacea_FSC22 Pandalus borealis_OTU57 Porifera_OTU422b_Erect Porifera_FSC86_Massive Parastichopus tremulus_OTU266 Nephtheidae_FSC39 Paguridae_OTU205 Majidae_OTU11 Ophiuroidea_OTU70 Ceramaster granularis_OTU388 Porifera_OTU1156_Massive Porifera_FSC83_Erect_3-15cN Boreonymphon_OTU130 Porifera_FSC78_Cuplike_3-15cm

Cluster Group	Taxa
K	Gastropoda_FSC65
	Thalassometra lusitanica_OTU131
	Serpulidae_OTU106
	Porifera_OTU387_Massive_1-3cm
	Brachiopoda_OTU34
	Munida sarsi_OTU200
	Ophiuroidea_FSC55
	Ophiuroidea_OTU70
	Porifera_FSC84_Massive_<3cm
	Chaetopteridae_OTU247
	Polychaeta_FSC3
	Pycnogonida_OTU161
	Porifera_OTU602_Massive_3-15cm
	Decapoda_FSC11
	Nephtheidae_FSC39_Coral_1-3cm
	Serpulidae_OTU228
	Majidae_OTU11

Cluster Group	Taxa
L	Halcampa_OTU126 Gastropoda_FSC65 Polychaeta_OTU913 Brachiopoda_OTU34 Serpulidae_OTU106 Munida sarsi_OTU200 Thalassometra lusitanica_OTU131 Polyplacophora_OTU33 Porifera_OTU387_Massive_1-3cm Serpulidae_OTU228 Ophiuroidea_OTU376 Echinus_OTU194 Ophiuroidea_OTU70 Reteporella_OTU204 Polychaeta_FSC3 Ophiuroidea_FSC55 Ophiactis abyssicola_OTU100 Nephtheidae_FSC39_Coral_1-3cm Porifera_OTU422_Erect_>15cm Majidae_OTU11 Pycnogonida_OTU161 Parastichopus tremulus_OTU266 Decapoda_FSC11 Anomiidae_OTU32 Porifera_FSC84_Massive_<3cm Holothuroidea_FSC54 Chaetopteridae_OTU247 Caryophyllia_OTU37_Coral_3-15cm Ophiuroidea_FSC57

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