Lands End and Cape Bank Special Area of Conservation

Condition Monitoring Survey 2018

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Executive summary

Special Areas of Conservation are (SACs) are designated under the EU Habitats Directive for a range of species and habitats. Under Article 17 of the Directive, Statutory Nature Conservation Bodies (SNCBs) must report on the implementation of the Directive every six years. To inform this, SNCBs undertake a programme of SAC monitoring. To fulfil its obligations, the Department for Environment, Farming and Rural Affairs (Defra) has directed the SNCBs to carry out a programme of Marine Protected Area (MPA) monitoring. Where possible, this monitoring will also inform assessment of the status of the wider UK marine environment, for example, assessment of whether Good Environmental Status (GES) has been achieved, as required under Article 11 of the Marine Strategy Framework Directive (MSFD) and enshrined into UK law under the UK Marine Strategy (UKMS).

Natural England is the SNCB responsible for marine nature conservation between 0 and 12 nm from the coast. SNCBs utilise evidence gathered by targeted environmental and ecological surveys and site specific MPA reports in conjunction with other evidence (including information on activities, pressures, historical data, and survey data collected by other organisations and to meet different obligations). These data are collectively used by SNCBs to assess the condition of designated features within sites, to inform and maintain up to date, site specific conservation advice and produce advice on operations and management measures for anthropogenic activities occurring within the site. This report in itself does not aim to assess the condition of the designated features or provide advice on the management of anthropogenic activities occurring within the site.

This document explores environmental and ecological data acquired from a drop-down camera survey of the nearshore extent of Lands End and Cape Bank SAC in 2018. This report will inform a later condition assessment and management activities for this site. The report compares the features of the SAC in 2018 with those recorded in previous surveys.

Lands End and Cape Bank SAC lies to the west of Lands End and extends to almost 22 km from the coast, covering an area of over 30,000 ha. The site is characterised by diverse rocky reef habitats. Within Lands End and Cape Bank SAC, Annex I reef features are designated for protection.

In 2018, Annex I reef habitats were identified in over half of the images captured and these were widespread throughout the SAC. There was no indication that the extents of these features had changed in comparison with previous years' data. There was no evidence that there had been significant changes in the biotopes, notable species or ecological function and structure within the SAC.

A number of recommendations for future surveying, interpretation and assessment of the SAC are provided. These include aiming to maximise the resolution at which habitats and species are recorded, bespoke surveys aimed at quantifying the extents of designated

features and subfeatures and the identification of key structural and functional taxa in future monitoring.

Contents

1. Introduction

Lands End and Cape Bank Special Area of Conservation (SAC) is part of a network of UK national sites designed to meet conservation objectives under the Conservation of Habitats and Species Regulations 2017 (as amended following the UK's withdrawal from the European Union). These sites are intended to contribute to an ecologically coherent network of Marine Protected Areas (MPAs) across the North East Atlantic, as agreed under the Oslo Paris (OSPAR) Convention and other international commitments to which the UK is a signatory.

Every six years, the UK is required to report on the conservation status of habitats and species listed under Annexes I, II, IV and V of the European Council Directive 92/43/EEC, known as the Habitats Directive. In order to fulfil its obligations, the Department for Environment, Farming and Rural Affairs (Defra) has directed the Statutory Nature Conservation Bodies (SNCBs) to carry out a programme of MPA monitoring. The SNCB responsible for nature conservation in inshore waters (between 0 nm and 12 nm from the coast) is Natural England (NE). Where possible, it is intended that this monitoring will also inform assessment of the status of the wider UK marine environment; for example, assessment of whether Good Environmental Status (GES) has been achieved, as required under Article 11 of the Marine Strategy Framework Directive (MSFD) and enshrined into UK law under the UK Marine Strategy (UKMS).

This monitoring report primarily explores data acquired from the 2018 post-designation monitoring survey of the near-shore section ('Lands End section') of Lands End and Cape Bank SAC. The specific aims of the report are detailed in Section 1.3.

This report does not aim to assess the condition of the designated features of the SAC. Instead, the SNCBs use the evidence provided in this report and other sources to make assessments on the condition of designated features within an MPA. The preliminary condition assessments summarised in Section 4.6 are therefore indicative only.

1.1 Site overview

Lands End and Cape Bank SAC lies to the west of Lands End and extends to almost 22 km from the coast (Figure 1). The SAC covers an area of over 30,000 ha. The rocky reef system is almost entirely composed of granite and in the coastal margin stretches for approximately 25 km along the coast. Coastal reef areas in the southern part of the SAC in particular are notable for their topographic complexity and an associated high degree of biological and biotope diversity.

The coastal region of Land's End is characterised by tide-swept kelp forests and sparse kelp parks of *Laminaria hyperborea* with a lower layer of dense foliose red, green, and brown algae including *Dictyopteris polypodioides*, *Palmaria palmata*, *Delesseria sanguinea* and *Drachiella spectabilis*, in the infralittoral zone. The spiny sea star *Marthasterias glacialis* is the most conspicuous member of the epifauna in this zone, although a diverse assemblage of encrusting fauna, including ascidians *Stolonica socialis*, jewel anemones *Corynactis viridis*, and soft corals, such as dead-man's fingers *Alcyonium digitatum*, are also present (Axelsson and Dewey, 2011).

Previous reports (Birchenough *et al*., 2008; Axelsson and Dewey, 2011) and the Regulation 35 conservation advice documentation (Reg. 35) (Natural England, 2012) identified a number of key species and biotopes for the coastal area of the SAC. Key species include *Alcyonium glomeratum, Eunicella verrucosa, C. viridis, Pentapora foliacea* (previously recorded as *P. fascialis*)*,* and *S. socialis*. The full list of key taxa is recorded in Table 19 (Appendix 1 Supporting data). In addition, the presence of a number of 'vulnerable' taxa was also highlighted. These were flagged as being potentially sensitive to disturbance and included branching sponges (e.g., *Raspailia* spp.), bryozoans (e.g., *Cellaria* spp.), and large hydroids (e.g., *Nemertesia* spp.).

A number of key biotopes were also recorded as a result of previous monitoring and these were summarised in the Reg. 35 documentation (Natural England, 2012). Biotopes were split between high energy infralittoral rock biotopes and high and moderate energy circalittoral rock biotopes. The identity of these biotopes highlights that the coastal area of Lands End and Cape Bank SAC is characterised by sessile faunal assemblages in a typically high energy, tide swept environment. The full list of key biotopes is recorded in Table 20 (Appendix 1 Supporting data).

Historically, there has been evidence of seasonal fishing activity (i.e., static fishing gear), but no evidence of habitat damage as a result of human activity or pressures has been recorded (Axelsson and Dewey, 2011).

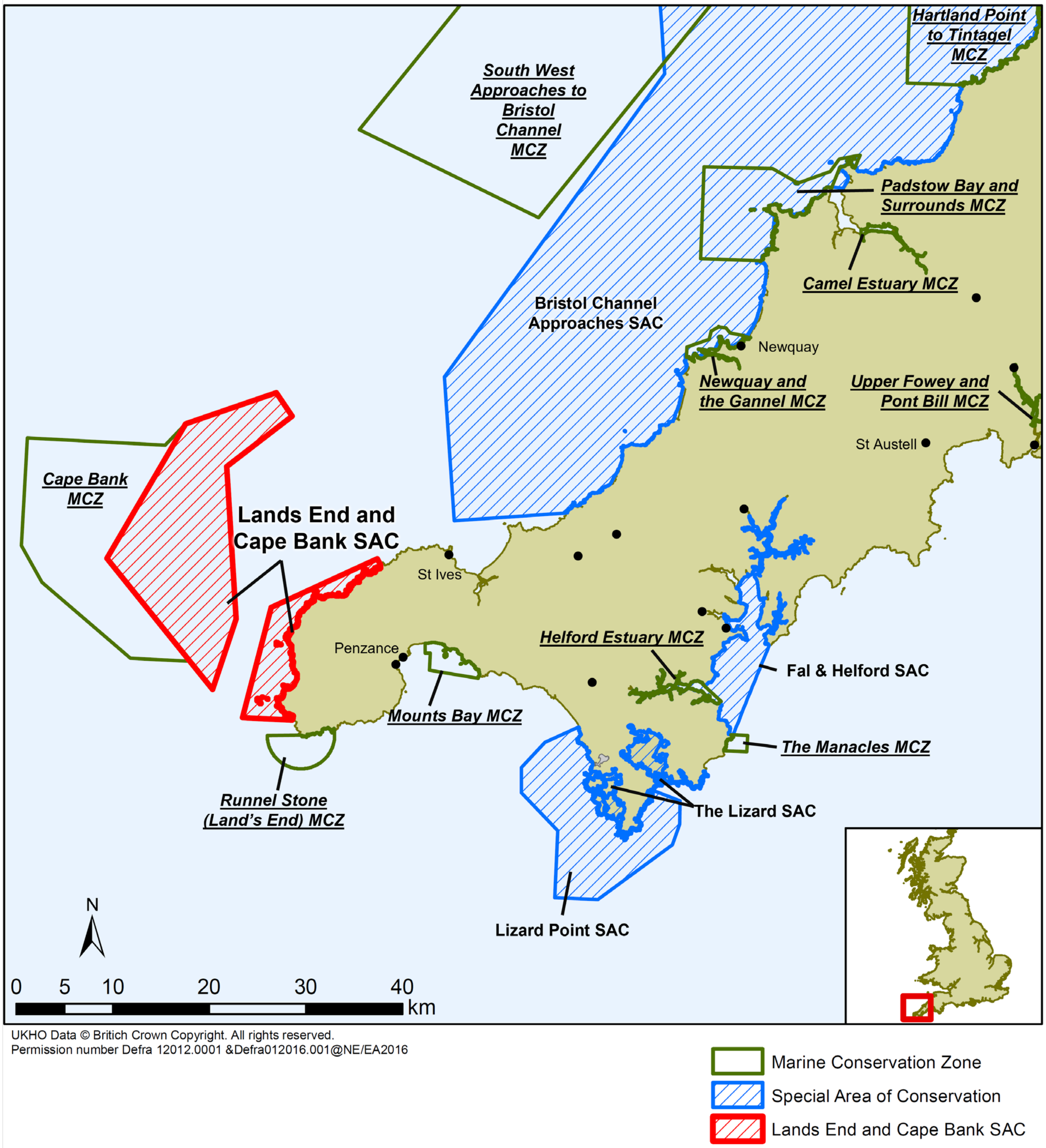


Figure 1. Location of Lands End and Cape Bank Special Area of Conservations (SAC). Nearby SACs (names in bold font) and Marine Conservation Zones (underlined) are highlighted. This report focusses on monitoring work conducted in the inshore Lands End section of the SAC.

1.2 Existing data

Comparisons will be made between the 2018 monitoring data and baseline data gathered in August 2010. Baseline data were gathered by SeaStar Survey Ltd using a drop down camera survey (Axelsson and Dewey 2011). Thirteen tow lines were surveyed within Lands End section of Lands End and Cape Bank SAC, representing a total tow length of

48.0 km. These surveys gathered and analysed a total of 353 images and 53 video segments within Lands End and Cape Bank SAC (Table 1). High and moderate energy circalittoral rock habitats were recorded throughout the SAC. Infralittoral rocks were more commonly recorded at shallower stations in the central and southern areas of the survey zone. Rocky habitats were interspersed with patches of sediment habitat (Figure 2). The data gathered in 2010 provide a baseline against which change can be compared in the 2017-18 data. The 2010 survey also included surveys of the Cape Bank section of the SAC conducted by Cefas. This area was not surveyed in 2018 and so the Cape Bank section of the SAC is not considered further here.

Table 1. Number (and percentage) of still images and video segments assigned to broadscale habitats (BSHs) for the 2010 Lands End and Cape Bank SAC survey (Axelsson and Dewey 2011). BSHs in bold are those habitats associated with Annex I Reefs, the designated feature for Lands End and Cape Bank SAC.

Broadscale Habitat	Still images	Video segments
A3.1 - High Energy Infralittoral Rock	**18 (13.6%)**	**4 (7.3%)**
A4.1 - High Energy Circalittoral Rock	**135 (38.2%)**	**13 (23.6%)**
A4.2 - Moderate Energy Circalittoral Rock	**32 (9.1%)**	**-**
A5.1 - Subtidal Coarse Sediment*	136 (38.5%)	38 (69.1%)
Not assigned	2 (0.6%)	-

*Sediment BSHs were inferred from visual clues, with no samples taken for ground-truthing

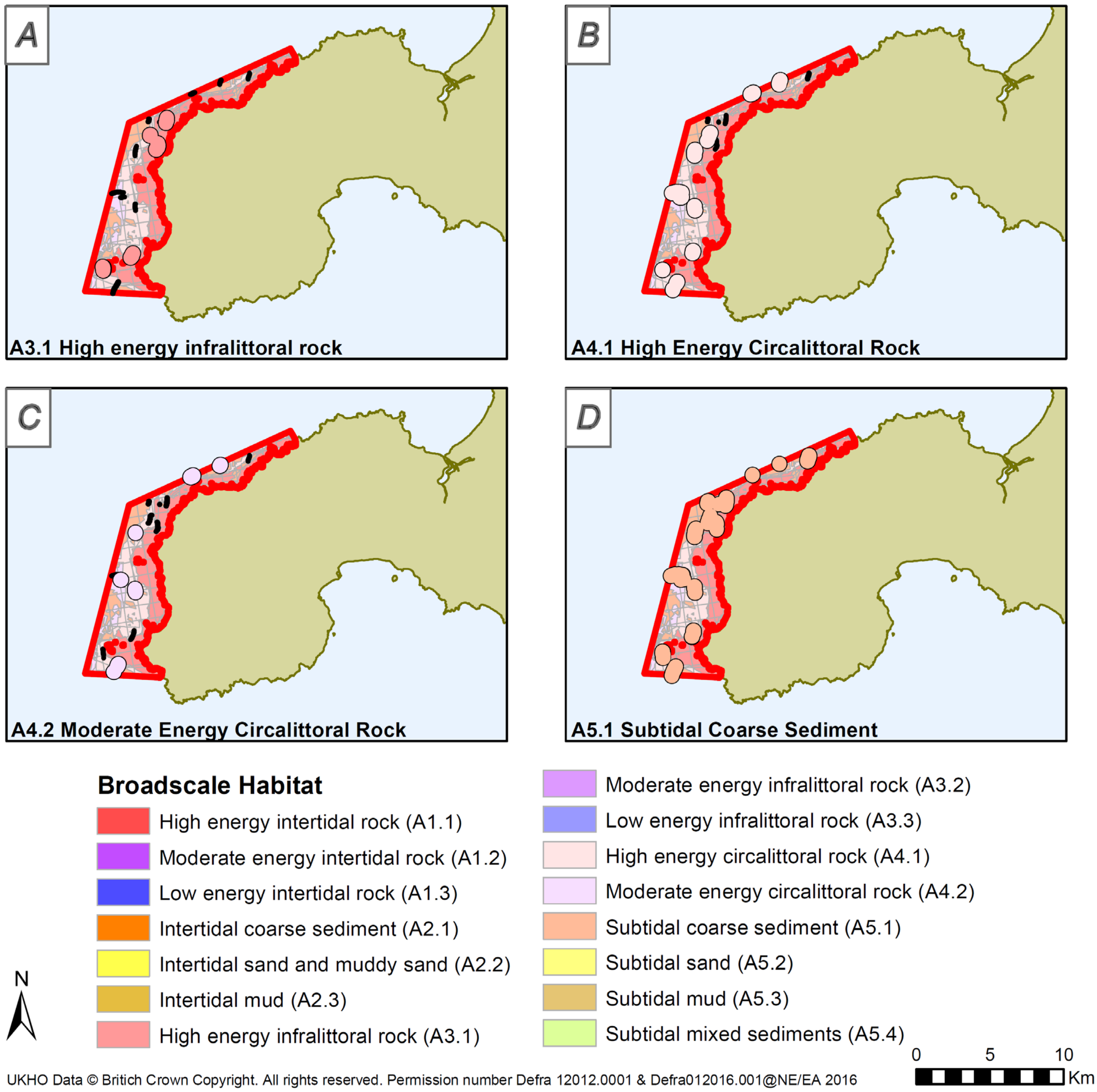


Figure 2. Distribution of still images assigned to broadscale habitats during the 2010 survey of the nearshore extent of Lands End and Cape Bank SAC . Background polygons are the modelled BSHs taken from the Marine Evidence database.

1.3 Aims and objectives

High level conservation objectives

High level site specific conservation objectives serve as benchmarks against which to monitor and assess the efficacy of management measures in maintaining a designated feature in, or restoring it to, ‘favourable’ conservation status.

As detailed on the Natural England Designated Sites View website (Natural England, 2022) the conservation objectives for the site, subject to natural change are:

1. The integrity of the site is maintained or restored as appropriate.
2. The site contributes to achieving the Favourable Conservation Status of its qualifying features.

Definition of favourable condition

Favourable conservation status, with respect to a habitat feature, means that, subject to natural change:

- Its extent and distribution are stable or increasing;
- Its structures and functions, including its quality, and the composition of its characteristic biological communities, are such as to ensure that it remains in a condition which is healthy and not deteriorating; and
- Its natural supporting processes are unimpeded.

The extent of a habitat feature refers to the total area in the site occupied by the qualifying feature and must also include consideration of its distribution. A reduction in feature extent has the potential to alter the physical and biological functioning of habitats (Elliott *et al*., 1998). The distribution of a habitat feature influences the component communities present and represents the structure and function of the habitat (JNCC, 2004).

Structure encompasses the physical components of a habitat type, the key and influential species present, and incorporates topography, habitat composition and distribution. The function of habitat features includes processes such as: elemental cycling, benthic-pelagic coupling, habitat modification, primary and secondary production, and recruitment dynamics. Habitat features rely on a range of supporting processes (e.g., hydrodynamic regime, water quality) which act to support their functioning as well as their resilience (e.g., the ability to recover following impact).

Report aims and objectives

The primary aim of this report is to describe the attributes of the designated features within Lands End and Cape Bank SAC. This report incorporates only the landward extent of the SAC. This information will contribute to the future assessment and monitoring of feature condition. The results presented will be used to develop recommendations for future monitoring , including the operational testing of specific metrics which may indicate whether the condition of the feature has been maintained, is improving or is in decline.

The broad objectives of this monitoring report are provided below:

1) Provide a description of the extent, distribution, structural and functional attributes of the designated features within the site (see Table 2 for more detail), to enable subsequent condition monitoring and assessment;
2) Note observations of any Annex I habitats, features of conservation importance and OSPAR Threatened and/or Declining Species and Habitats not covered as features of the site;
3) Present evidence relating to non-indigenous species (Descriptor 2) and marine litter (Descriptor 10), to satisfy requirements of the UK Marine Strategy (formerly MSFD);
4) Record any anthropogenic activities or pressures encountered during the dedicated monitoring survey;
5) Provide practical recommendations for appropriate future monitoring approaches for the designated features (e.g., metric selection, survey design, data collection approaches) with a discussion of their requirements.

Reporting sub-objectives (Objective 1)

To achieve Objective 1, a number of reporting sub-objectives will be addressed to provide evidence for Feature Attributes and supporting processes as defined in the Supplementary Advice on Conservation Objectives (SACOs) developed by Natural England for Lands End and Cape Bank SAC[1]. The specific attributes that have been surveyed and described in this report are listed in Table 2. Additional attributes, largely pertaining to the physical and physico-chemical properties of the site, were beyond the scope of this monitoring work. Additional information on these attributes is available in the SACO.

[1] SACO for Lands End and Cape Bank SAC (accessed 09/11/2021)

Table 2. Attributes monitored as part of the 2018 Lands End and Cape Bank SAC condition assessment monitoring survey.

Feature/ Subfeature	Attribute	Target
Annexe I reefs	Extent and distribution	Maintain the total extent of reef habitat at 24,938 ha, and spatial distribution as defined on the map, subject to natural variation in sediment veneer.
Annexe I reefs	Distribution: presence and distribution of biological communities	Maintain the presence and spatial distribution of reef communities
Annexe I reefs	Structure and function: presence and abundance of key structural and influential species	[Maintain OR Recover OR Restore] the abundance of listed species[2], to enable each of them to be a viable component of the habitat.
Annexe I reefs	Structure: species composition of component communities	Maintain the species composition of component communities
Annexe I reefs	Structure: non-native species and pathogens (habitat)	Restrict the introduction and spread of non-native species and pathogens, and their impacts

2. Methods

2.1 Survey design

A drop camera survey was conducted by the Cornwall Inshore Fisheries and Conservation Authority (CIFCA) over four days between May and July 2018. Sites were accessed by the research vessel *RV Tiger Lily*. Detailed survey reports are provided in the CIFCA report (Jenkin *et al*., 2018) with the overall approach summarised in the sections below.

[2] The Lands End and Cape Bank SAC Supplementary Advice refers the reader to Covey *et al*. (2016). A copy of this paper has been requested.

The initial aim was to survey along 28 survey lines. Fourteen lines were intended to be sites revisited from the 2010 survey (Figure 2), with an additional fourteen sites representing ‘control’ sites. This included a number of sites outside of the SAC boundary. The aim was to assess whether assemblages outside of the SAC boundary differed from those inside the site. In total, 23 lines were successfully surveyed in 2018 (Figure 3). It was agreed with the Marine Protected Areas Group that a repeat survey of the five sites not surveyed did not require completion (Jenkin *et al*., 2018).

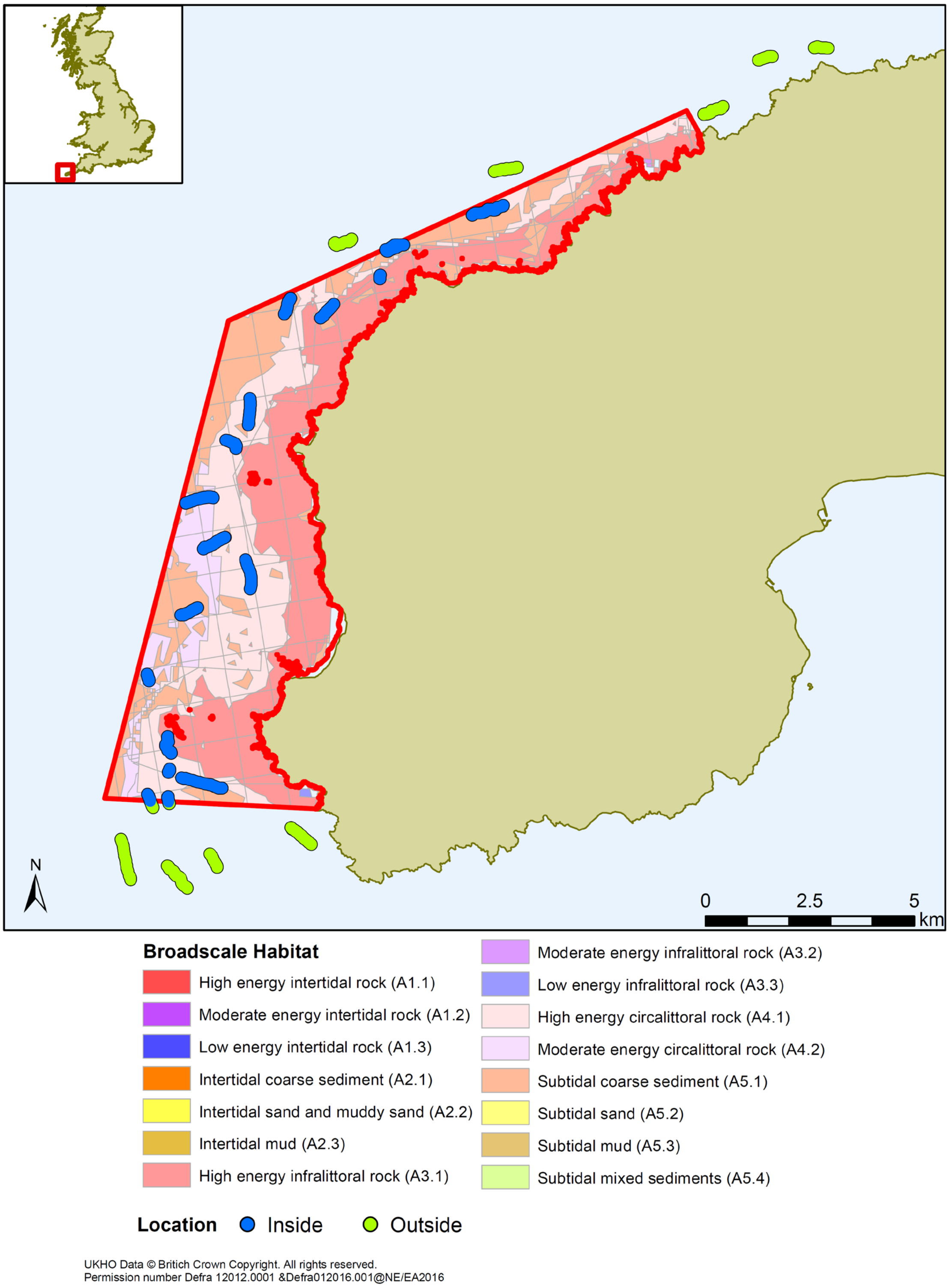


Figure 3. Location of images captured within Lands End and Cape Bank SAC. The 2018 survey included surveying of stations both inside (blue) and outside (green) of the SAC boundary.

2.2 Data acquisition and processing

A drop camera survey was conducted in line with Mapping European Seabed Habitats (MESH) recommended operating guidelines for underwater video and photographic imaging techniques (Coggan *et al*., 2017).

The imagery survey was conducted using a drift tow approach with a SeaSpyder camera system. The SeaSpyder was 'flown' just above the seabed, recording video imagery. The camera frame was periodically landed on the seabed to allow high quality still images to be captured at a frequency of one image every 60 seconds. The targeted speed over ground of the survey vessel was aimed at 0.3 knots for the duration of every tow. This value varied between 0.3 and 1.5 knot depending on the tidal state. Tows were not carried out when the drift speed exceeded 1 knot. Field notes were made during each camera deployment, noting station and sample metadata, real-time observations of substrate and taxa, an initial assessment of the range of broadscale habitats (BSHs) seen and the general quality of the imagery.

2.3 Image analysis

Analysis of video and still imagery data was conducted by Seastar Survey Ltd. (O'Dell, 2019). Analyses followed the protocols detailed in JNCC and Natural England/Cefas guidance (Parry, 2015).

Still images and video segments were assigned BSHs and information on the physical nature of the habitat were recorded, including substrate type and seabed morphology. Still images and video segments containing the Annex I reef habitat were tagged. Taxa were identified to the highest taxonomic level practicable. Some taxa could not be confidently assigned to a particular taxon. In these instances, taxa were labelled either at a broader taxonomic level (e.g., 'Bryozoa'). For a number of taxa, morphological descriptors were also noted (e.g., "Bryozoa (encrusting"). Taxon abundances were determined as counts or percentage cover and a semi-quantitative SACFOR abundance was also recorded.

In addition to recording the taxa observed in samples, records were also made of proportions of different benthic habitats present in each image (e.g., bedrock, boulders, gravels, sands, muds). Note was also made where litter items were observed.

2.4 Data preparation and statistical analyses

Data preparation

Prior to analysis, the taxonomic nomenclature used in the data from both the 2018 and 2010 surveys were checked against the World Register of Marine Species[3] to ensure that taxonomic nomenclature was up to date and that there were no taxon synonyms in the data which might artificially inflate apparent taxon abundances.

Digital imagery data are best suited for the identification and relative abundances of sessile taxa. Although highly motile taxa, including fish, are often observed in such data, imagery data are not an efficient methodology to quantify such aspects of the community. Occasional observations of fish taxa in imagery data will likely therefore give an artificial and inconsistent inflation of taxon richness which could potentially bias our interpretation of the data. As such, mobile epifauna taxa were removed prior to statistical analysis of the data.

Taxon abundances were recorded as ordinal SACFOR classes. This allows taxon abundances to be compared between species, even when growth forms differ. That is, encrusting, colonial, and plant-like species are typically recorded as percentage cover data, whereas 'solitary' and non-colonial taxa are often recorded as individual abundances. Using SACFOR classes allows comparison of all of the taxa recorded, as opposed to requiring separate consideration of abundance and percentage cover data sets.

SACFOR data were converted to numerical values. Values were assigned from 1 to 6 to reflect increasing taxon abundances, with 1 representing 'rare' and 6 representing 'superabundant' taxa. This provided a numeric data set of taxon abundances which incorporated all taxa observed, regardless of growth forms. These converted numerical values allowed statistical analyses to be conducted on the data as described below.

Statistical analyses

All imagery data were included in subsequent analyses. Current guidance (Turner *et al*., 2016) recommends that imagery data at less than 'good' quality are excluded from analysis. However, an important aim of the current report is to compare 2018 data with those gathered in 2010. All of the data gathered as part of the 2010 survey were included in the assessment (Axelsson and Dewey, 2011) and no indication of image quality was

[3] Available at https://www.marinespecies.org/ (accessed 11/05/2022)

recorded. As such, to enable comparison with historic data, all data gathered in 2018 were included in the analysis.

Data were analysed using a combination of univariate and multivariate approaches as outlined below. Unless stated otherwise, all analyses were conducted in the R (version 4.02) software environment (R Core Team, 2020).

Univariate analyses

Ecologists often reduce multidimensional biological assemblage data to single variables which provide a univariate reflection of the multivariate biological diversity of the data. The use of univariate values allows traditional univariate statistical approaches, such as analysis of variance, to be carried out. As the taxonomic data are semi-quantitative in nature (i.e., using SACFOR abundance), univariate statistical analyses were restricted to taxon richness values (i.e., the number of taxa recorded in images) (*cf.* Curtis, 2017).

Multivariate analyses

Multivariate analyses can provide additional insight into the taxa that drive the differences between assemblages. It is common to transform taxon abundance data prior to conducting multivariate analyses to reduce the influence that highly abundant taxa have when comparing assemblages (Clarke and Warwick, 2001). In addition, data transformation is often carried out to satisfy statistical assumptions for certain analyses (Clarke and Warwick, 2001, but see Warton *et al.*, 2012). The use of the ordinal SACFOR scale can essentially be considered as a transformation of the taxon abundance data. As such, no additional transformation of this data was necessary.

Differences in the structure of assemblages between habitats were assessed using permutational multivariate analysis of variance using the 'adonis2' function in the R package 'vegan' (McArdle and Anderson, 2001; Oksanen *et al.*, 2022). Comparisons were based on 999 permutations of "Bray-Curtis" distance matrices. Where significant differences between assemblage groups were apparent ($\alpha = 0.05$), post-hoc comparisons were calculated by re-running the adonis2 function for each pair of habitat groups. Significance values were adjusted for multiple comparisons using the Holm method (Holm, 1979) in the R function 'p.adjust'.

Non-metric multidimensional scaling (nmMDS) ordination plots were produced to compare biological assemblages between BSHs. nmMDS plots allow us to visualise the similarity of multivariate assemblages in a reduced number of dimensions. Effectively, the distance between two points in a nmMDS ordination is a measure of how similar two samples are. Points in close proximity are more similar in terms of the identity and the abundance of taxa present. Ordinations were generated using the 'metaMDS' routine in the 'vegan' package for R (Clarke, 1993; Oksanen *et al.*, 2020).

The taxa driving differences between assemblages were highlighted using similarity percentages (SIMPER) (Clarke, 1993) using the 'simper' routine in the R package 'vegan'.

This function identifies the taxa contributing most to the Bray-Curtis dissimilarity between groups of samples.

2.5 Non-indigenous species (NIS)

The taxa recorded in the imagery data were cross-reference against lists of non - indigenous species selected for the assessment of Good Environmental Status in GB waters under MSFD Descriptor 2, Ecological Status assessment for WFD Water Bodies (coastal and estuarine) and identified as significant by the GB Non-Native Species Secretariat. These taxa are listed in Appendix 2 Non-indigenous species.

3. Results

3.1 Imagery overview

The still images captured as part of the benthic habitat survey of the nearshore section of Lands End and Cape Bank SAC in 2018 were generally of ‘good’ quality (90.1% of images, n = 673). Some images were considered ‘poor’ (9.4%, n = 70) and a small number were considered ‘very good’ (0.5%, n = 4). The majority of the 106 video segments were of ‘good’ quality (95.5% of video segments; n = 101). A small number of segments were considered to be ‘poor’ (4.7%; n = 5). As highlighted in Section 2.4, all data were used in the statistical analyses.

There was general agreement in how imagery data were assigned to BSHs for both rock (Figure 4) and sediment (Figure 5) habitats. There were however some minor discrepancies. For example, the location of samples assigned to the ‘A4.2 Moderate energy circalittoral rock’ BSH differed between video (Figure 4E) and still imagery (Figure 4F) data. This highlights the potentially subjective nature of biotope and habitat descriptions. This is explored further in the Discussion.

The statistical assessments of imagery data in the following sections are based on the still image data. These data were considered to be of higher quality than the video data and as such are likely to provide a more realistic indication of the taxa and habitats present (O’Dell, 2019).

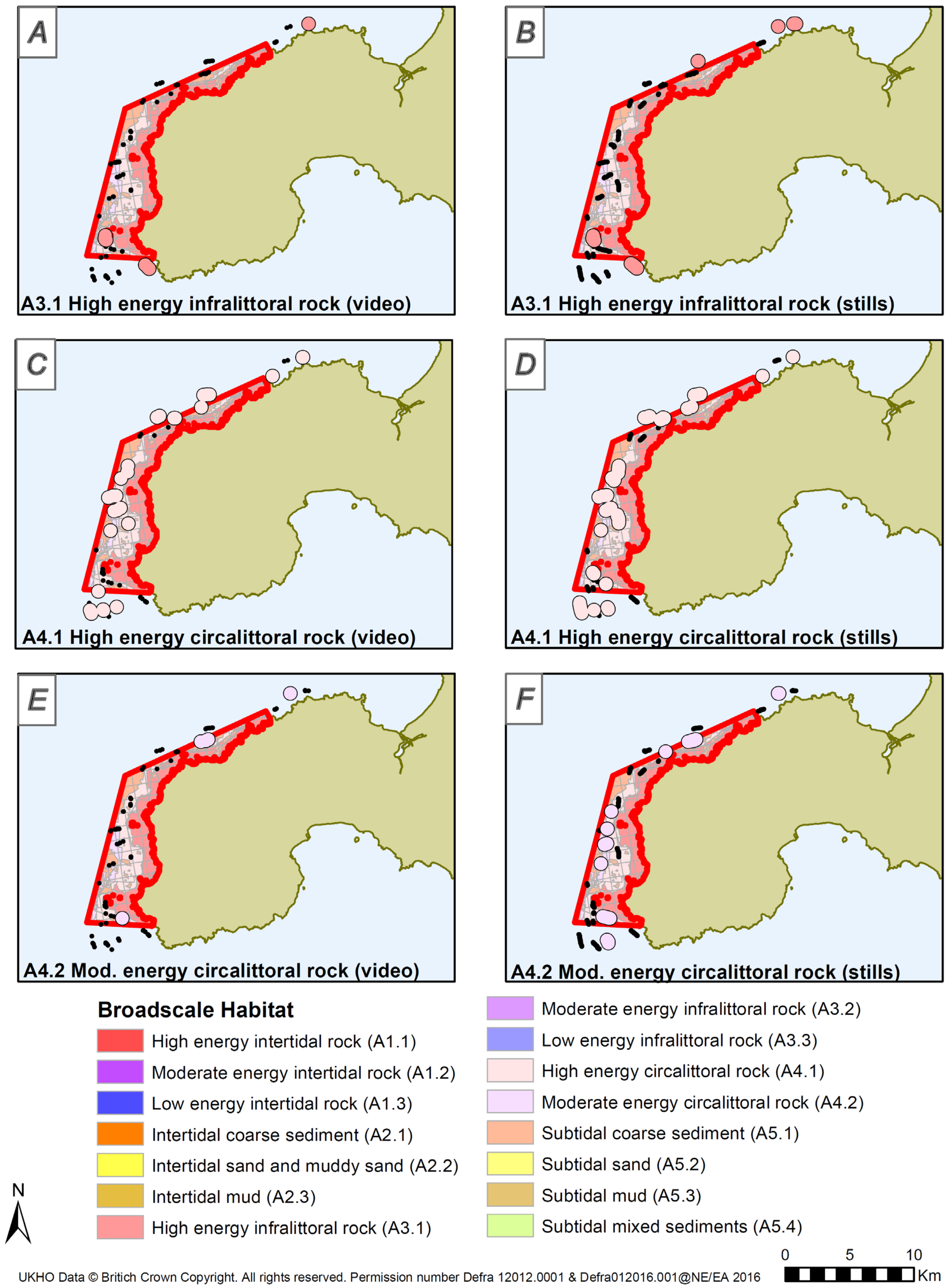


Figure 4. Distribution of video segments (left column) and still images (right column) assigned to rocky broadscale habitats (BSHs) during the 2018 Lands End and Cape Bank SAC survey. Background polygons are the modelled BSHs taken from the Marine Evidence database.

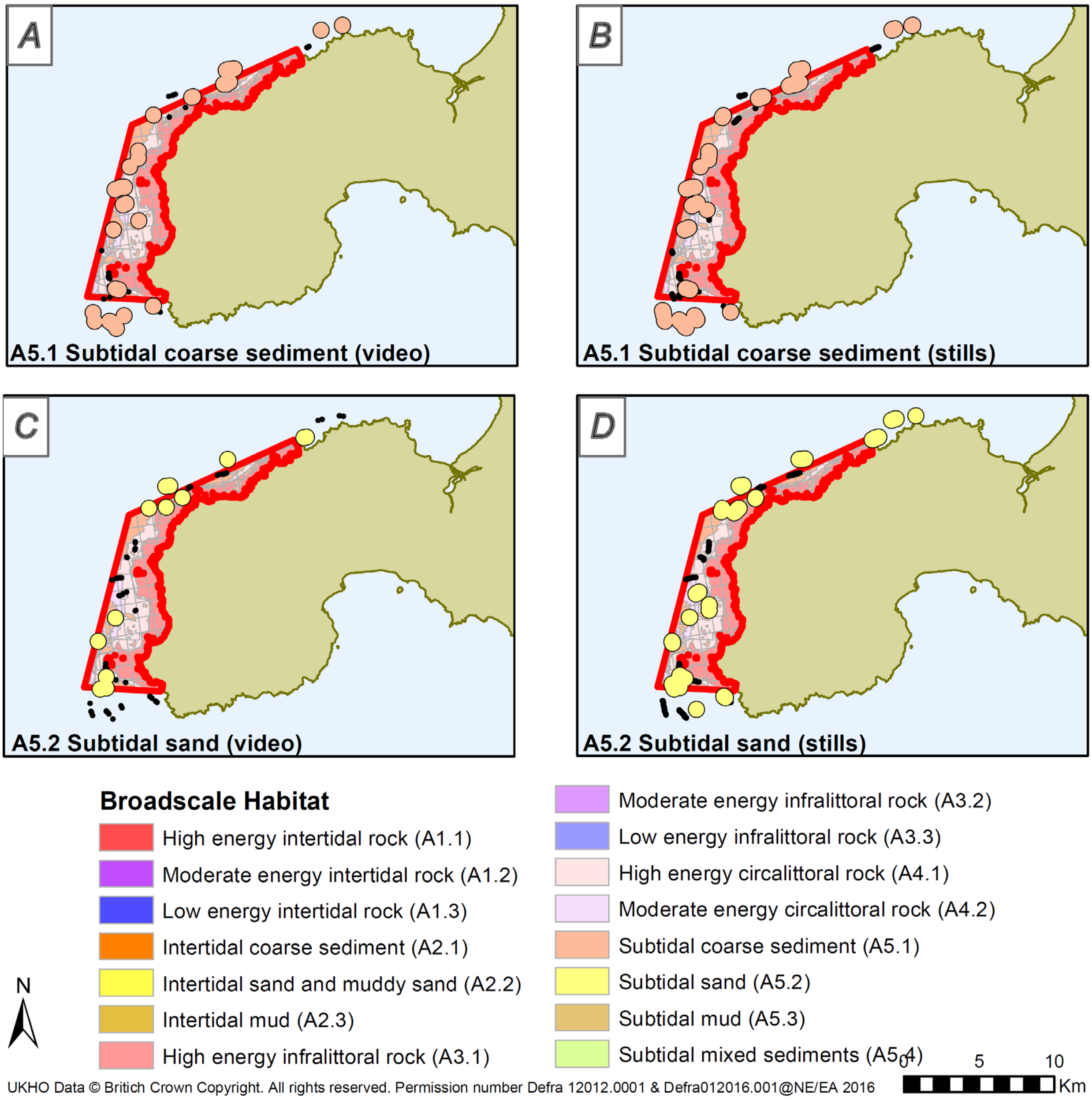


Figure 5. Distribution of video segments (left column) and still images (right column) assigned to sedimentary broadscale habitats (BSHs) during the 2018 Lands End and Cape Bank SAC survey. Background polygons are the modelled BSHs taken from the Marine Evidence database.

3.2 Environmental overview (Objectives 1 and 2)

The seabed surveyed in the nearshore section of Lands End and Cape Bank SAC in 2018 were "characterised by a mixture of rocky reef features and coarse sands and gravels" (O'Dell, 2019). Rocky reef habitats included bedrock, boulder, and cobble (stony) reefs. Many of the observed reefs were recorded as sand scoured or almost completely covered by sand. In many cases, the presence of underlying hard substrata was only evidenced by the presence of sparse outcrops and/or the presence of species associated with hard substrates (O'Dell, 2019).

Sand-dominated areas contained scour-tolerant taxa such as the sponge *Polymastia boletiformis*, robust hydroids including *Nemertesia antennina*, ascidians, in particular *Stolonica socialis*, and a number of bryozoan taxa including *Alcyonidium diaphanum*, *Flustra foliacea* and *Crisularia plumosa*. Areas with reduced sand scour, particularly in areas characterised by bedrock and boulder habitats, had a higher degree of faunal diversity. Dense bryozoan turfs were common and composed of crisiids and *Cellaria* spp. A diverse array of sponges were recorded, in addition to soft corals, anemones and echinoderms (O'Dell, 2019). Rocky reef assemblages in shallower areas were dominated by algal taxa. This included areas of kelp forest and dense foliose red and brown algae growth (O'Dell, 2019).

Annex I reef habitats were recorded throughout the SAC and were also commonly recorded in imagery data outside of the SAC boundary. Across all data, 54% of still images (n = 410) were tagged as being representative of this feature. A higher proportion of imagery data were flagged as Annex I reefs inside the SAC boundary (61%, n = 272) compared to outside (46%, n = 138) (Figure 6).

In addition to the reef features for which Lands End and Cape Bank SAC is designated, sediment dominated habitats were also commonly recorded throughout the SAC in 2018. Although sediment habitats are not qualifying or designated features within the SAC, Subtidal Sands and Gravels are included in the UK Biodiversity Action Plan[4]

Broadly speaking, the distribution of habitats recorded in 2018 agreed with the predicted distribution of habitats from previous surveys and the Marine Evidence modelling outputs. The distribution of the habitats recorded in 2018 and the assemblages associated with them are detailed in the sections below.

[4] https://jncc.gov.uk/our-work/uk-bap-priority-habitats/#list-of-uk-bap-priority-habitats (Accessed 14/03/2022)

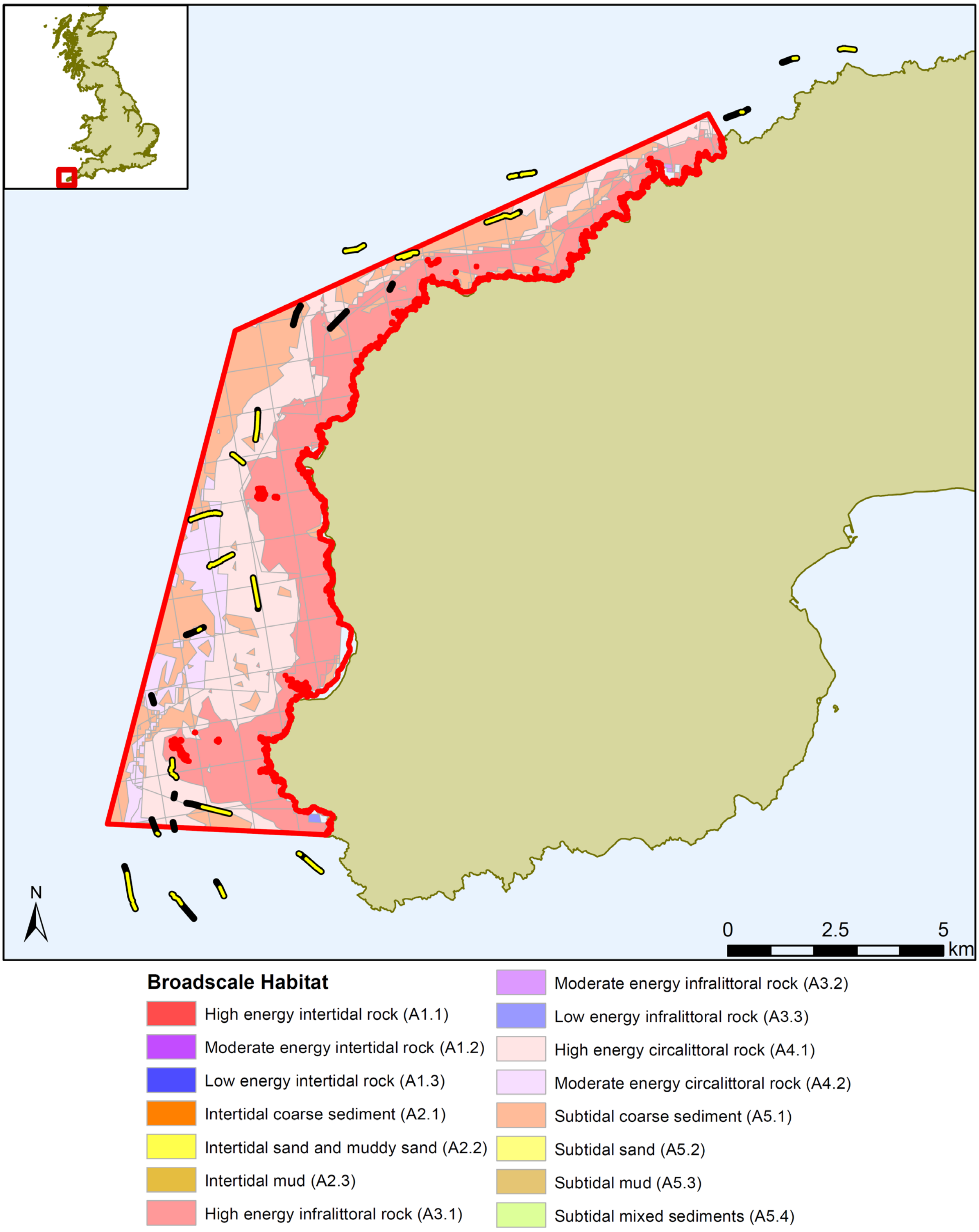


Figure 6. Video segments flagged as Annex I reef habitat during the 2018 Lands End SAC image survey. Annex I reefs (yellow) were assigned to 410 of the 750 still images captured in the 2018 survey. Background polygons are the modelled broadscale habitats taken from the Marine Evidence database.

3.3 Broadscale habitats (Objective 1)

The 2018 survey identified three rock and two sediment BSHs (Table 3). The assigning of sediment BSHs to still and video imagery was based on visual clues only. Given that no supporting particle size analyses were conducted to ground truth these observations, caution is recommended when considering the images and videos assigned to sediment habitats. Broadscale habitats could not be assigned to three still images. These data were removed from subsequent analyses.

The sections below provide a high level overview of the rock and sediment BSHs recorded in 2018. More detailed descriptions of the assemblages and biotopes within each BSHs are provided in Section 3.5.

Table 3. Number (and percentage) of still images and video segments assigned to broadscale habitats (BSHs) for the 2018 Lands End and Cape Bank SAC survey. BSHs in bold are those habitats associated with Annex I Reefs, the designated feature for the SAC.

Broadscale Habitat	Still images	Video segments
A3.1 - High Energy Infralittoral Rock	**69 (9.2%)**	**10 (9.4%)**
A4.1 - High Energy Circalittoral Rock	**214 (28.5%)**	**37 (34.9%)**
A4.2 - Moderate Energy Circalittoral Rock	**53 (7.1%)**	**5 (4.7%)**
A5.1 - Subtidal Coarse Sediment*	219 (29.2%)	41 (38.7%)
A5.2 - Subtidal Sand*	192 (25.6%)	13 (12.3%)
Not assigned	3 (0.4%)	-

*Sediment BSHs were inferred from visual clues, with no samples taken for ground-truthing

Subtidal rock habitats

Approximately 9% of still images were assigned to the 'A3.1 High energy infralittoral rock' habitat (Table 3). These images were principally recorded in relatively shallow and near-shore waters, with a mean ± SD depth of 23.7 ± 3.0 m (values ranging between 18.4 and 28.7 m) (Table 4; Figure 4A,B).

The most commonly recorded rocky BSH in 2018 in the still image survey was 'A4.1 High energy circalittoral rock' which was assigned to approximately 30% of the still images captured in 2018 (Table 3). This BSH was recorded throughout the SAC at depths ranging from 25 to 56 metres, with a mean ± SD depth of 38.7 ± 7.4 m (Table 4).

Approximately 7% of still images were assigned to the 'A4.2 Moderate energy circalittoral rock' BSH. These were recorded at depths ranging from 25 to 53 m (mean ± SD = 38.5 ± 8.1 m) (Table 3). As highlighted above, a number of still images were assigned to this

BSH, though video data gathered in the same location were assigned to ‘A4.1 High energy circalittoral rock’.

Table 4. Mean ± standard deviation depth and % substratum cover for the three rocky broadscale habitats (BSHs) assigned to digital still images captured during the 2018 Lands End and Cape Bank SAC monitoring survey All BSHs are associated with Annex I Reefs, the designated feature for Lands End and Cape Bank SAC.

Physical characteristic	A3.1 High energy infralittoral rock (n = 69)	A4.1 High energy circalittoral rock (n = 214)	A4.2 Moderate energy circalittoral rock (n = 53)
Depth (m)	23.7 ± 3.0	38.7 ± 7.4	38.5 ± 8.1
Bedrock %	57.5 ± 45.3	63.1 ± 40.6	33.2 ± 38.4
Boulder (≥256 mm) %	24.3 ± 39.1	10.8 ± 24.7	32.2 ± 40.5
Cobble (64-256 mm) %	1.2 ± 5.4	7.2 ± 17.5	5.7 ± 12.3
Pebble (4-64 mm) %	0.7 ± 2.6	4.7 ± 12.4	2.9 ± 5.8
Finer sediments (<4 mm) %	16.3 ± 25.6	14.2 ± 20.6	26.0 ± 28.0

Subtidal sediment habitats

Approximately 55% of still images and 51% of video segments were assigned to sediment BSHs (Table 3). As highlighted above, these habitats were assigned based on visual cues and no ground truth samples were taken for quantitative analysis of sediments.

The majority of images assigned to sediment habitats were assigned to the ‘A5.1 Subtidal coarse sediment’ BSH (representing approximately 29% of all image samples and 39% of video segments; Table 3). These images were distributed through the SAC at depths ranging from 22 to 57 m (mean ± SD = 44.2 ± 8.8 m) (Table 5; Figure 5A,B). This BSH was typically found interspersed with rocky habitats, suggesting a mosaic of habitats and/or shallow sediments overlying rocky BSHs.

192 images (representing 26% of images captured) were assigned to the ‘A5.4 Subtidal mixed sediment) BSH. These images were captured at depths ranging from 19 to 58 m (mean ± SD = 38.0 ± 10.2 m) (Table 5). As with ‘A5.1 Subtidal coarse sediment’, images assigned to this BSH were typically interspersed with areas of rocky habitat (Figure 4, Figure 5).

Table 5. Mean ± standard deviation depth and % substratum cover for the two sediment BSHs assigned to digital still images captured during the 2018 Lands End and Cape Bank SAC monitoring survey. Sediment BSHs were assigned based on visual clues only. No depths were recorded for the 'A5.4 Subtidal mixed sediment' BSH.

Physical characteristic	A5.1 Subtidal coarse sediment (n = 219)	A5.2 Subtidal sand (n =192)
Depth (m)	44.2 ± 8.8	38.0 ± 10.2
Bedrock %	1.0 ± 5.1	0.1 ± 0.7
Boulder %	1.6 ± 5.9	0.1 ± 1.1
Cobble %	11.7 ± 16.5	0.1 ± 0.5
Pebble %	26.5 ± 26.6	0.3 ± 2.6
Finer sediments %	59.2 ± 35.1	99.5 ± 2.9

3.4 Comparison between inside and outside Lands End and Cape Bank SAC

For the 2018 Lands End and Cape Bank SAC survey, additional imagery data were gathered from stations outside of the SAC boundary (Figure 3). Reef data gathered outside the SAC were compared with reef data gathered from inside the SAC. Mean ± SD taxon richness inside the SAC boundary was 18.3 ± 5.5 taxa per image. Mean taxon richness was slightly lower outside the of the SAC boundary 17.2 ± 4.7 taxa per image. Taxon richness values inside the SAC boundary were compared with those outside the SAC using a mixed effects model. This approach allows us to account for the variability in taxon richness values associated with different biotopes. Biotope was therefore modelled as a random term. Although mean taxon richness values were slightly higher inside the SAC boundary, the model showed that this difference was not statistically significant at $\alpha = 0.05$ (i.e., $p = .08$) (Table 6).

Table 6. Linear mixed effect model comparing taxon richness values in reef habitats inside Lands End and Cape Bank SAC with values outside the SAC boundary (refer to Figure 3B). Biotope was modelled as a random factor; σ^2 gives the within-group variance; τ_{00} gives the between-group variance. ICC is the intra-class correlation coefficient. The marginal R^2 considers the variance of the fixed effect only, whereas the conditional R^2 takes both the fixed and random effects into account.

Predictors	Model estimate	Confidence Interval	*p*
Fixed effect			
(Intercept)	17.31	15.68 – 18.94	< .001
In_Out[Outside]	-1.02	-2.14 – 0.11	.076
Random effects			
δ^2	20.57		
$\tau_{00\ Biotope}$	7.87		
ICC	0.28		
$N_{Biotope}$	17		
Observations	350		
Marginal R^2/ Conditional R^2	0.008/0.283		

3.5 Epibiota communities (Objectives 1 and 2)

A total of 179 taxa were recorded in the still imagery data gathered in 2018. Taxa highlighted as being of particular note within the near-shore area of Lands End and Cape Bank SAC were highlighted in the Reg. 35 advice (Natural England, 2012) and are summarised in Section 1.1. The majority of these taxa were also recorded in the 2018 survey. Some taxa of note from the 2010 report were not recorded in 2018. Temporal changes to the distributions of these key taxa is explored in Section 3.6.

Taxon richness values recorded in rocky habitats (mean ± SD = 17.8 ± 5.3 taxa per image) were significantly higher than those recorded in sediment habitats (mean ± SD = 5.6 ± 6.9 taxa per image) ($F_{1,745}$ = 707.7, p <2.2 x 10^{-16}). This is to be expected given that still and video imagery techniques do not readily record the infauna taxa that typically characterise sediment habitats. As sediment habitats are not a designated feature of Lands End and Cape Bank SAC and the fact that infauna taxa are not reliably and consistently recorded with the imagery techniques used in the 2018 survey, statistical comparisons and detailed descriptions of assemblages were conducted only on the rock BSHs for which benthic imagery methods are primarily designed.

Multivariate analysis showed that the structure of benthic assemblages significantly differed between rocky BSHs (Table 7A). Post hoc pairwise comparisons showed that assemblages within each of the three rocky BSHs differed from each other (Table 7B). Although all rock BSHs significantly differed from each other, the differences between MNCR level 2 habitats (i.e., 'A4 Circalittoral rock and other hard substrata' and 'A3 Infralittoral rock and other hard substrata') were more pronounced than differences within the MNCR level 2 'A.4 Circalittoral rock' habitat. This was reflected by both the relatively high *F* statistics between the different MNCR level 2 habitats (Table 7B) and by the clustering of images by BSH in the non-metric multidimensional scaling plot (Figure 7).

MNCR (JNCC, 2022) biotopes assigned to imagery data are described in the following sections.

Table 7. Model outputs comparing multivariate assemblages between the three rock BSHs recorded within still imagery at Lands End and Cape Bank SAC in 2018. A) Main effects model calculated using the 'adonis2' R package; B) Post hoc pairwise comparisons. P_{adj} values indicate those adjusted for multiple comparisons using the Holm (1979) method. Broadscale habitat codes refer to Table 3.

A)

Predictors	DF	Sum of Sq.	R^2	*F*	*P*
Broadscale habitat	2	12.07	0.167	33.32	0.001
Residual	333	60.31	0.833		
Total	335	72.38	1.00		

B)

Pairwise comparison	DF	R^2	F	*P*	$P_{adj.}$
A3.1 vs A4.1	1, 281	0.17	55.36	0.001	0.003
A3.1 vs A4.2	1, 120	0.21	32.68	0.001	0.003
A4.1 vs A4.2	1, 265	0.04	9.99	0.001	0.003

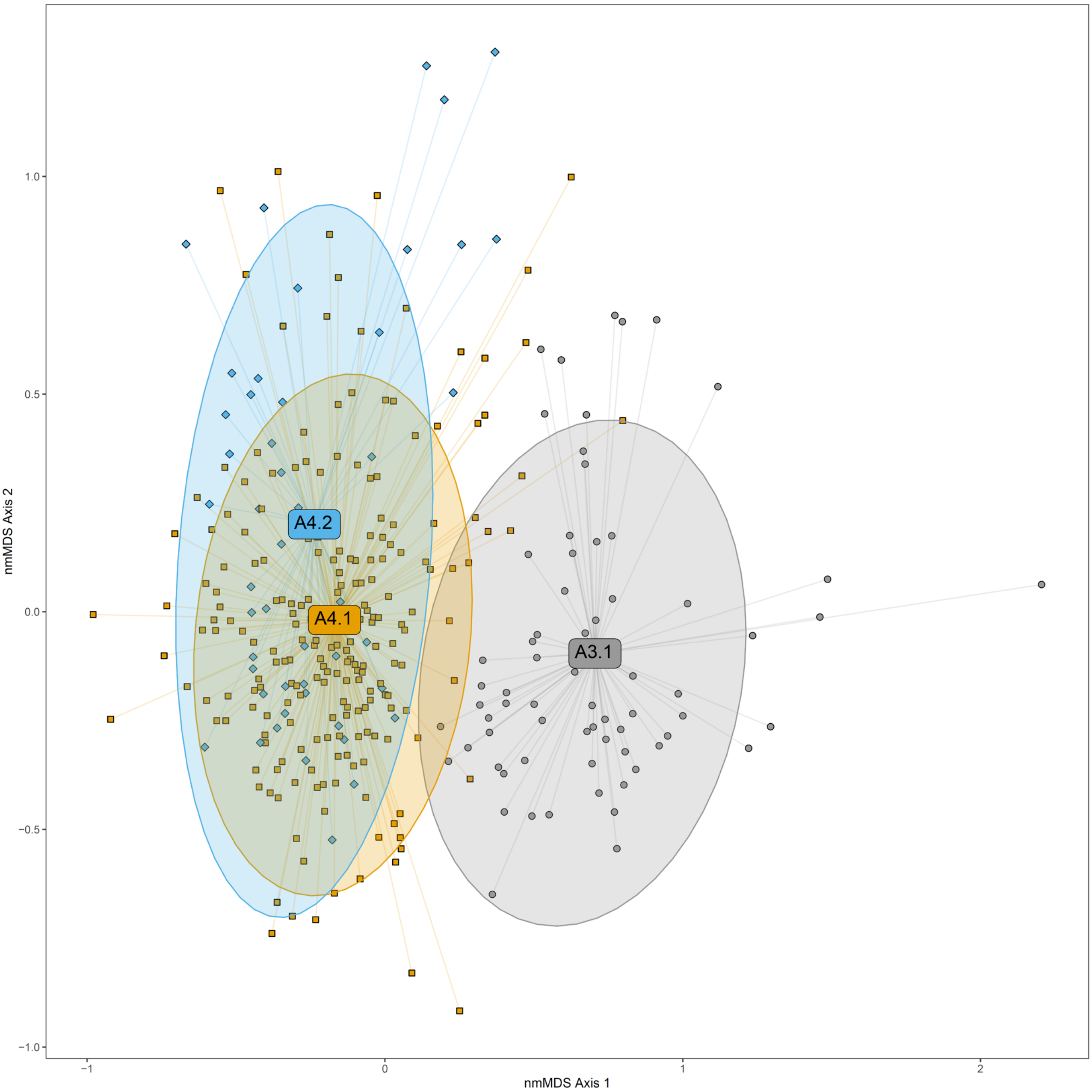


Figure 7. Non-metric multidimensional scaling (nmMDS) plots of SACFOR-derived taxon abundance data recorded in still imagery data within rocky habitats in the nearshore area of Lands End and Cape Bank SAC in 2018. Shaded ellipses represent the 90% confidence interval for a multivariate t distribution. Point shape and colours indicate the three BSHs recorded in the survey; label positions indicate the centroid for each BSH. BSH codes refer to Table 3. Stress = 0.25.

High Energy Infralittoral Rock (A3.1)

A total of 98 taxa were recorded in the 69 still images assigned to the 'A3.1 High energy infralittoral rock' BSH. Foliose red algae were recorded in all of the images assigned to this BSH. The median value of the numerically-converted SACFOR abundances corresponded to this taxon being Abundant. In addition, faunal turfs were also recorded in almost all images within this BSH (96%, n = 66) and where present, were typically recorded as Common. The bryozoan sea chervil *Alcyonidium diaphanum* was recorded in 81% of images (n = 56), though was recorded at sparser densities, corresponding to Occasional abundances. Coralline red algae (Family Corallinaceae), encrusting sponges (Phylum Porifera), foliose brown algae (Class Phaeophyceae), the red algae *Delesseria sanguinea* and encrusting bryozoans (Phylum Bryozoa) were each recorded in >50% of images within this BSH.

Images captured within this BSH were assigned to seven MNCR biotopes (Table 8). The most commonly recorded biotopes within this BSH were IR.HIR.KFaR.FoR 'Foliose red seaweeds on exposed lower infralittoral rock' and IR.HIR.KSed.XKScrR 'Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock'. Combined, these biotopes were assigned to approximately 57% of images within this BSH. These biotopes were not widely distributed within the SAC boundary. A number of occurrences were recorded in images captured outside the SAC boundary. Those within the SAC boundary were restricted to the south of the SAC to the west of Land's End (Figure 8).

Within this BSH, mean ± SD taxon richness was 15 ± 4.8 taxa per image. Taxon richness values did not significantly differ between biotopes ($F_{6,62}$ = 1.06, p = .398). However, permutational multivariate analysis of variance[5] did show significant differences in the structure of assemblages assigned to different biotopes within this BSH ($F_{6,62}$ = 3.31, p = .001).

[5] Calculated using the 'adonis2' function in the 'vegan' R package (Oksanen *et al*., 2022).

Table 8. Summary of biotopes assigned to still images within the 'A3.1 High energy infralittoral rock' broadscale habitat recorded in the Lands End and Cape Bank SAC survey in 2018.

MNCR code	MNCR name	n	Mean ± SD depth (m)	Mean ± SD taxon richness
IR.HIR	High energy infralittoral rock	1	24.3	11
IR.HIR.KFaR.FoR	Foliose red seaweeds on exposed lower infralittoral rock	20	25.4 ± 2.35	14.6 ± 4.33
IR.HIR.KFaR.FoR.Dic	Foliose red seaweeds with dense *Dictyota dichotoma* and/or *Dictyopteris membranacea* on exposed lower infralittoral rock	10	25.6 ± 0.71	16.7 ± 3.86
IR.HIR.KFaR.LhypFa	*Laminaria hyperborea* forest with a faunal cushion (sponges and polyclinids) and foliose red seaweeds on very exposed upper infralittoral rock	3	20.3 ± 2.57	17 ± 2.65
IR.HIR.KFaR.LhypR	*Laminaria hyperborea* with dense foliose red seaweeds on exposed infralittoral rock	15	21.3 ± 2.25	13.1 ± 4.79
IR.HIR.KFaR.LhypR.Pk	*Laminaria hyperborea* park with dense foliose red seaweeds on exposed lower infralittoral rock	1		12
IR.HIR.KSed.XKScrR	Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock	19	23.5 ± 3.23	16.1 ± 5.68

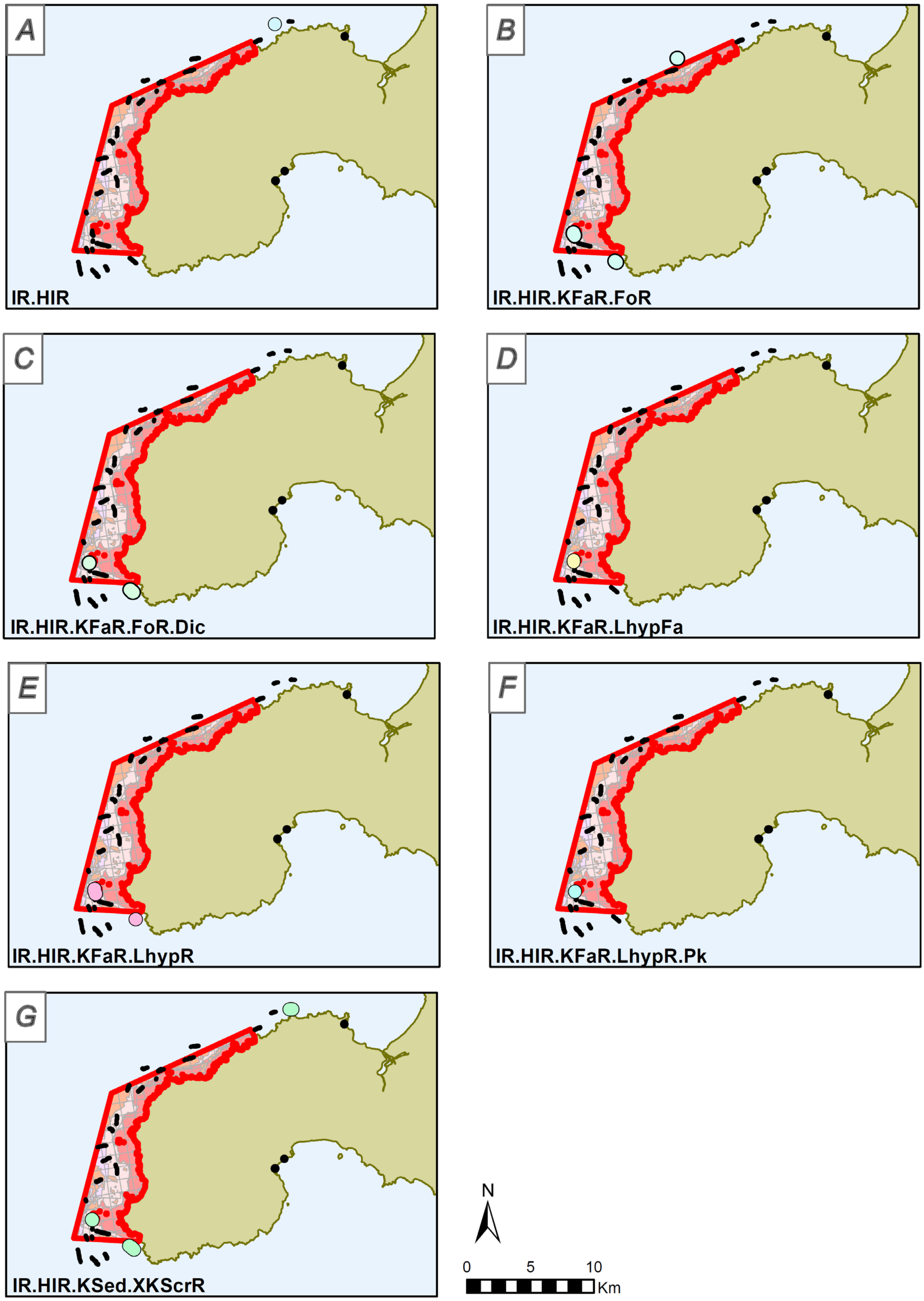


Figure 8. Distribution of still images captured during the 2018 Lands End and Cape Bank SAC survey assigned to biotopes within the 'A3.1 High energy infralittoral rock' broadscale habitat (BSH).. Background polygons are the modelled BSHs taken from the Marine Evidence database.

High Energy Circalittoral Rock (A4.1)

The most commonly recorded rock BSH in the 2018 imagery was 'A4.1 High energy circalittoral rock' (n = 214 still images assigned to this BSH). Images in this BSH were characterised by sessile faunal assemblages. A total of 141 taxa were recorded in still images assigned to this BSH. Characteristic of this BSH were faunal turfs, which were recorded in 98% of images within this BSH (n = 209) and where observed, were typically recorded at 'Superabundant' abundances. Other characteristic taxa included dead man's fingers *Alcyonium digitatum* (86% of images; n = 183), and unidentified hydrozoans, sponges, and bryozoans, each recorded in over 70% of images within this BSH.

Images captured within this BSH were assigned to six MNCR biotopes. All biotopes recorded in this BSH were within the 'Mixed faunal turf communities' biotope family (CR.HCR.XFa) (Table 9). Approximately 27% of images in this BSH (n = 57) were assigned to this level 4 biotope. The most commonly-assigned biotope was the MNCR level 5 biotope 'Bryozoan turf and erect sponges on tide-swept circalittoral rock' (CR.HCR.XFa.ByErSp) which was assigned to 37% of images (n = 79) within this BSH. A further five images (representing 2% of images in this biotope) were assigned to the closely related MNCR level 6 biotope '*Eunicella verrucosa* and *Pentapora foliacea* on wave-exposed circalittoral rock' (CR.HCR.XFa.ByEr.Sp.Eun). Combined, these biotopes were recorded throughout the survey zone (Figure 9A-C).

The MNCR level 5 biotope '*Corynactis viridis* and a mixed turf of crisiids, *Bugula*, *Scrupocellaria*, and *Cellaria* on moderately tide-swept exposed circalittoral rock' (CR.HCR.XFa.CvirCri) was assigned to 20% (n = 42) of images within this BSH. Observations of this biotope were more densely concentrated in the southern and central area of the SAC (Figure 9D). Thirty images (representing 14% of images) were assigned to the MNCR level 5 biotope 'Sparse sponges, *Nemertesia* spp. and *Alcyonidium diaphanum* on circalittoral mixed substrata' (CR.HCR.XFa.SpNemAdia). These images were concentrated around the central and northern areas of the SAC (Figure 9F). A single image within this BSH was assigned to '*Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock' (CR.HCR.XFa.FluCoAs). This image was located approximately 3.5 km outside of the SAC boundary, to the north east of the boundary in the vicinity of Carn Naun (Figure 9F).

Within this BSH, mean ± SD taxon richness was 19 ± 5.2 taxa per image and taxon richness values differed between biotopes ($F_{5,208}$ = 13.44, p = 2.3 x 10^{-11}). Taxon diversity was highest in the FluCoAs biotope, with 30 taxa recorded. However, this was restricted to a single image. There were no consistent patterns in the diversity of biotopes within this BSH (Table 9).

All of the biotopes assigned to images within this BSH are representative of exposed and rocky coastal habitats. Furthermore, all are associated with Annexe I reef habitats (JNCC, 2022).

Table 9. Summary of biotopes assigned to still images within the 'A4.1 High energy circalittoral rock' broadscale habitats recorded in the Lands End and Cape Bank SAC survey in 2018. Superscripts indicate groupings of biotopes based on taxon richness. Differing superscripts indicate significantly different taxon richness values between groups (α = 0.05, based on post hoc Tukey tests).

MNCR code	MNCR name	n	Mean ± SD depth (m)	Mean ± SD taxon richness
CR.HCR.XFa	Mixed faunal turf communities	57	37.6 ± 8.11	16.7 ± 4.44[a]
CR.HCR.XFa.ByErSp	Bryozoan turf and erect sponges on tide-swept circalittoral rock	79	40.8 ± 7.86	20.8 ± 4.27[b]
CR.HCR.XFa.ByErSp.Eun	*Eunicella verrucosa* and *Pentapora foliacea* on wave-exposed circalittoral rock	5	39.1 ± 5.26	18.8 ± 5.59[ab]
CR.HCR.XFa.CvirCri	*Corynactis viridis* and a mixed turf of crisiids, *Bugula*, *Scrupocellaria*, and *Cellaria* on moderately tide-swept exposed circalittoral rock	42	38 ± 6.23	16 ± 5.15[a]
CR.HCR.XFa.FluCoAs	*Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock	1	25	30[b]
CR.HCR.XFa.SpNemAdia	Sparse sponges, *Nemertesia* spp. and *Alcyonidium diaphanum* on circalittoral mixed substrata	30	36.5 ± 4.73	22.3 ± 4.77[b]

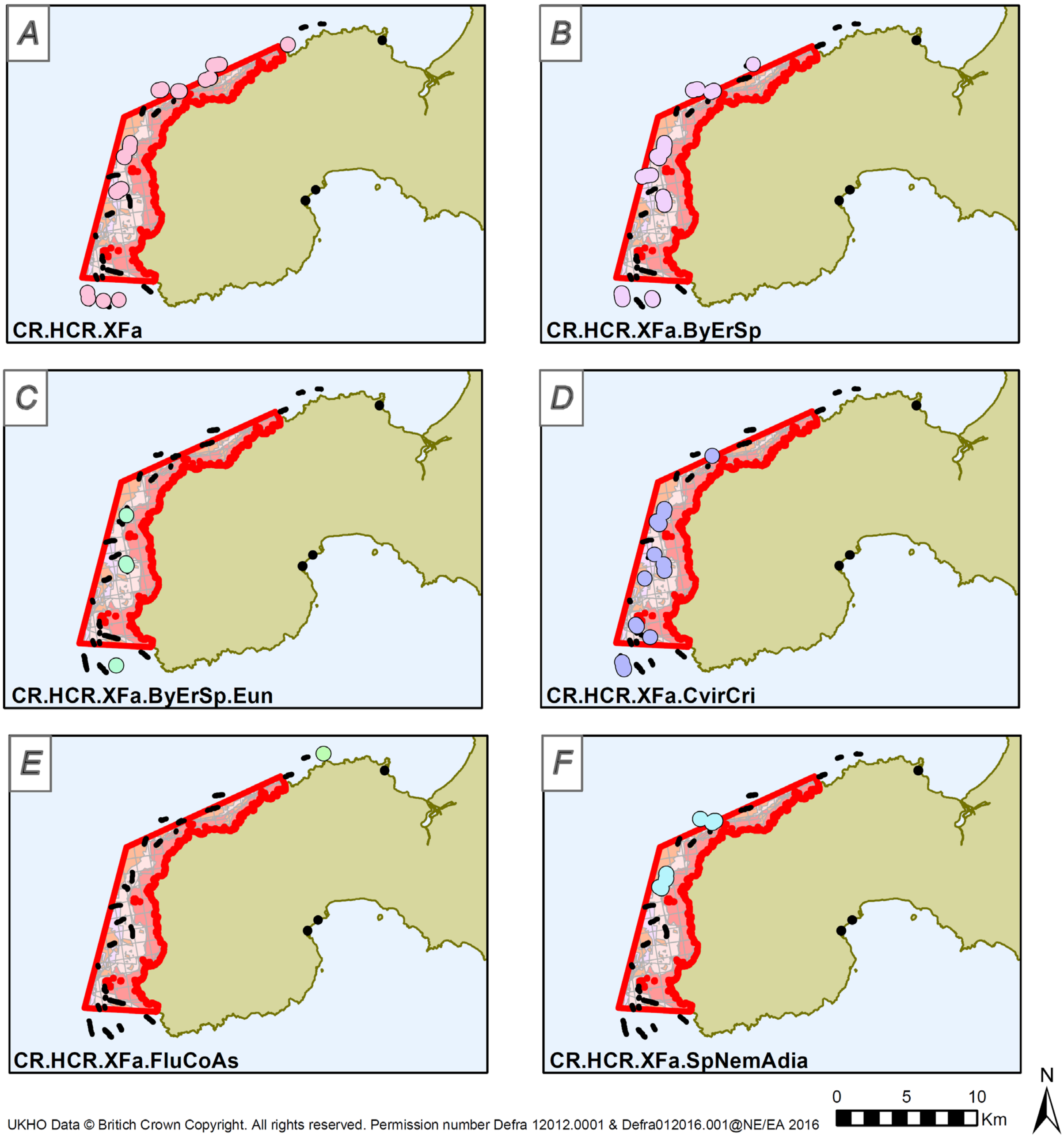


Figure 9. Distribution of still images captured during the 2018 Lands End and Cape Bank SAC survey assigned to biotopes within the 'A4.1 High energy circalittoral rock' broadscale habitats (BSH). MNCR codes refer to Table 9. Background polygons are the modelled BSHs taken from the Marine Evidence database.

Moderate Energy Circalittoral Rock (A4.2)

A total of 96 taxa were recorded in images assigned to the 'A4.2 Moderate energy circalittoral rock' BSH. As in the A4.1 data, the most commonly recorded taxon within this BSH were unidentified faunal turfs, which were recorded in 94% of images within this BSH (n = 50) and were typically recorded as 'Superabundant'. Also commonly recorded were anthozoans (*Caryophyllia (Caryophyllia) smithii*, and *Alcyonium digitatum*), bryozoans (‘encrusting Bryozoa’, and *Alcyonidium diaphanum*) and hydrozoans, all of which were recorded in over 70% of images assigned to this BSH.

The 53 images assigned to this BSH were assigned to three biotopes in total. The most commonly recorded was the MNCR level 5 biotope ‘*Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock’ (CR.MCR.EcCr.UrtScr) which was assigned to 47% of images (n = 25) in this BSH. This biotope was most common in the central and northern area of the SAC (Figure 10A). The MNCR level 5 ‘*Caryophyllia (Caryophyllia) smithii*, sponges and crustose communities on wave-exposed circalittoral rock’ (CR.MCR.EcCr.CarSp) and level 4 ‘Echinoderms and crustose communities’ (CR.MCR.EcCr) biotopes were also recorded in this BSH and were observed in similar numbers (Table 10). Both of these biotopes were assigned to images captured either outside of the SAC, or in the vicinity of the southern and northern boundaries of the SAC (Figure 10B-C).

Within this BSH, mean ± SD taxon richness was 16.9 ± 4.5 taxa per image and these values differed between biotopes ($F_{2,50}$ = 7.96, p = .001), with images assigned to the ‘CR.MCR.EcCr.UrtScr *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock’ biotope typically having a higher taxon richness than those in other biotopes (Table 10).

All of the recorded biotopes within this BSH are indicative of exposed and moderately exposed rocky coasts with stable substrata composed of bedrock and/or boulders. All three biotopes are associated with Annexe I reef habitats (JNCC, 2022).

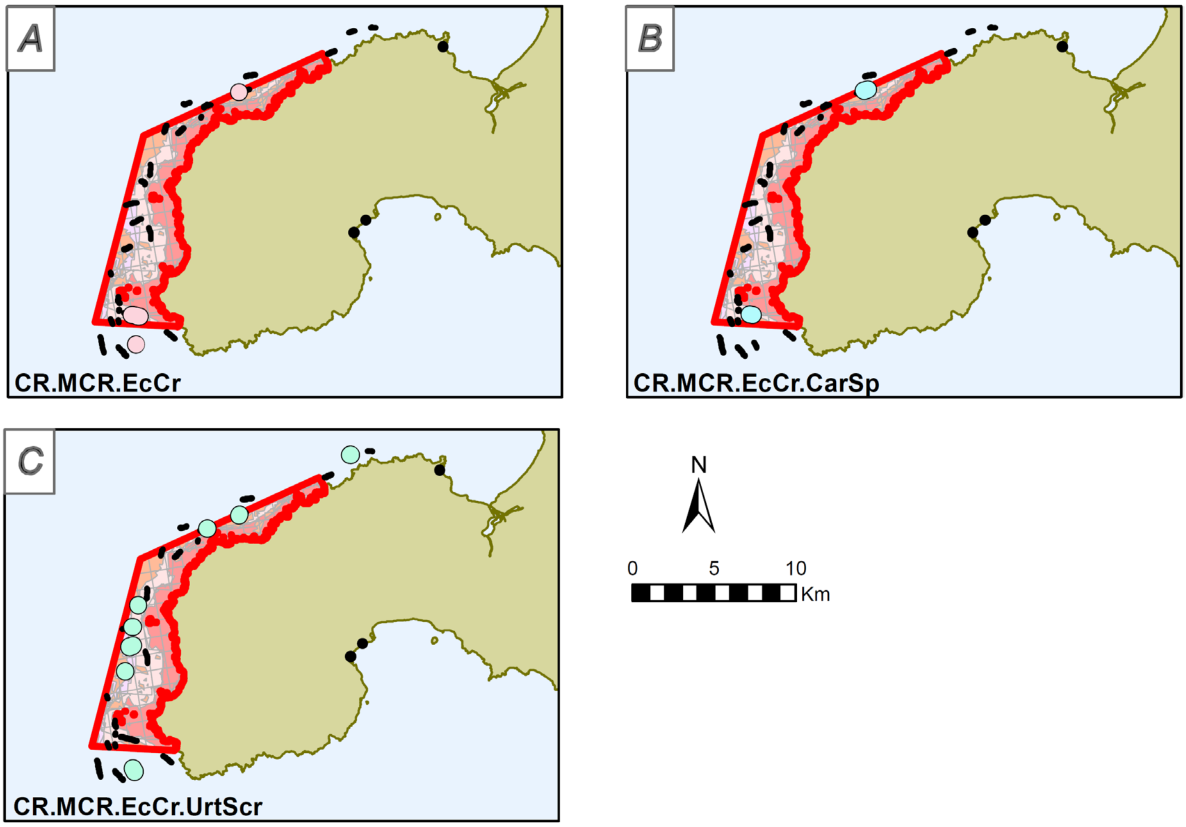


Figure 10. Distribution of still images captured during the 2018 Lands End and Cape Bank SAC survey assigned to biotopes within the 'A4.2 Moderate energy circalittoral rock' broadscale habitat (BSH). MNCR codes refer to Table 10. Background polygons are the modelled BSHs taken from the Marine Evidence database.

Table 10. Summary of biotopes assigned to still images within the 'A4.2 Moderate energy circalittoral rock' broadscale habitats recorded in the Lands End and Cape Bank SAC survey in 2018. Superscripts denote biotope groupings based on taxon richness values. Differing superscripts indicate significantly different taxon richness values between groups (α = 0.05, based on post hoc Tukey tests).

MNCR code	MNCR name	n	Mean ± SD depth (m)	Mean ± SD taxon richness
CR.MCR.EcCr	Echinoderms and crustose communities	15	35.9 ± 3.65	15.3 ± 3.15[a]
CR.MCR.EcCr.CarSp	*Caryophyllia (Caryophyllia) smithii*, sponges and crustose communities on wave-exposed circalittoral rock	13	36.1 ± 5.58	14.4 ± 3.69 [a]
CR.MCR.EcCr.UrtScr	*Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	25	41.1 ± 10.1	19.2 ± 4.49 [b]

Subtidal coarse sediment (A5.1)

Subtidal coarse sediments were the most commonly recorded BSH in the 2018 monitoring (Table 3). Images within the 'A5.1 Subtidal coarse sediment' BSH were assigned to nine biotopes. Despite these images being assigned to a sediment BSH, four of these biotopes, representing 6% (n = 14) of images within this BSH, were assigned to circalittoral rock BSHs (Table 11; Figure 11A-D).

The most commonly-recorded biotope within this BSH was the MNCR level 3 biotope 'Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands' (SS.SCS) which was assigned to 50% of images in this BSH (n = 110). This biotope had the lowest mean taxon richness within this BSH, with a mean ± SD of 9.1 ± 5.9 taxa recorded per image. Although there were areas of the SAC in which it was not observed, this biotope had wide coverage throughout the SAC (Figure 11E). Also common was the MNCR level 4 biotope 'Circalittoral coarse sediment', which was assigned to a quarter of images (n = 56). This biotope was also widely distributed throughout the SAC (Figure 11F).

Typically, in sediment habitats, the majority of fauna live beneath the sediment surface. There is a tendency therefore for such habitats to often appear devoid of flora and fauna, with azoic images commonly observed during imagery surveys. In the 2018 data, 'azoic' images made up only 5% of the images recorded in this BSH (n = 11).

A total of 144 taxa were recorded in the 219 images assigned to the 'A5.1 Subtidal coarse sediment' BSH. Mean ± SD taxon richness within this BSH was 10.2 ± 6.7 taxa per image and taxon richness values differed by biotope ($F_{8,210}$ = 7.80, p = 3.65 x 10^{-9}). Although the rocky biotopes within this BSH tended towards elevated taxon richness values compared with sediment biotopes, this relationship was not universal across all biotopes within this BSH (Table 11).

Tube-dwelling polychaete worms belonging to Family Serpulidae were the most commonly-recorded taxa in this BSH, recorded in 89% of images (n = 194). Unidentified faunal turfs and encrusting bryozoans were commonly recorded, with both appearing in over 70% of images (n = 158 and n = 155, respectively). The bryozoan *Alcyonidium diaphanum* and unidentified hydrozoan were also recorded in over half of the images in this BSH (n = 131 and n = 129, respectively). These taxa are often associated with rocky habitats, including the unconsolidated cobbles and pebbles which characterise this BSH, in addition to sediment-covered circalittoral rock.

Table 11. Summary of biotopes assigned to still images within the 'A5.1 Subtidal coarse sediment broadscale habitat recorded in the Lands End and Cape Bank SAC survey in 2018. Superscripts denote biotope groupings based on taxon richness values. Differing superscripts indicate significantly different taxon richness values between groups (α = 0.05, based on post hoc Tukey tests).

MNCR code	MNCR name	n	Mean ± SD depth (m)	Mean ± SD taxon richness
CR.HCR.XFa	Mixed faunal turf communities	3	46 ± 3.75	15.7 ± 6.11[acd]
CR.HCR.XFa.FluCoAs.X	*Flustra foliacea* and colonial ascidians on tide-swept exposed circalittoral mixed substrata	1	32.2	12[acd]
CR.HCR.XFa.SpNemAdia	Sparse sponges, *Nemertesia* spp. and *Alcyonidium diaphanum* on circalittoral mixed substrata	6	35.3 ± 0.96	22.3 ± 1.75[c]
CR.MCR.EcCr	Echinoderms and crustose communities	1	37.2	21[acd]
CR.MCR.EcCr.UrtScr	*Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	3	44.7 ± 9.82	21 ± 7.81[cd]
SS.SCS	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	110	45.3 ± 7.14	9.06 ± 5.92[a]
SS.SCS.CCS	Circalittoral coarse sediment	56	50.4 ± 6.49	13 ± 7.38[bd]
SS.SCS.CCS.SpiB	*Spirobranchus triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	8	44.1 ± 2	17.4 ± 3.66[cd]
SS.SSa.IFiSa.ScupHyd	*Sertularia cupressina* and *Hydrallmania falcata* on tide-	31	31.5 ± 4.9	9.65 ± 4.36[bd]

MNCR code	MNCR name	n	Mean ± SD depth (m)	Mean ± SD taxon richness
	swept sublittoral sand with cobbles or pebbles.			

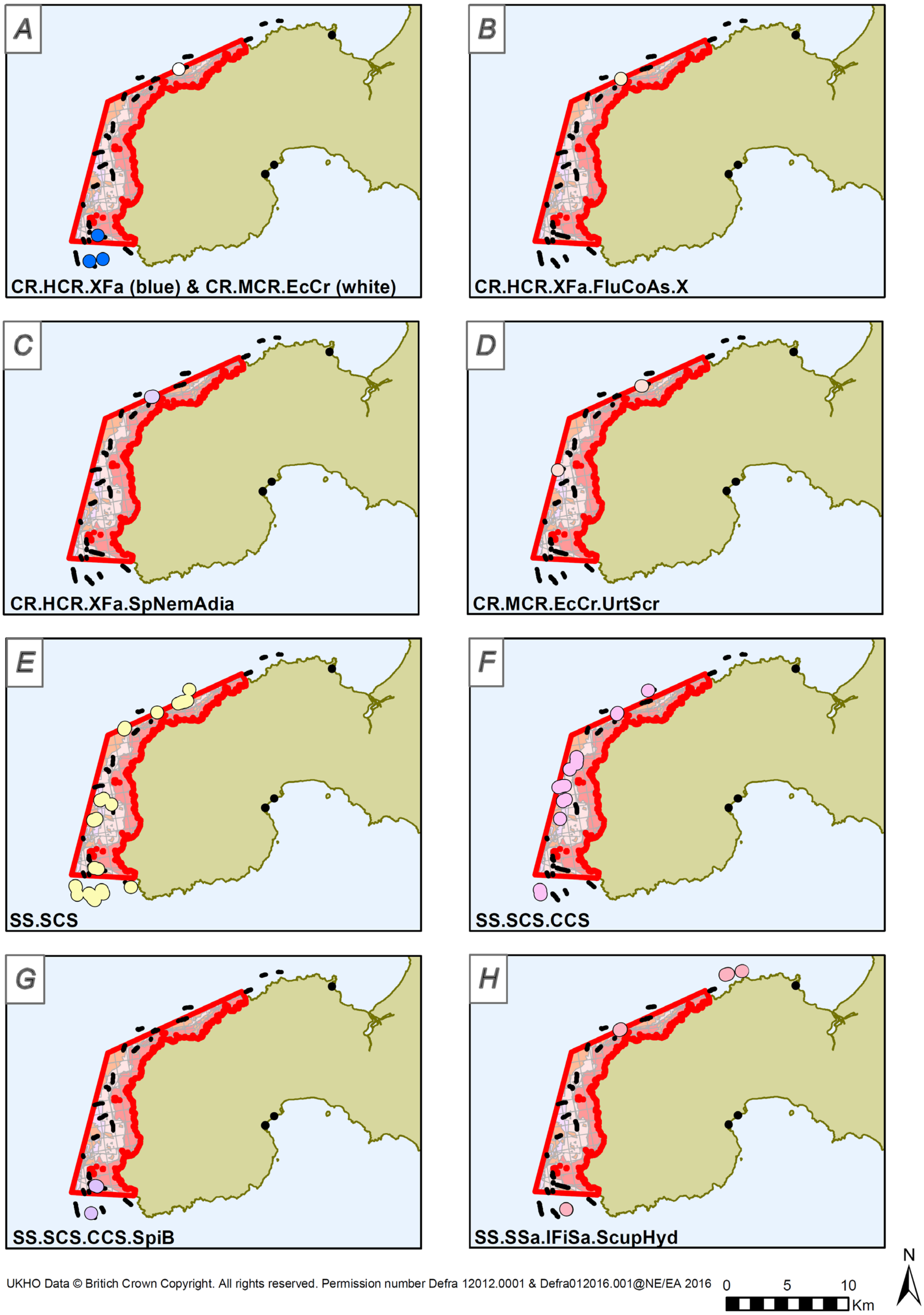


Figure 11. Distribution of still images captured during the 2018 Lands End and Cape Bank SAC survey assigned to biotopes within the 'A5.1 Subtidal coarse sediment' broadscale habitat (BSH). Four biotopes within this BSH (A-D) are typical of circalittoral rock habitats. MNCR codes refer to Table 11. Background polygons are the modelled BSHs taken from the Marine Evidence database.

Subtidal sand (A5.2)

A total of 28 unique taxa were recorded in the 192 images assigned to the 'A5.2 Subtidal sand' BSH. Taxon richness values were relatively low in this BSH, with a mean ± SD of 0.4 ± 1.3 taxa recorded per image. No taxa were recorded in 80% (n = 154) of images assigned to this BSH. The most commonly recorded taxa within this BSH were serpulid polychaete worms and unidentified faunal turfs, which were each recorded in 7% of images within this BSH (n = 13 images).

Four biotopes were assigned to images within this BSH (Table 12). The most commonly recorded biotope was the MNCR level 3 biotope 'SS.SCS Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)', which was assigned to 70% of images within this BSH (Table 12). This biotope was recorded throughout much of the SAC (Figure 12). Less commonly recorded were the MNCR level 3 biotope 'SS.SSa Sublittoral sands and muddy sands' and the MNCR level 4 'SS.SCS.CCS Circalittoral coarse sediment' biotope, recorded in 20% and 9% of images within this BSH, respectively (Table 12). Two images were assigned to the MNCR level 5 biotope 'SS.SSa.IFiSa.ScupHyd *Sertularia cupressina* and *Hydrallmania falcata* on tide-swept sublittoral sand with cobbles or pebbles'. Both of these images were captured outside of the SAC boundary (Figure 12).

Taxon richness differed by biotope ($F_{3,188}$ = 7.12, p = 1.47 x 10^{-4}), with the two images assigned to 'SS.SSa.IFiSa.ScupHyd *Sertularia cupressina* and *Hydrallmania falcata* on tide-swept sublittoral sand with cobbles or pebbles' having higher taxon richness values than other biotopes within this BSH (Table 12).

Table 12. Summary of biotopes assigned to still images within the 'A5.2 Subtidal sand' broadscale habitat recorded in the Lands End and Cape Bank SAC survey in 2018. Superscripts denote biotope groupings based on taxon richness values. Differing superscripts indicate significantly different taxon richness values between groups (α = 0.05, based on post hoc Tukey tests).

MNCR code	MNCR name	n	Mean ± SD depth (m)	Mean ± SD taxon richness
SS.SCS	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	135	35.6 ± 7.82	0.22 ± 0.93[a]
SS.SCS.CCS	Circalittoral coarse sediment	17	35.5 ± 6.33	0.88 ± 1.9[a]
SS.SSa	Sublittoral sands and muddy sands	38	47.6 ± 13.1	0.71 ± 1.61[a]
SS.SSa.IFiSa.ScupHyd	*Sertularia cupressina* and *Hydrallmania falcata* on tide-swept sublittoral sand with cobbles or pebbles.	2	29.8 ± 2.19	3.5 ± 2.12[b]

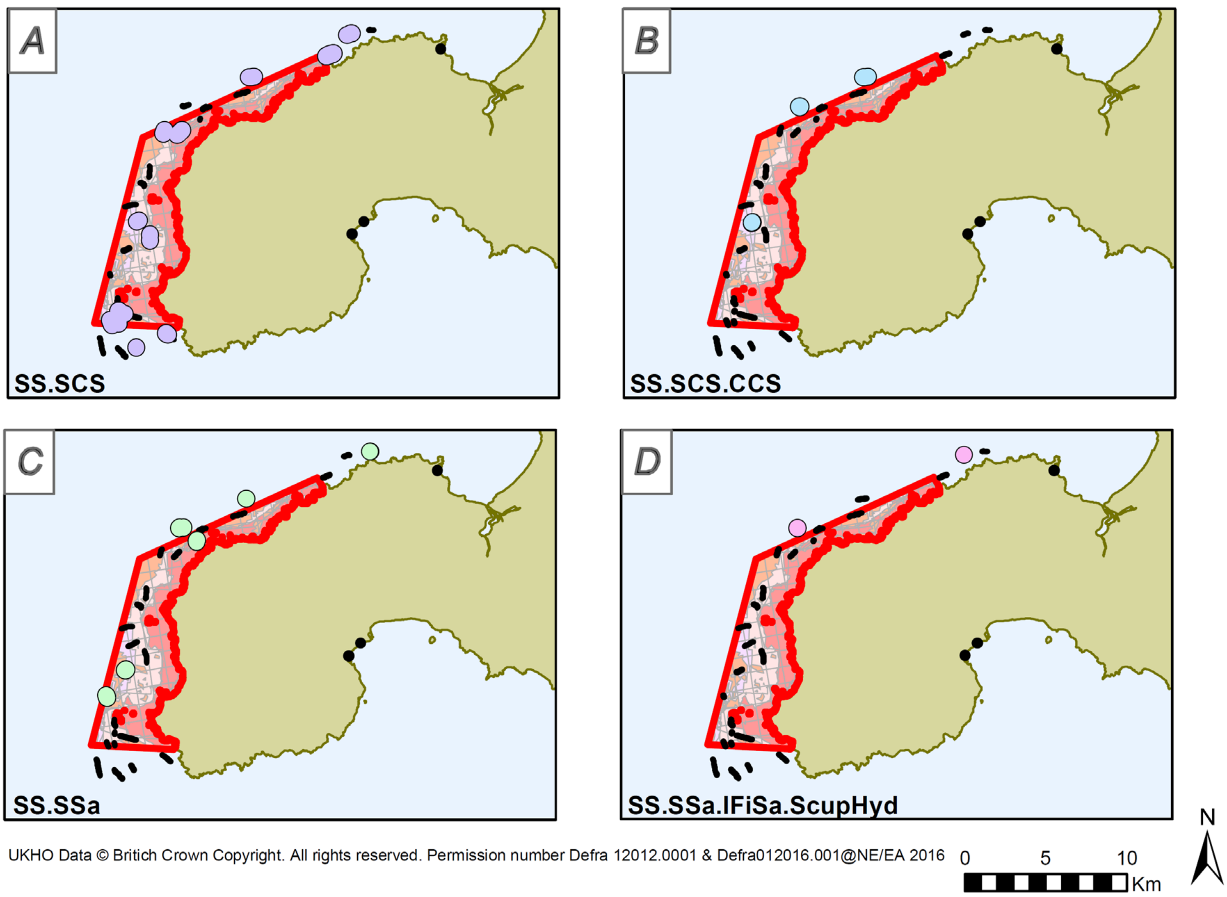


Figure 12. Distribution of still images captured during the 2018 Lands End and Cape Bank SAC survey assigned to biotopes within the 'A5.2 Subtidal sand' broadscale habitats (BSH). MNCR codes refer to Table 12. Background polygons are the modelled BSHs taken from the Marine Evidence database.

3.6 Temporal comparison

The following sections aim to gain insight into temporal changes occurring within the nearshore extent of Lands End and Cape Bank SAC. One aim of the 2018 survey was to revisit a number of sites surveyed in 2010 (Axelsson and Dewey, 2011). The locations of many of the stations surveyed in 2018 overlapped with or were within the vicinity of those visited in 2010. However, a number of nearshore stations visited in 2010 were not revisited in 2018. This includes stations in the vicinity of Gamper Bay in the south of the SAC, offshore of Botallack in the central area of the SAC, and offshore of Porthmeor Cove in the north of the SAC. These stations were visited in 2010 but not revisited in 2018 (Figure 16, Appendix 1 Supporting data). As such, this makes a like for like temporal comparison by station impossible. It is possible however to examine general trends across the SAC.

Reef feature extents

In both the 2010 and 2018 surveys, ‘A4.1 High energy circalittoral rock’ was the most commonly recorded rocky habitat and was distributed throughout the SAC (Table 1, Table 3). In both years, this habitat was distributed throughout the survey zone (Figure 2B, Figure 4D). There is no indication that the extent of this habitat within the SAC has significantly changed.

The lower energy ‘A4.2 Moderate energy circalittoral rock’ BSH was assigned to a similar proportion of images in 2018 than in 2010. The still images assigned to this BSH were distributed over a wider spatial range in 2018 (Figure 4F) than was observed in 2010 (Figure 2C).

A number of sites visited in 2010 were not revisited in 2018. This included sites in the nearshore area of the SAC between Cape Cornwall and Botallack Head (refer to Figure 16, Appendix 1 Supporting data). In 2010, this area contained a concentration of images assigned to the ‘A3.1 High energy infralittoral rock’ BSH (Figure 2A). This area was not revisited in 2018. As such, there was an apparent decline in the distribution of this habitat between the two surveys. Although this habitat was recorded in 2018, it was only recorded in the south of the SAC and in areas surveyed outside of the SAC boundary (Figure 4B). Aside from sites not revisited in 2018, this BSH was recorded in the same area in 2018 as was recorded in 2010.

Comparing the distribution of images assigned to infralittoral and circalittoral rock habitats, there is no evidence that the extent of these reef-associated habitats have changed between 2010 and 2018.

Taxon richness: overall trend

Comparisons were made between the 2018 still image data described in Section 3.5 and the data gathered as part of the 2010 survey (Axelsson and Dewey, 2011) to investigate whether there has been significant changes between the two monitoring events. These comparisons were made at the BSH (i.e., MNCR level 3) level. The aim of this approach was to minimise the potential subjectivity inherent in assigning imagery data to biotopes (see also Drew *et al*., 2008).

Comparing taxon richness values between years (with ‘year’ nested within each BSH), taxon richness was significantly higher in 2018 than in 2010 (Table 13). Post hoc pairwise comparisons showed that this difference was apparent in all three rocky BSHs in addition to the sedimentary ‘A5.1 Subtidal coarse sediment’ (all Holm adjusted pairwise comparisons significant at $p \leq 2.6 \times 10^{-9}$) (Figure 13).

Table 13. Nested ANOVA model summary outputs comparing taxon richness values recorded in 2010 and 2018 at Lands End and Cape Bank SAC. Values for a given year are nested within broadscale habitat (BSH).

	DF	Sum of Squares	Mean Square	*F*	*P*
BSH	3	13776	4592	192.8	<0.001
BSH:Year	4	12410	3102	130.3	<0.001
Residuals	898	21383	24		

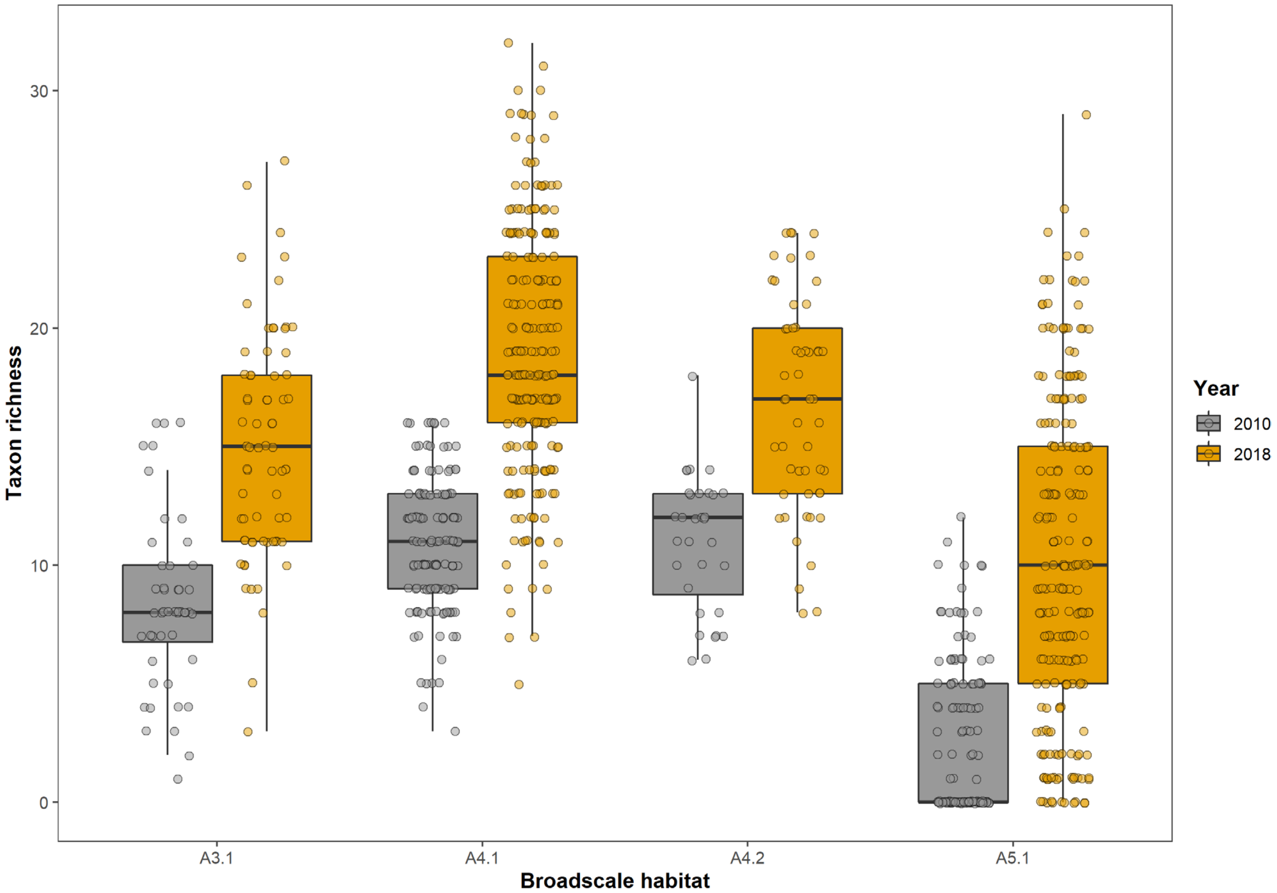


Figure 13. Taxon richness observed in broadscale habitat (BSHs) in 2010 and 2018 at Lands End and Cape Bank SAC ‘A5.2 Subtidal sand’ was not recorded in 2010 and so is excluded. A small amount of random noise was added to the positions of individual points to enhance visualisation of discrete count data. BSH codes refer to Table 3. The high number of zero counts in the ‘A5.1 Subtidal coarse sediment’ BSH is a reflection of this habitat being sedimentary. A large proportion of taxa in this habitat will be within the sediment and so less likely to be observed in imagery data.

Taxon richness: taxonomic resolution

There is potential that the apparent increase in taxon richness between 2010 and 2018 is linked to differences in the taxonomic resolution at which taxa were recorded in the two years. For example, if multiple bryozoan taxa recorded in 2018 were all recorded as a single 'Bryozoa' taxon during the 2010 monitoring, then this would result in a potentially misleading apparent increase in taxon richness between the two years.

It appears that taxonomic resolution was not a principal driver behind the observed difference in taxon richness. Although the taxonomic resolutions at which taxa were recorded were broadly similar between the two years (Table 14), a larger proportion of taxa were actually recorded at higher taxonomic resolutions (i.e., Family, Genus and Species taxonomic levels) in 2010 (66.8% of taxon observation) than in 2018 (55.9% of taxon observations). This would not be the case if differences in how taxa were recorded were driving the apparent increase in taxon richness between 2010 and 2018.

As such, it appears that the observed increase in taxon richness between 2010 and 2018 was not linked to the resolution at which taxa were recorded in the two years. Consideration of assemblage structures can potentially provide insight into the taxa driving the differences in assemblages between years.

Table 14. Resolution at which observed taxa were identified in still images in 2010 and 2018 at Lands End and Cape Bank SAC. Taxa recorded in the 'A5.2 Subtidal sand' were excluded as this broadscale habitat was not recorded in 2010.

	Percentage of observations (%)	
Taxonomic resolution	**2010**	**2018**
Kingdom*	0	7.12
Phylum	15.27	18.12
Class	17.8	10.5
Order	0.15	5.32
Family	12.7	14.87
Genus	8.99	6.46
Species	45.1	37.61

***'Unidentified faunal turf' was recorded in 2018**

Assemblage structure:

The sections above show that taxon richness was significantly higher in 2018 than in 2010. This does not appear to be linked to practical differences in how taxa were recorded in the two surveys.

Permutational analyses of variance were conducted for each BSH to investigate differences in the structure of assemblages between years. Analyses were conducted using the 'adonis2' function in the 'vegan' R package (McArdle and Anderson, 2001; Oksanen *et al*., 2022). As the 'A5.2 Subtidal sand' BSH was not recorded in 2010, these data were excluded from this analysis. Comparisons showed that assemblages differed between years in each of the four BSHs compared (Table 15).

Table 15. Model outputs comparing multivariate assemblages between years within the four BSHs recorded in still images at Lands End and Cape Bank SAC. Comparisons were based on presence-absence taxon data. Adjusted p values (p_{adj}) were corrected for multiple comparisons using Holm's (1979) method.

BSH	Model term	DF	Sum of Sq.	R^2	F	p	p_{adj}
A3.1 High energy infralittoral rock	Year	1	12.0	0.36	64.20	0.001	0.004
	Residual	115	21.38	0.64			
	Total	116	33.31	1			
A4.1 High energy circalittoral rock	Year	1	19.81	0.25	116	0.001	0.004
	Residual	347	59.26	0.75			
	Total	348	79.07	1			
A4.2 Moderate energy circalittoral rock	Year	1	6.63	0.33	41.65	0.001	0.004
	Residual	83	13.21	0.67			
	Total	84	19.84	1			
A5.1 Subtidal coarse sediment	Year	1	11.46	0.15	45.96	0.001	0.004
	Residual	269	67.06	0.85			
	Total	270	78.52	1			

Post hoc SIMPER analyses were conducted to identify the taxa driving these apparent differences between years. As the aim here was to identify which taxa were driving these differences, rather than to identify differences in the relative abundances of taxa between years, data were presence-absence transformed prior to analysis.

Across the four BSHs recorded in both 2010 and 2018, taxa were generally more commonly recorded in the 2018 data than the 2010 data. This is in keeping with the observed elevations in taxon richness values between the 2010 and 2018 data.

Within the 'A3.1 High energy infralittoral rock' BSH, there were frequent records of unidentified faunal turfs ('U_faunal_turf') in the 2018 data, with this taxon recorded in almost all of the images analysed within this BSH in 2018 (n = 66 of 69 images). No individual taxon was primarily responsible for the differences in assemblages within this BSH. Contributions to differences in assemblages were comparable across the 128 taxa recorded in the two sampling years (Table 21, Appendix 1 Supporting data). The majority (70%) of recorded taxa were however more prevalent in the 2018 data (n = 89 of the 128 taxa recorded in this BSH in both years). This includes various bryozoan taxa including *Alcyonidium diaphanum*, the spiny starfish *Marthasterias glacialis*, and various red algae such as *Delesseria sanguinea*, Corallinaceae, and *Cryptopleura ramosa*.

Similar to what was observed in the 'A3.1 High energy infralittoral rock' habitat, no individual taxon was a principal driver of temporal change within the 'A4.1 High energy circalittoral rock' BSH. Most of the 189 taxa observed in this BSH were more prevalent in 2018 (68%, n = 128) than in 2010 (32%, n = 61). As with the infralittoral data, faunal turfs were commonly recorded within this BSH. In addition to *A. diaphanum* and *M. glacialis* highlighted above, the solitary coral *Caryophyllia (Caryophyllia) smithii* was relatively common in this BSH in 2018, as well as other cnidarians (e.g., *Corynactis viridis*, *Nemertesia* spp.) and a range of bryozoan taxa (e.g. *Crisularia plumosa*, Crisiidae, and *Cellaria fistulosa*) (Table 22, Appendix 1 Supporting data).

Faunal turfs, *C. smithii*, and *A. diaphanum* were also more commonly recorded in 2018 compared with observations in the 2010 data (Table 23, Appendix 1 Supporting data). Tube-building worms (Family Serpulidae) were also relatively common in 2018. The majority of taxa recorded within this BSH were more prevalent in the 2018 data (69% of taxa, n = 86 of the 125 taxa recorded in this biotope). Despite this, a number of taxa responsible for distinguishing between the two surveys were actually more commonly recorded in 2010. This includes a number of sponges (e.g., *Clathria (Microciona)*, *Cliona celata*) and bryozoans (e.g., Crisiidae, *Crisularia plumosa*) (Table 23, Appendix 1 Supporting data).

Many of the taxa which differentiated between monitoring years in the 'A5.1 Subtidal coarse sediment' BSH are more typically associated with rock substrates than with sediment habitats. For example, bryozoans including *A. diaphanum*, encrusting sponges and bryozoans, and hydrozoans are all linked to rocky substrates and all were more commonly recorded in 2018 (Table 24, Appendix 1 Supporting data).

Biotopes and key taxa

As described above, the resolution at which individual taxa were identified did not differ substantially between 2010 and 2018. However, the resolutions at which biotopes were assigned to individual images did differ between the two surveys. A greater proportion of images were assigned to coarser (MNCR Level 3 and Level 4) biotope levels in 2018 compared to 2010 (Figure 14A). Much of this difference is related to the relatively high number of images assigned to sediment biotopes in 2018. The majority of sediment images gathered in 2018 were assigned to Level 3 biotopes (Figure 14B). The resolutions at which biotopes were assigned were more similar in rock habitats, though the 2018 images still had a greater proportion of images assigned at coarser biotope levels (Figure 14B).

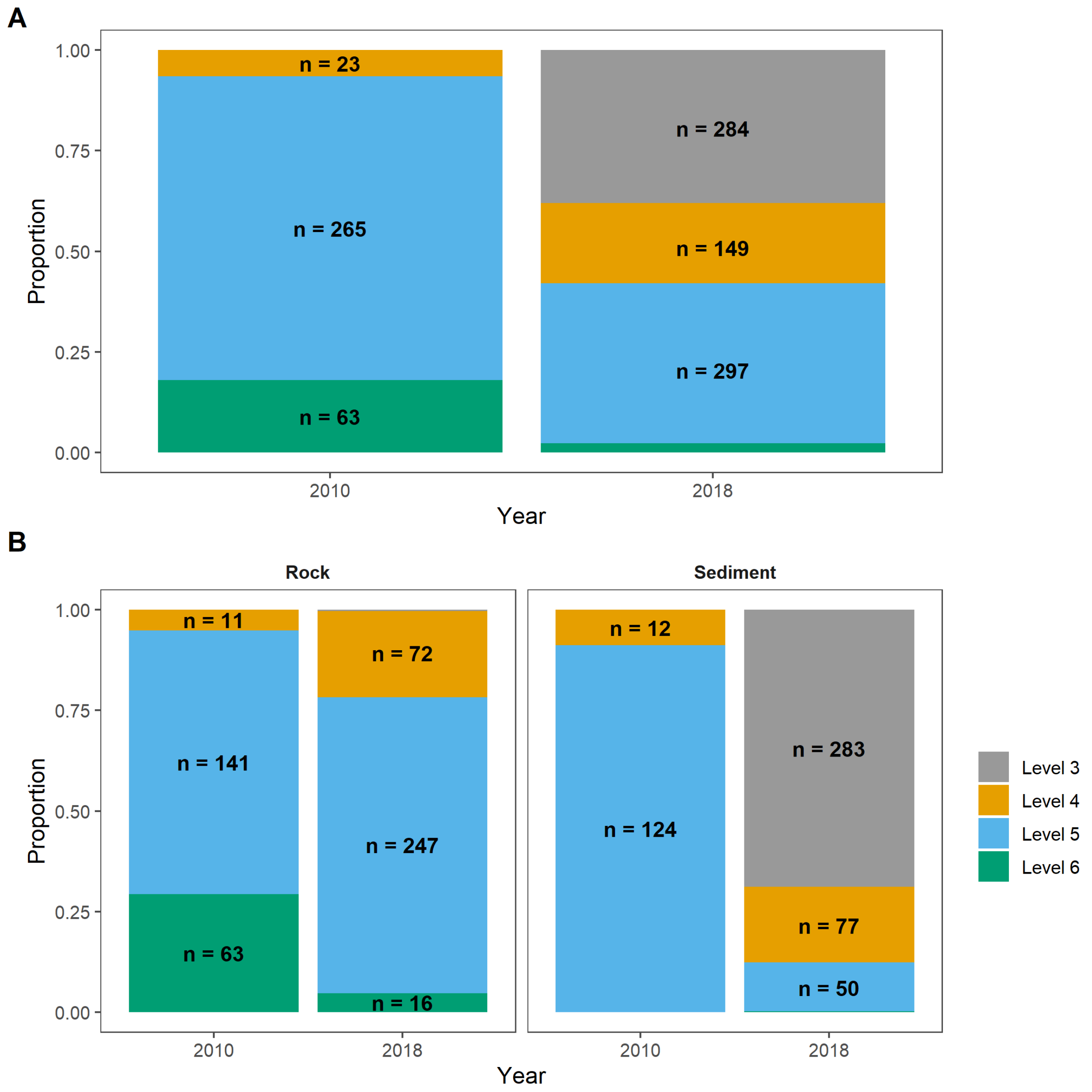


Figure 14. Proportion of still images assigned to different MNCR biotope levels in 2010 and 2018 at Lands End and Cape Bank SAC. A) Proportion of all images recorded in 2010 (n = 351) and 2018 (n = 747); B) Proportion of images split by rock and sediment habitats.

The differences in the resolutions of recorded biotopes make like for like comparisons of biotope distributions between the two years difficult. The Reg. 35 advice (Natural England, 2012) highlights a number of key biotopes as being characteristic of the nearshore area of Lands End SAC (see Section 1.1). These were derived from the biotopes recorded in previous monitoring activity (Birchenough *et al*., 2008; Axelsson and Dewey, 2011). Many of these biotopes were recorded in the 2018 survey (summarised in Table 20, Appendix 1 Supporting data). A number of key biotopes however were not recorded in 2018. These tended to be the higher resolution biotopes (MNCR level 5 and 6). It should be noted however that a number of key biotopes were also not recorded in the 2010 data.

In addition to highlighting key biotopes, previous reports and the Reg. 35 guidance also highlighted a number of key species. Many of these species are also characteristic of a number of biotopes within the SAC. As such, comparisons can be made of the distributions of individual key taxa between years to assist the detection of potential ecological changes at the community scale.

Of the 25 key species highlighted in the Reg. 35 advice (Natural England, 2012), 21 were also recorded in 2018. Three of the four key taxa not recorded in 2018 were species of red (n = 2) or brown (n = 1) algae. Those key species that were recorded in both 2010 and 2018 were recorded in a similar proportion of captured images (Table 19, Appendix 1 Supporting data).

The geographic distributions of key taxa were broadly similar in the 2010 and 2018 surveys (refer to Figure 17, Appendix 1 Supporting data). A number of taxa, including the jewel anemone *Corynactis viridis* and soft corals belonging to genus *Alcyonium*, were recorded across the extent of the SAC in 2010 and were similarly distributed in 2018. Other taxa, such as the pink sea fan *Eunicella verrucosa* were more patchily-distributed in both surveys.

Some taxa appear to have become more widespread between 2010 and 2018. The extent of the starfish *Marthasterias glacialis* in particular was recorded across a greater extent of the SAC (Figure 17, Appendix 1 Supporting data) and was recorded in a greater proportion of images within each BSH in 2018 (Table 16). Some taxa were less widespread in 2018. Much of this is likely to be linked to the relatively low proportion of images captured within shallower infralittoral habitats. That is, also the distribution of algal taxa appears relatively low in 2018 compared to 2010 (Figure 17, Appendix 1 Supporting data), the proportion of images within which algal taxa were recorded was broadly similar between the two surveys (Table 16). As such, there was no strong evidence of significant changes to any of the distributions of notable or characteristic taxa between the two surveys.

A number of taxa considered as being vulnerable to disturbance were also highlighted by Axelsson and Dewey (2011). As with the noteworthy taxa, no significant reductions in the distribution of these taxa were apparent in 2018. The distribution of some vulnerable taxa, including the turf-forming bryozoan *Cellaria* spp. and the large hydroid *Nemertesia* spp. showed relatively wider distributions in the 2018 data than in 2010 (Figure 17, Appendix 1 Supporting data).

Table 16. Observations of taxa considered as characteristic of Lands End and Cape Bank SAC in the 2010 and 2017 surveys (refer to Section 1.1 and Axelsson and Dewey, 2011). Values indicate the percentage (and number) of images within each broadscale habitat in which each taxon was recorded.

Taxon	A3.1 - High energy infralittoral rock		A4.1 - High energy circalittoral rock		A4.2 – Moderate energy circalittoral rock		A5.1 – Subtidal coarse sediment	
	2010	2017	2010	2010	2010	2017	2010	2010
	(n = 48)	(n = 69)	(n = 135)	(n = 214)	(n = 32)	(n = 53)	(n = 136)	(n = 219)
Laminaria hyperborea	16.7% (8)	29% (20)	0%	0%	0%	0%	0%	0%
Dictyopteris polypodioides	56.3% (27)	31.9% (22)	0.7% (1)	0.5% (1)	0%	0%	0%	0%
Delesseria sanguinea	47.9% (23)	56.5% (39)	2.2% (3)	0%	0%	0%	0%	0%
Drachiella spectabilis	22.9% (11)	0%	0%	0%	0%	0%	0%	0%
Marthasterias glacialis	14.6% (7)	43.5% (30)	8.1% (11)	57.5% (123)	0%	20.8% (11)	0.7% (1)	8.7% (19)
Stolonica socialis	0%	14.5% (10)	8.9% (12)	30.4% (65)	0%	34% (18)	0.7% (1)	3.7% (8)
Corynactis viridis	2.1% (1)	33.3% (23)	51.1% (69)	68.2% (146)	65.6% (21)	39.6% (21)	7.4% (10)	4.6% (10)
Alcyonium digitatum	22.9% (11)	34.8% (24)	73.3% (99)	85.5% (183)	90.6% (29)	75.5% (40)	8.8% (12)	14.2% (31)
Alcyonium glomeratum	0%	0%	1.5% (2)	0.9% (2)	0%	0%	0%	0%
Eunicella verrucosa	0%	0%	2.2% (3)	2.3% (5)	0%	0%	0%	0%
Pentapora spp.	8.3% (4)	0%	31.1% (42)	24.8% (53)	28.1% (9)	9.4% (5)	5.1% (7)	3.2% (7)

3.7 Non-indigenous species (NIS) (Objective 3)

The taxa identified in the still and video imagery data in 2018 were cross-referenced against the list of non-indigenous species (NIS) compiled by Eno *et al.,* (1997), the UKMS (formerly MSFD) UK priority monitoring species list 2020–2021 (GB Non-Native Species Secretariat, 2021) and the WER (Water Environment Regulations) (formerly WFD) Technical Advisory Group impact list (WFD UK TAG, 2015). No listed NIS species were recorded in the 2018 data.

Within the 2018 data, many taxa were recorded at broader taxonomic levels, or were recorded using morphological descriptors, rather than being recorded at the species level as provided in the NIS list (Appendix 2 Non-indigenous species). As such, although no specific NIS were recorded in 2018, there is potential that taxa recorded at coarser taxonomic levels could include NIS. It should be noted however, that the coarse taxonomic levels recorded for a number of records in 2018 could potentially include a large number of taxa, of which very few are considered as NIS. For example, amphipods belonging to Genus *Caprella* were recorded in 2018. This is a large genus, containing over 150 species, of which one *Caprella mutica* is considered a non-indigenous taxon in UK waters.

Table 17. Summary of taxa assigned to high level taxonomic groups during the 2018 Lands End and Cape Bank SAC which could potentially contain non-indigenous species (NIS). The NIS used for comparison are provided in Appendix 2 Non-indigenous species.

Taxon recorded	Major taxonomic group	Occurrences	Potential NIS
Serpulidae	Polychaeta	371	*Ficopomatus enigmaticus*
Caprella	Amphipoda	9	*Caprella mutica*
Decapoda	Decapoda	18	Six potential NIS (*Paralithodes camtschaticus, Homarus americanus, Dyspanopeus sayi, Eriocheir sinensis, Hemigrapsus sanguineus,* and *Hemigrapsus takanoi*)
Didemnidae	Ascidiacea	10	*Didemnum vexillum*
Ascidiacea	Ascidiacea	59	Five potential NIS (*Didemnum vexillum, Ciona savignyi, Corella eumyota, Asterocarpa humilis,* and *Styela clava*)
Actiniaria	Cnidaria	105	*Diadumene lineata*
Asteroidea	Echinodermata	4	*Asterias amurensis*
Pectinidae	Bivalvia	4	*Mizuhopecten yessoensis*

Taxon recorded	Major taxonomic group	Occurrences	Potential NIS
Littorinimorpha	Gastropoda	1	*Crepidula fornicata*
Gastropoda		70	Four potential NIS (*Crepidula fornicata, Ocinebrellus inornatus, Rapana venosa,* and *Urosalpinx cinerea*)
Phaeophyceae	Ochrophyta	74	Two potential NIS (*Sargassum muticum*, and *Undaria pinnatifida*)
Rhodophyta	Rhodophyta	287	Seven potential NIS (*Asparagopsis armata, Botryocladia wrightii, Bonnemaisonia hamifera, Polysiphonia subtilissima, Caulacanthus okamurae, Agarophyton vermiculophyllum,* and *Grateloupia turuturu*)

3.8 Observed anthropogenic activities and pressures (Objective 4)

Litter of some sort was recorded in three of the still images captured in the 2018 survey. All three images were assigned to the 'A4.1 High energy circalittoral rock' BSH. The litter in two of the images was tentatively flagged as fishing gear (reported as "*Fishing gear?*"). Recorded litter items were not assigned to pre-determined categories, but fishing gear would fall under category 'A5 Fishing line (monofilament)', 'A6 Fishing line (entangled)', or 'A8 Fishing net' of the Marine Strategy Directive litter categories (European Commission, 2013) It was not possible to identify the litter in the third image (reported as "*Possible litter present – indet. object between cobbles*").

Litter was also flagged in 12 video segments. Seven video segments were flagged as containing fishing gear and related items (five images reported as "*rope/line*", two images reported as "*?fishing gear*"). These could correspond to the three litter categories highlighted for the still imagery. One item each were labelled as "*clothing*", "*rubber?*", and "*frisbee?*". The clothing item could be categorised as 'E1 Clothing/rags' and the rubber as 'F5 Other'. No identifier was assigned for litter recorded in two video segments beyond recording as '*Litter*'.

Litter items were concentrated in the central portion of the survey zone, typically located 2-3 km offshore between Whitesand Bay in the south and Cape Cornwall in the north (Figure 15).

No additional evidence of anthropogenic disturbances or pressures were recorded in the imagery or survey log data.

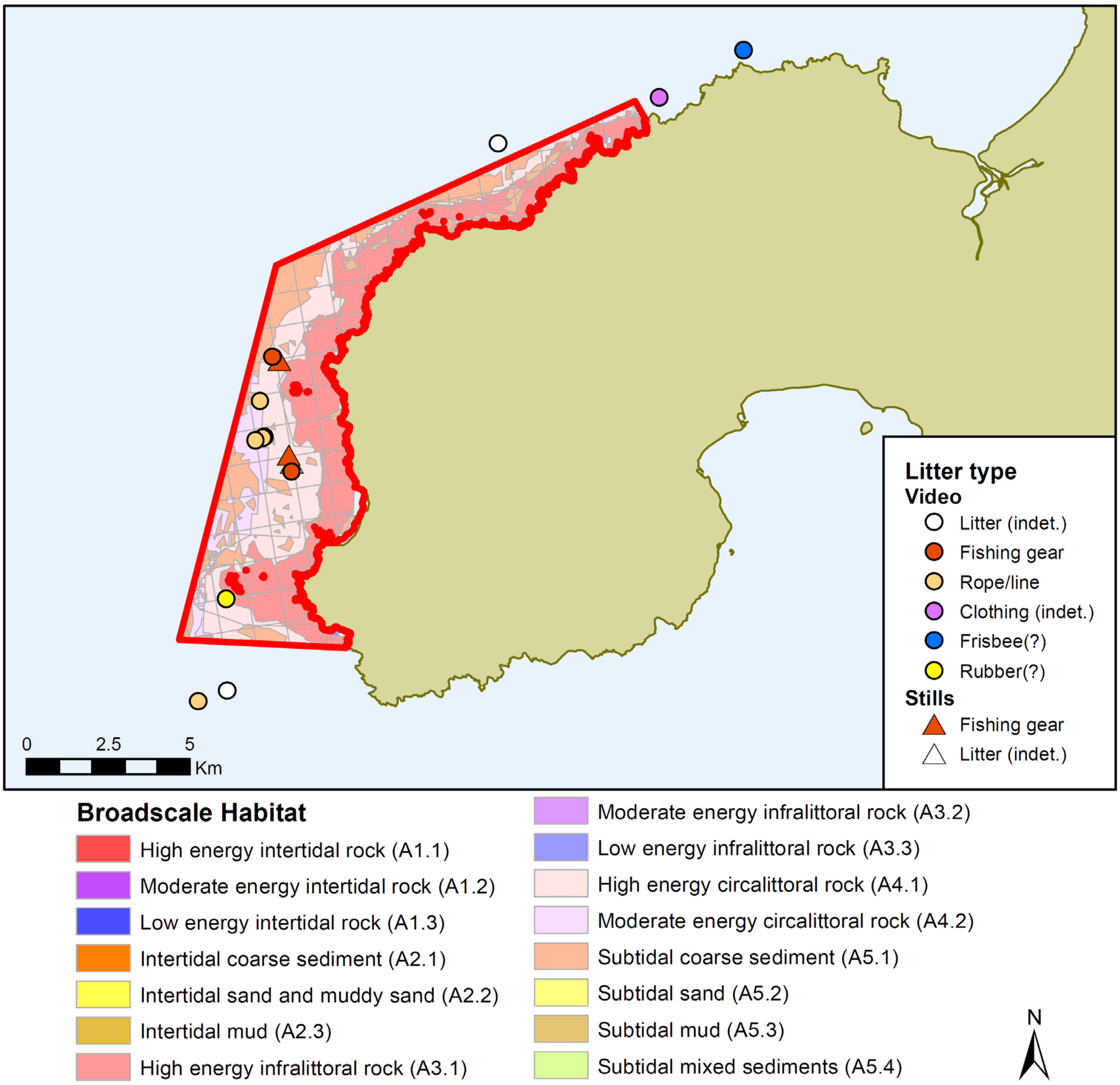


Figure 15. Location of litter items recorded in still (n = 3) and video (n = 12) imagery during the 2018 survey of Lands End and Cape Bank SAC. Background polygons are the modelled broadscale habitats taken from the Marine Evidence database.

4. Discussion

The 2018 monitoring survey provided information on the designated features of the nearshore (‘Lands End’) region of Lands End and Cape Bank SAC. This discussion reviews and summarises this evidence and provides an indicative assessment of the relevant features. No previous condition assessment has been published for Lands End and Cape Bank SAC. However, the 2010 report (Axelsson and Dewey, 2011) did provide a preliminary assessment of the condition of the SAC based on the information available at the time. That report considered that the imagery data gathered in 2010 reflected an ‘excellent’ representation of Annex I reef habitats. The authors concluded that all of the considered features of the site to be in ‘good’ or ‘excellent’ condition (Axelsson and Dewey, 2011).

4.1 Extent of reef features within Lands End and Cape Bank SAC

Annex I reefs were identified in over half of the images captured in 2018. As the 2018 survey was not designed with the specific intention of mapping reef features associated with the SAC, a thorough and quantitative assessment of the extent of reef habitats cannot be made. It is clear however that reef habitats were widespread throughout the SAC in 2018. Baseline extents of Annex I reefs were mapped in 2007 (Birchenough et al., 2008) and the extents inferred from the 2010 baseline monitoring agreed with those data (Axelsson and Dewey, 2011).

The location of stations visited in 2018 did not perfectly match those visited previously. However, many of the sites visited in 2018 were in close vicinity of those visited in 2010 (though it should be noted that a number of 2010 sites were not revisited in 2018). A substantial change in the extent of Annex I reefs over time would be indicated by differences in the observed distribution of reefs between the two years. The distribution of Annex I reefs in the 2018 data was broadly similar to that recorded previously. As such, there is no evidence that the extent of this feature has changed. As there is no apparent change to the extent of Annex I reefs within the SAC, this corresponds to a **favourable assessment**.

Given that the 2018 survey did not seek to explicitly quantify the extent of reefs, no data on the extent of individual reef sub-features is available. As such, this assessment can only be made with **low confidence**. A specific survey would be required to quantitatively assess the extent of reef features within the near-shore region of Lands End and Cape Bank SAC.

4.2 Presence, distribution, and composition of biological communities

The resolutions at which biotopes were assigned in the 2018 data was typically coarser than those reported in 2010 (Axelsson and Dewey, 2011). In 2010, 93% of images were assigned at MNCR level 5 or level 6 biotopes. In 2018, only 42% of images were assigned at this resolution, with the remaining 58% assigned at coarser MNCR level 3 and level 4 (i.e., habitat level) resolutions. This makes a like for like comparison of biotopes between years difficult.

The Reg. 35 advice (Natural England, 2012) highlighted a number of key biotopes and key taxa for the near-shore area of Lands End and Cape Bank SAC. The majority of these key biotopes were recorded in 2018. Those biotopes that were not recorded in 2018 were characteristic of shallow infralittoral rock habitats. A number of stations which housed infralittoral habitats and biotopes in 2010 were not revisited in 2018 and this (at least in part) explains their relative lack of occurrence in the 2018 data.

A similar number of key biotopes were also absent from the 2010 data (n = 8 of 22 key biotopes not recorded) than were absent from the 2018 data (n = 10 of 22 key biotopes not recorded). The 'missing' key biotopes from the 2018 data are also linked to biotope resolutions. As biotopes were recorded at a coarser level in 2018, it follows that MNCR level 5 and level 6 biotopes will be under-represented. The mean ± SD MNCR level of 'missing' key biotopes in 2018 was MNCR level 5.2 ± 0.8 suggesting that high resolution biotopes were under-represented in 2018. Coarser MNCR level (i.e., habitat level) occurrences of all of the key biotopes were recorded in 2018. As such, there is no evidence of substantial change to the presence of biotopes within the SAC.

The Reg. 35 advice (Natural England, 2012) also highlighted a number of key taxa that were notable or characteristic of the near-shore area of Lands End and Cape Bank SAC. Many of these taxa are also indicative of their associated biotopes. As such, consideration of the distribution of individual taxa provides a useful proxy for assessing the presence, distribution, and composition of biological communities.

The key taxa identified in the Reg. 35 advice were generally widely distributed throughout the SAC in 2018. This includes a number of taxa which are likely to be sensitive to physical disturbance. For example, soft corals belonging to genus *Pentapora* were widely distributed in 2018, similar to the distribution reported in 2010 (Axelsson and Dewey, 2011). A number of taxa, such as the pink sea fan *Eunicella verrucosa* remained patchily-distributed in 2018. This was similarly distributed in 2010.

A number of algal taxa associated with infralittoral habitats were recorded less commonly in 2018. This is linked to there being fewer images captured in shallower infralittoral rock habitats in 2018 compared to the 2010 survey. As described in Section 2.1, a number of stations visited in 2010 were not revisited in 2018. This included stations which were recorded as infralittoral rock habitats in 2010. As such, the relative lack of algal taxa in the

2018 data reflects differences in the survey locations rather than a change to the ecology, or the condition of the SAC. The presence and distribution of taxa in 2018 was similar to that reported in 2010. As such, this corresponds to **favourable condition** for this attribute. However, as this preliminary assessment is largely reliant on individual taxa rather than biotopes, and given that infralittoral rock habitats are relatively underrepresented, the preliminary assessment must be made at **low confidence**.

4.3 Conservation of structure and function

Natural England guidance is currently under development to enable practitioners to identify the species that are key contributors to the structure and function of protected areas. When available, such guidance will allow greater confidence and consistency in the assessment of structure and function in protected areas.

Conservation of structure

A number of taxa could be considered as being particularly sensitive to physical damage within rocky subtidal habitats. Such taxa often share a number of physical, physiological, behavioural, and ecological traits. Traits which are considered particularly susceptible to impact include slow-growth rate and short dispersal potential, long lifespans, physical fragility and/or a sessile nature (e.g., Kaiser, *et al.,* 2017).

A number of taxa were highlighted following the 2010 survey as being potentially sensitive to physical damage (Axelsson and Dewey, 2011). These included Ross coral *Pentapora fascialis*, pink sea fan *Eunicella verrucosa*, branching sponges (*Raspailia* spp.), turf forming bryozoans (*Cellaria* spp.), and large hydroid species (*Nemertesia* spp.). All of these taxa were recorded in the 2018 data and there was no evidence of substantial changes to their distributions since 2010.

The presence and extents over which these taxa were recorded reflects that the structure of the SAC is currently at **favourable condition**. Given that there is currently no published guidance on the assessment of conservation of structure and as a result of the limitations in the data for temporal comparisons, this preliminary assessment is made with **low confidence**.

Influential species

A number of taxa were recorded in 2018 that could be regarded as influential with regards to the physical structure and ecological functioning of Lands End and Cape Bank SAC. In addition, many of these taxa are likely to be sensitive to anthropogenic disturbance within the SAC (see Axelsson and Dewey, 2011). As such, these taxa have the potential to be considered as influential indicator species:

- Bryozoan taxa – bryozoans such as Ross coral *Pentapora fascialis* and sea chervil *Alcyonidium diaphanum* can form extensive turfs on exposed rock. As such, they therefore have the potential to influence the physical nature of the benthic environment, by providing refugia for other species within the benthos. In addition, bryozoans have the potential to influence the functioning of the ecosystem, with taxa actively filtering materials from the water column as they feed and therefore influencing benthic-pelagic coupling. Bryozoan taxa were widely distributed throughout the SAC in both the 2018 and 2010 surveys.
- Cnidarians and hydroids – similar to the bryozoans summarised above, cnidarians and hydrozoans were also widely distributed throughout the near-shore area of Lands End and Cape Bank SAC. As with bryozoans, these taxa influence the physical nature of the habitat. These taxa are often considered as being sensitive to physical disturbance. Some, such as pink sea fan *Eunicella verrucosa*, are large and slow-growing and have associated communities relying on them for refugia (Readman *et al*., 2018). However, unlike other widespread cnidarians such as Dead man's fingers *Alcyonium digitatum*, pink sea fan was recorded in relatively few images in the 2010 and 2018 surveys.
- Sponges – the rock boring sponge *Cliona celata* was highlighted in the Reg. 35 advice document (Natural England, 2012) as being key species for the near-shore coastal area of the Lands End and Cape Bank SAC. This is a large and often conspicuous species. However, given that the species burrows directly into the rocky benthos and that it has a tough and inflexible outer layer (Snowden, 2007), it is perhaps less sensitive to physical disturbance. The larger surface area of branching sponges means that they are potentially at greater risk of anthropogenic disturbance. They also likely contribute to ecological function, contributing to habitat heterogeneity and directly influencing the movement of energy and materials within the marine environment. As part of the 2010 report, Axelsson and Dewey (2011) highlighted that branching spores such as *Raspailia* spp. are a potentially good indicator species. Branching sponges have also been used as indicators of human disturbance in other reef habitats (Kaiser, *et al.,* 2017).

As the distributions of these potentially influential species showed no sign of negative change in the 2018 data, the preliminary assessment of is considered to be **favourable**. As no guidance on the selection and assessment of influential species has been published to date, and limitations in the data for temporal comparisons this preliminary assessment is made with **low confidence**.

Conservation of function

The functioning of ecosystems is intrinsically tied to the biological and non-biological processes happening within (Naeem *et al*., 2002). Ecosystem functions include processes such as the flow of energy and materials within the ecosystem, biogeochemical cycles, the productivity of biological components and the provision of habitat structure. To assess their contributions to ecosystem functioning, investigation of the biological traits expressed by species within protected areas would be beneficial. Biological traits analysis, in addition to assessments of taxonomic and functional diversity would provide evidence of how the functioning of the site is being conserved (Frid *et al*., 2008; Froján *et al*., 2011). This approach is recommended for future assessments within Lands End and Cape Bank SAC and other protected areas (see Section 5).

The 2008 (Bichenough *et al*., 2008) and 2010 monitoring reports (Axelsson and Dewey, 2011) concluded that the assemblages observed at the time provided excellent ecological structure and conservation of function. The 2018 data suggest no fundamental changes to the broad structure of the SAC features and the associated biological communities which drive ecosystem functioning. As such, the near-shore coastal area of Lands End and Cape Bank SAC receives a preliminary assessment of **favourable condition** for conservation of function. Without published guidance on how this aspect of the SAC should be assessed, this preliminary assessment can only be made with **low confidence**.

4.4 Non-native species and pathogens

No taxa listed on the non-indigenous species (NIS) list were recorded in the 2018 survey. There is the potential however, that NIS were in fact present during the survey. Many taxon records in the 2018 data were made either at relatively coarse taxonomic levels, or were made using morphological descriptors, rather than accepted taxonomic nomenclature. The taxa recorded under these broad groups could include NIS.

In addition to no observations made of NIS in 2018, there was also no explicit record of NIS in the 2010 data. However, as with the 2018 data, the 2010 data included records of taxa at higher taxonomic levels which could potentially include NIS. For example, the 2010 data identified polychaete worms belonging to family Serpulidae. As well as native taxa, this family includes the NIS *Ficopomatus enigmaticus*. As such, although no NIS have been conclusively recorded within the SAC, the presence of such taxa cannot be ruled out entirely.

No evidence of pathogens or diseased organisms were recorded in the 2018 survey data. Taxa such as the pink sea fan *Eunicella verrucosa* are susceptible to disease which manifests as a blackening or necrosis of the organism's body (e.g., Hall-Spencer *et al*., 2007). No observations of such necrosis were recorded in either the 2018 or 2010 data. However, assessment of the condition of this species was not an objective of the 2018 monitoring survey.

No NIS taxa were explicitly recorded in either the 2017 or 2010 surveys and no record of diseased taxa were made in either survey. As such, a preliminary assessment of **favourable condition** is made. There is however the potential for NIS to have been present but grouped at a broader taxonomic level. In addition, the survey was not specifically aimed at assessing the health or condition of individual organisms. As such, this preliminary assessment is made with **low confidence**.

4.5 Observed anthropogenic activities and pressures

Consideration of anthropogenic activities and pressures contributes to reporting Objective 4 (Section 1.3). Marine litter was not extensively recorded in the 2018 imagery data. Observations of litter were recorded in 3 still images and in 12 video segments. The majority of observed litter items were linked to fishing activity, with miscellaneous litter items also recorded. There was not evidence of habitat damage as a result of anthropogenic activities and pressures in 2018 and this is in keeping with what was recorded as part of the 2010 report (Axelsson and Dewey, 2011).

4.6 Preliminary condition assessment

Table 18. Summary of preliminary condition assessment of Lands End and Cape Bank SAC (refer to Sections 4.1 to 4.4 for further information).

Feature/attribute	Feature/ Subfeature	Target	Preliminary condition assessment
Extent and distribution	Annexe I reefs; Infralittoral rock; Circalittoral rock	Maintain the total extent of reef habitat at 24,938ha, and spatial distribution as defined on the map, subject to natural variation in sediment veneer.	The 2018 survey did not assess habitat or feature extents. There was no indication of change from previous surveys. **Favourable (low confidence)**.
Distribution: presence and distribution of biological communities	Annexe I reefs; Infralittoral rock; Circalittoral rock	Maintain the presence and spatial distribution of reef communities	No evidence of change from existing baseline. **Favourable (low confidence)**.
Structure: species composition of component communities	Annexe I reefs; Infralittoral rock; Circalittoral rock	Maintain the species composition of component communities	No evidence of change from existing baseline. **Favourable (low confidence)**.
Structure and function: presence and abundance of key structural and influential species	Annexe I reefs; Infralittoral rock; Circalittoral rock	[Maintain OR Recover OR Restore] the abundance of listed species, to enable each of them to be a viable component of the habitat.	*Structure*: **Favourable (low confidence)** *Influential species*: **Favourable (low confidence)** *Function*: **Favourable (low confidence)**
Structure: non-native species and pathogens (habitat)	Annexe I reefs; Infralittoral rock; Circalittoral rock	Restrict the introduction and spread of non-native species and pathogens, and their impacts	No explicit identification of NIS or pathogens. **Favourable** (**low confidence**)

5 Recommendations for future monitoring (Objective 5)

- **Maximise resolution of biotope identification** – as far as possible, assessments of changes over time should be based on like-for-like comparisons. The current report aimed to assess changes in the presence and distribution of biotopes between 2010 and 2018 surveys. In 2010, biotopes were typically assigned at a higher resolution than those in 2018. As such, direct comparison of the two surveys was more difficult. Despite biotopes being recorded at a coarser resolution, taxonomic data were comparable between the two surveys. This allowed assemblages to be broadly compared between years. It is clear that future monitoring should aim to maximise the quality of the data reported, in particular aiming to gather biotope data at as high a resolution as possible. This would ensure that any changes in the presence, location, extent and distribution of habitats and species are more readily detected.
- **Bespoke reef extent surveys** – given the lack of bespoke surveys to allow quantitative measurement of the extent of Annex I reef habitats within the SAC, it is difficult to confidently assess whether the distribution of these habitats is changing over time. A bespoke survey would allow a more thorough assessment of change and would also inform the design of future monitoring work, allowing targeted monitoring of particular areas of reef habitat to be made.
- **Identification of key structural and functional taxa** – guidance is required to assist with the identification of key structural and functional taxa in protected sites. This would allow for the consistent and objective identification of such taxa and inform robust identification of trends over time.
- **Incorporation of biological traits analyses** – although informative, species composition, biodiversity measures and biotope descriptions can provide only limited information on the ecological functioning of assemblages. The diversity of biological and ecological traits expressed within assemblages would provide valuable additional insight into the ecological functioning of protected sites. This would give us an improved understanding of the condition and resilience of designated sites and provide valuable insight into the determination of key functional and structural taxa within the site. Furthermore, analyses could be carried out on the data already gathered, without modification to the sampling approaches already adopted. In addition, many traits, such as the morphological traits which are important mediators of many ecological functions (for example, habitat provision, taxon palatability) are conserved even at relatively coarse taxonomic resolutions. This means that valuable information on functional diversity and trait diversity can still be inferred even where it is not possible to identify taxa to species level.

- **Update habitat maps** – the information gathered in the 2018 Lands End and Cape Bank SAC survey should be incorporated into an updated habitat map. Although the existing habitat map provided a reasonable prediction of the broadscale habitats (BSH) recorded in 2018, a number of minor discrepancies were apparent. An updated habitat map would provide a more realistic and up to date view of the distribution of habitats within Lands End and Cape Bank SAC. This would inform future monitoring and provide a more accurate baseline against which future change could be compared.
- **Fixed locations for long term monitoring/temporal comparisons** – mosaic-like distributions of habitats and biotopes are typical of rocky benthic habitats in high and moderate energy environments. As such, there is the potential for considerable spatial variability in the analysis of such data. Revisiting fixed monitoring locations would reduce the impact of spatial variability and increase our confidence in the assessment of any change in monitored habitats and biotopes over time.
- **Imagery interpretation QA procedure development –** Categorisation of BSH type and biotope from digital images is prone to a degree of subjectivity and therefore potential inconsistencies in the results. Guidance exists to standardise the approach in determining BSH and biotopes from imagery (e.g., Turner *et al*., 2016), but there remains the potential for inconsistencies to occur in categorising BSH and biotopes. This primarily arises from variation in analyst experience and skills and ambiguity in the criteria and terminology used to define BSH types and biotopes. These issues of consistency will be exacerbated by differences in image quality. Consistent determination of BSH or biotope is important in correctly confirming the presence of the protected features and when comparing time series data where such factors such as the individual analyst and image quality are likely to change. The risks of inconsistent BSH and biotope categorisation may be reduced by the addition of quality assurance procedures (e.g. checks by second analyst) with associated remedial actions and the replacement of subjective terminology with quantitative criteria in defining BSH types and biotopes where possible. It is recommended that these aspects are considered in revisions to image interpretation procedures and BSH type and biotope definitions.

References

AXELSSON, M. AND DEWEY, S., 2011. Lizard Point cSAC and Land's End & Cape Bank cSAC baseline surveys 2010. Drop-down camera (stills photography and video) and Remotely Operated Vehicle (ROV) surveys. Southampton: SeaStar Survey Ltd.

BIRCHENOUGH, S.N.R., COGGAN, R.A., LIMPENNY, D.S, BARRIO-FROJAN, C., JAMES, J.W.C., TYLER-WALTERS, H., KIRBY, S. J. AND BOYD, S.E. 2008. Offshore Special Area of Conservation: The Lizard Point. SAC selection assessment. Acquisition of Survey data and preparation of Site Briefing Statements for Draft Marine Special Areas of Conservation within the 0-12 Nautical Mile Zone. A Report for CEFAS.

CLARKE, K.R. 1993. Non-parametric multivariate analyses of changes in community structure. Australian Journal of Ecology, 18, 117–143.

CLARKE, K.R. AND WARWICK, R. M. 2001. Change in marine communities: an approach to statistical analysis and interpretation, 2nd edition. PRIMER-E: Plymouth.

COGGAN, R., MITCHELL, A., WHITE, J. AND GOLDING, N. 2007. Recommended operating guidelines (ROG) for underwater video and photographic imaging techniques. Mapping European Seabed Habitats (MESH) video working group report v.11.2 [online]. Available online: http://www.emodnet-seabedhabitats.eu/PDF/GMHM3_Video_ROG.pdf [Accessed 25/05/2022].

COVEY, R., PIRIE, C., CLIFTON, S. AND JENNER, L. 2016. Typical Species - achieving the benefits while avoiding the pitfalls. Natural England.

CURTIS, L.A. 2017. Analysis of stills and video footage collected from Lyme Bay and Torbay Site of Community Importance. Report Number: ER17-326: Ecospan Environmental Limited Report to Natural England.

DREW, S., SAVAGE, A., CHAPMAN, A., WATSON, H., POMFRET, J., SOTHERAN, I. AND FOSTER-SMITH, B. 2008. Natural England SAC Site Selection Assessment. Greater Thames Estuary. Contract FST20-18-030 Acquisition of survey data and preparation of site specific briefing statements for draft marine SACs.

ELLIOTT, M., NEDWELL, S., JONES, N., READ, S.J., CUTTS, N.D. AND HEMINGWAY, K.L. 1998. Volume II: Intertidal sand and mudflats and subtidal mobile sandbanks. An overview of dynamic and sensitivity characteristics for conservation management of marine SACs. UK Marine SACs project, Oban, Scotland. English Nature.

ENO, N.C., CLARK, R.A. AND SANDERSON, W.G. (eds.). 1997. Non-native marine species in British waters: a review and directory. Peterborough: Joint Nature Conservation Committee.

EUROPEAN COMMISSION. 2013. Guidance on monitoring of marine litter in European Seas. MSFD Technical Subgroup on Marine Litter. JRC Scientific and Policy Reports. Available from: https://circabc.europa.eu/sd/a/d3d0aa0f-c4c2-4b82-afe8-79f9f4d23560/MSCG-11_2013_10c%20MSFD%20Guidance%20on%20Monitoring%20Marine%20Litter.pdf [Accessed 11/05/2022].

FRID, C.L.J., PARAMOR, O.A.L., BROCKINGTON, S. AND BREMNER, J. 2008. Incorporating ecological functioning into the designation and management of marine protected areas. In: Davenport, J., Burnell, G.M., Cross, T., Emmerson, M., McAllen, R., Ramsay, R. AND Rogan, E. Challenges to Marine Ecosystems, Developments in Hydrobiology, vol 202. https://doi.org/10.1007/978-1-4020-8808-7_7

FROJÁN, C.R.S.B., COOPER, K.M. BREMNER, J., DEFEW, E.C., HUSSIN, W.M.R.W., PATERSON, D.M. 2011. Assessing the recovery of functional diversity after sustained sediment screening at an aggregate dredging site in the North Sea. Estuarine, Coastal and Shelf Science, 92(3): 358-366.

GB NON NATIVE SPECIES SECRETARIAT. 2021. Marine Pathways Group. Reports, Documents and Links. MSFD UK Priority Monitoring Species List 2020–2021. Available from: http://www.nonnativespecies.org/index.cfm?pageid=597 [Accessed 04/05/2022].

HALL-SPENCER J.M., PIKE J. AND MUNN, C.B. 2007. Diseases affect cold water corals too: *Eunicella verrucosa* (Cnidaria: Gorgonacea) necrosis in SW England. Diseases of Aquatic Organisms 76: 87-97.

HOLM, S. 1979. A simple sequentially rejective multiple test procedure. Scandinavian Journal of Statistics, 6(2), 65–70.

JENKIN, A., STURGEON, S., TRUNDLE, C., NAYLOR, H. AND OWEN, K., 2018. Cruise Report: Monitoring Survey of the Lands End and Cape Bank SAC. Cornwall Inshore Fisheries and Conservation Authority (CIFCA), Hayle.

JNCC. 2004. Common standards monitoring guidance for littoral rock and inshore sublittoral rock habitats. Peterborough, JNCC. Peterborough, UK. Available online: Common Standards Monitoring Guidance for Littoral Rock and Inshore Sublittoral Rock Habitats (jncc.gov.uk) [accessed 18/03/2022].

JNCC. 2022. The Marine Habitat Classification for Britain and Ireland Version 22.04. Available from: https://mhc.jncc.gov.uk/

KAISER, M.J., HORMBREY, S., BOOTH, J.R., HINZ, H. AND HIDDINK, J.G. 2018. Recovery linked to life history of sessile epifauna following exclusion of towed mobile fishing gear. Journal of Applied Ecology, 55(3), pp.1060-1070. https://doi.org/10.1111/1365-2664.13087

NAEEM, S., LOREAU, M. AND INCHAUSTI, P. 2002. Biodiversity and ecosystem functioning:The emergence of a synthetic ecological framework. In: LOREAU, M., NAEEM, S. AND INCHAUSTI, P. (Eds). Biodiversity and ecosystem functioning. Synthesis and perspectives. Oxford University Press, New York: 3-11.

NATURAL ENGLAND. 2012. Lands End & Cape Bank candidate Special Area of Conservation Formal advice under Regulation 35(3) of The Conservation of Habitats and Species Regulations 2010. Version 2.0.

NATURAL ENGLAND, 2022. Natural England Conservation Advice for Marine Protected Areas Lands End and Cape Bank SAC. Designated Sites View website. Available online: https://designatedsites.naturalengland.org.uk/SiteGeneralDetail.aspx?SiteCode=UK0030375&SiteName=lands%20end%20and%20cape%20bank%20sac&countyCode=&responsiblePerson=&SeaArea=&IFCAArea= [accessed 12/04/2022].

MCARDLE, B.H. AND ANDERSON, M.J. 2001. Fitting Multivariate Models to Community Data: A Comment on Distance-Based Redundancy Analysis. Ecology, 82, 290-297. http://dx.doi.org/10.1890/0012-9658(2001)082[0290:FMMTCD]2.0.CO;2

O'DELL, J., 2019. Marine underwater video and stills analysis of Land's End and Cape Bank SAC. A report to Cefas by Seastar Survey Ltd., 61 pages

OKSANEN, J., SIMPSON, G.L., BLANCHET, F.G., KINDT, R., LEGENDRE, P., MINCHIN, P.R., O'HARA, R.B., SOLYMOS, P., STEVENS, M.H.H., SZOECS, E., WAGNER, H., BARBOUR, M., BEDWARD, M., BOLKER, B., BORCARD, D., CARVALHO, G., CHIRICO, M., DE CACERES, M., DURAND, S., EVANGELISTA, H.B.A., FITZJOHN, R., FRIENDLY, M., FURNEAUX, B., HANNIGAN, G., HILL, M.O., LAHTI, L., MCGLINN, D., OUELLETTE,

M.H., CUNHA, E.R., SMITH, T., STIER, A., TER BRAAK, C.J.F., WEEDON, J. 2022. vegan: Community Ecology Package. R package version 2.6-4. https://CRAN.R-project.org/package=vegan

PARRY, M.E.V. 2015. Guidance on Assigning Benthic Biotopes using EUNIS or the Marine Habitat Classification of Britain and Ireland JNCC report No. 546 Joint Nature Conservation Committee, Peterborough http://jncc.defra.gov.uk/pdf/Report_546_web.pdf

R CORE TEAM, 2020. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/

READMAN, J.A.J., JACKSON, A. AND HISCOCK, K. 2018. Eunicella verrucosa and Pentapora foliacea on wave-exposed circalittoral rock. In TYLER-WALTERS, H. AND HISCOCK, K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 14-06-2022]. Available from: https://www.marlin.ac.uk/habitat/detail/77

SNOWDEN, E. 2007. Cliona celata Boring sponge. In TYLER-WALTERS, H. AND HISCOCK, K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 14-06-2022]. Available from: https://www.marlin.ac.uk/species/detail/2188

TURNER, J., HITCHIN, B., VERLING, E. AND VAN REIN, H. 2016. Epibiota Remote Monitoring from Digital Imagery: Interpretation Guidelines. NMBAQC/JNCC.

WARTON, D., WRIGHT, S.T. AND WANG, Y. 2012. Distance-based multivariate analyses confound location and dispersion effects. Methods in Ecology and Evolution, 3, 89-101. doi: 10.1111/j.2041-210X.2011.00127.x.

WFD UK TAG. 2015. Water Framework Directive UK Technical Advisory Group (WFD UK TAG) Revised classification of aquatic alien species according to their level of impact guidance paper v7.6 (22/07/2015). Available online: http://wfduk.org/sites/default/files/UKTAG%20classification%20of%20alien%20species%20working%20paper%20v8.pdf [Accessed 08/04/2022].

Appendix 1 Supporting data

Table 19. Key species highlighted in the Regulations 35 advice for the coastal section of Lands End and Cape Bank SAC. The number of observations of these taxa recorded in still images is provided for 2010 (n = 353 images) and 2018 (n = 750 images).

Phylum	Taxon	Common name	2010 Observations	2018 Observations
Bryozoa	*Alcyonidium diaphanum*	Sea chervil	85	396
	Pentapora fascialis	Ross coral	62	65
Chordata	*Dendrodoa grossularia*	Baked bean ascidian	0	3
	Stolonica socialis	Orange sea grapes	13	101
Cnidaria	*Alcyonium digitatum*	Dead man's fingers	152	279
	Alcyonium glomeratum	Red sea fingers	2	2
	Corynactis viridis	Jewel anemone	102	200
	Eunicella verrucosa	Pink sea fan	3	5
	Urticina felina	Dahlia anemone	33	76
Echinodermata	*Antedon bifida*	Rosy feather-star	9	4
	Echinus esculentus	Common sea urchin	4	12
	Holothuria (Panningothuria) forskali	Cotton spinner	5	16
	Luidia ciliaris	Seven armed starfish	5	0
	Marthasterias glacialis	Spiny starfish	19	188
	Ophiothrix fragilis	Common brittlestar	0	11
Ochrophyta	*Dictyopteris polypodioides*	Sea fern	28	23
	Dictyota dichotoma	Forkweed	39	36
	Laminaria hyperborea	Kelp	8	20
	Saccorhiza polyschides	Kelp	4	0
Porifera	*Cliona celata*	Boring sponge	26	43
Rhodophyta	*Calliblepharis ciliata*	A bryozoan	3	1
	Delesseria sanguinea	Sea beech	26	40
	Drachiella spectabilis	A red alga	11	0
	Palmaria palmata	Dulse	12	0
	Plocamium cartilagineum	A red alga	2	3

Table 20. Key biotopes highlighted in the Regulations 35 advice for the coastal section of Lands End and Cape Bank SAC. The number of still images assigned to each of these biotopes is provided for 2010 (n = 353 images) and 2018 (n = 750 images).

MNCR biotope code	Biotope name	2010 Observations	2018 Observations
CR.HCR.XFa	Mixed faunal turf communities	2	60
CR.HCR.Xfa.CvirCri	*Corynactis viridis* and a mixed turf of crisiids, *Bugula, Scrupocellaria*, and *Cellaria* on moderately tide-swept exposed circalittoral rock	23	42
CR.HCR.XFa.ByErSp	Bryozoan turf and erect sponges on tide-swept circalittoral rock	53	79
CR.HCR.XFa.ByErSp.Eun	*Eunicella verrucosa* and *Pentapora fascialis* on wave-exposed circalittoral rock	2	5
CR.HCR.XFa.SpNemAdia	Sparse sponges, *Nemertesia* spp. and *Alcyonidium diaphanum* on circalittoral mixed substrata	20	36
CR.HCR.XFa.FluCoAs.(Paur)	*Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock (*Polyclinum aurantium* and *Flustra foliacea* on sand-scoured tide-swept moderately wave-exposed circalittoral rock)	10	0
CR.MCR.EcCr.CarSp	*Caryophyllia smithii*, sponges and crustose communities on wave-exposed circalittoral rock	17	13
CR.MCR.EcCr.UrtScr	*Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	8	28
CR.MCR.EcCr.CarSp.PenPcom	*Caryophyllia smithii* and sponges with *Pentapora foliacea*, *Porella compressa* and crustose communities on wave-exposed circalittoral rock	0	0
CR.MCR.EcCr.FaAlCr	Faunal and algal crusts on exposed to moderately	0	0

MNCR biotope code	Biotope name	2010 Observations	2018 Observations
	wave-exposed circalittoral rock		
CR.MCR.EcCr.FaAlCr.Flu	*Flustra foliacea* on slightly scoured silty circalittoral rock	1	0
IR.HIR.Ksed	Sediment-affected or disturbed kelp and seaweed communities	9	0
IR.HIR.Ksed.XKHal	*Halidrys siliquosa* and mixed kelps on tide-swept infralittoral rock with coarse sediment	0	0
IR.HIR.KFar.FoR	Foliose red seaweeds on exposed lower infralittoral rock	6	20
IR.HIR.KFar.FoR.Dic	Foliose red seaweeds with dense *Dictyota dichotoma* and/or *Dictyopteris membranacea* on exposed lower infralittoral rock	17	10
IR.HIR.KFaR.LhypR	*Laminaria hyperborea* with dense foliose red seaweeds on exposed infralittoral rock	0	15
IR.HIR.KFaR.LhypR.Ft	*Laminaria hyperborea* forest with dense foliose red seaweeds on exposed upper infralittoral rock	0	0
IR.HIR.KFaR.LhypR.Pk	*Laminaria hyperborea* park with dense foliose red seaweeds on exposed lower infralittoral rock	2	1
IR.HIR.KFaR.LhypRVt	*Laminaria hyperborea* and red seaweeds on exposed vertical rock	0	0
IR.HIR.KSed.XKScrR	Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock	14	19
IR.HIR.Ksed.Sac	*Saccorhiza polyschides* on exposed unstable and scoured infralittoral rock	0	0
IR.HIR.KFaR	Kelp with cushion fauna	0	0

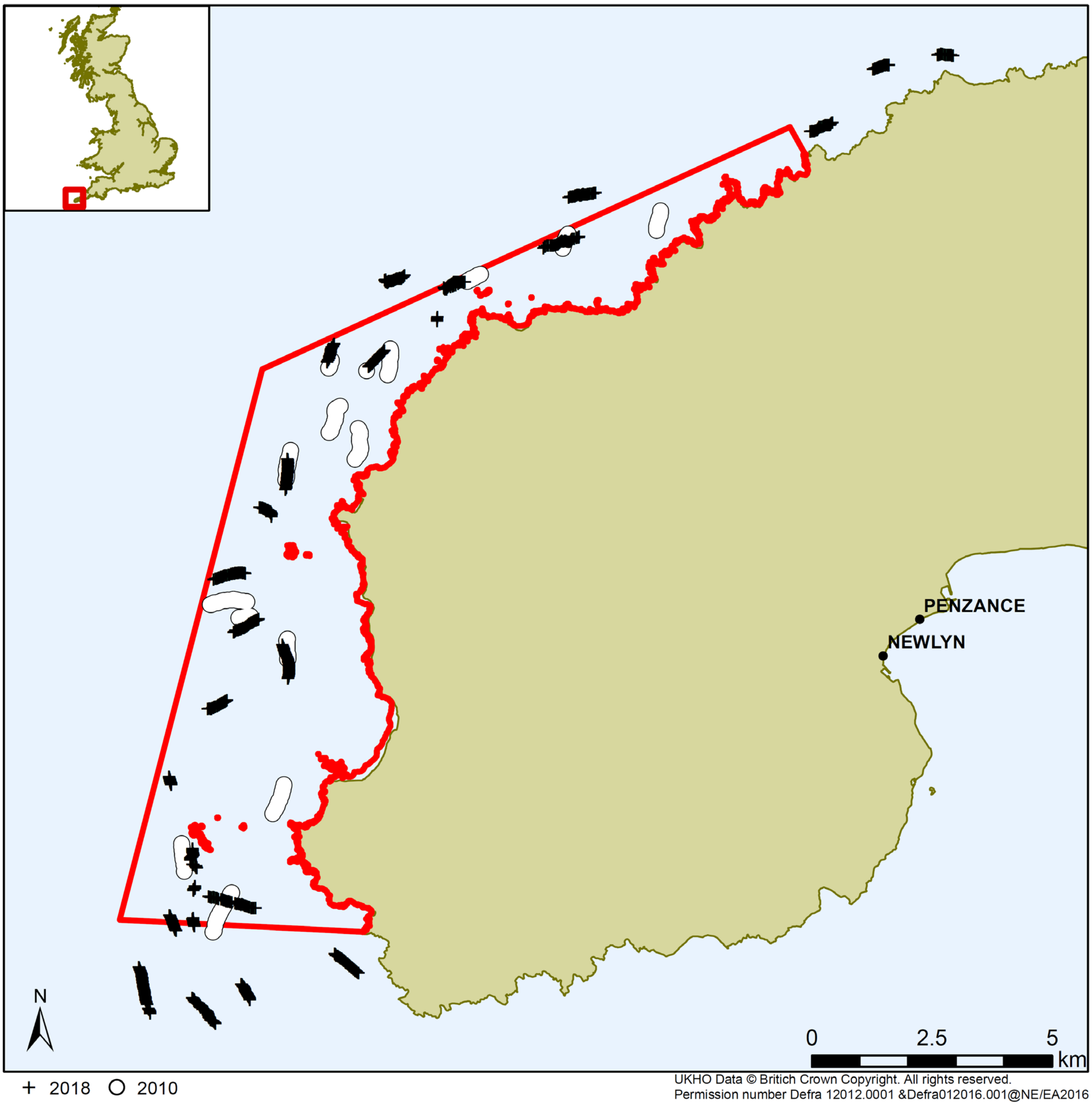


Figure 16. Locations at which imagery data were gathered as part of the 2010 and 2018 surveys of Lands End and Cape Bank SAC A number of nearshore stations visited in 2010 (white circles) were not revisited in 2018 (black crosses).

Table 21. Contribution of major taxonomic groups to differences in A3.1 High energy infralittoral rock assemblages between 2010 and 2018 at Lands End and Cape Bank SAC. Based on SIMPER analysis of presence-absence data to identify the taxa driving the differences. For each taxon, the contribution ± SD to between group dissimilarity is provided. For each taxon the highest values between the two years is highlighted. Cumulative contributions are provided for the taxa that contribute 60% of the calculated difference between years.

Taxon	Contribution ± SD	Mean 2010	Mean 2018	Cumulative %
Rhodophyta (foliose)	0.05 ± 0.01	0	1.00	5.22
Rhodophyta (turf)	0.05 ± 0.01	1.00	0	10.45
Faunal turf	0.04 ± 0.02	0	0.96	15.3
Alcyonidium diaphanum	0.03 ± 0.02	0.13	0.81	19.08
Laminaria	0.03 ± 0.03	0.58	0	22.14
Corallinaceae	0.03 ± 0.02	0	0.58	25.01
Phaeophyceae (foliose)	0.02 ± 0.02	0	0.57	27.76
Dictyota dichotoma	0.02 ± 0.03	0.73	0.46	30.5
Porifera (crust)	0.02 ± 0.02	0.27	0.57	33.21
Dictyopteris polypodioides	0.02 ± 0.02	0.56	0.32	35.88
Chromophycota	0.02 ± 0.02	0.54	0	38.52
Delesseria sanguinea	0.02 ± 0.02	0.48	0.57	41.14
Bryozoa (encrusting)	0.02 ± 0.02	0	0.51	43.56
Marthasterias glacialis	0.02 ± 0.02	0.15	0.43	45.89
Tubularia	0.02 ± 0.02	0	0.41	48.03
Alcyonium digitatum	0.02 ± 0.02	0.23	0.35	50.07
Cryptopleura ramosa	0.02 ± 0.02	0	0.38	52.04
Laminaria hyperborea	0.02 ± 0.03	0.17	0.29	53.99
Bryozoa (turf)	0.02 ± 0.02	0.21	0.36	55.93
Ascidiacea (colonial)	0.02 ± 0.02	0	0.41	57.81
Crisiidae	0.02 ± 0.02	0.10	0.36	59.63
Hydrozoa	0.02 ± 0.02	0	0.36	61.35

Table 22. Contribution of major taxonomic groups to differences in A4.1 High energy circalittoral rock assemblages between 2010 and 2018 at Lands End and Cape Bank SAC. Based on SIMPER analysis of presence-absence data to identify the taxa driving the differences. For each taxon, the contribution ± SD to between group dissimilarity is provided. For each taxon the highest values between the two years is highlighted. Cumulative contributions are provided for the taxa that contribute 60% of the calculated difference between years.

Taxon	Contribution ± SD	Mean 2010	Mean 2018	Cumulative %
Faunal turf	0.03 ± 0.01	0	0.98	4.45
Hydrozoa	0.03 ± 0.02	0	0.79	8.05
Hydrozoa (turf)	0.03 ± 0.02	0.75	0	11.43
Caryophyllia (Caryophyllia) smithii	0.02 ± 0.02	0.17	0.7	14.21
Clathria (Microciona)	0.02 ± 0.02	0.61	0	16.94
Alcyonidium diaphanum	0.02 ± 0.02	0.39	0.74	19.47
Marthasterias glacialis	0.02 ± 0.02	0.08	0.57	21.97
Porifera (crust)	0.02 ± 0.02	0.43	0.76	24.44
Serpulidae	0.02 ± 0.02	0.09	0.57	26.85
Bryozoa (encrusting)	0.02 ± 0.02	0.47	0.74	29.2
Cellaria	0.02 ± 0.02	0	0.54	31.52
Corynactis viridis	0.02 ± 0.02	0.51	0.68	33.81
Bryozoa (turf)	0.02 ± 0.02	0.41	0.44	36.05
Crisularia plumosa	0.02 ± 0.02	0.44	0.39	38.26
Nemertesia antennina	0.02 ± 0.02	0.59	0.7	40.43
Pholadinae	0.02 ± 0.02	0.48	0	42.59
Crisiidae	0.02 ± 0.02	0.72	0.6	44.75
Rhodophyta (foliose)	0.02 ± 0.02	0	0.48	46.88
Nemertesia	0.02 ± 0.02	0	0.47	48.88
Tubularia indivisa	0.02 ± 0.02	0	0.44	50.86
Polyclinidae	0.01 ± 0.02	0.19	0.38	52.73
Plumularioidea	0.01 ± 0.02	0	0.40	54.42
Alcyonium digitatum	0.01 ± 0.02	0.73	0.86	55.99
Ascidiacea (colonial)	0.01 ± 0.02	0	0.36	57.52
Stolonica socialis	0.01 ± 0.02	0.09	0.30	59.03
Pentapora fascialis	0.01 ± 0.02	0.31	0	60.4

Table 23. Contribution of major taxonomic groups to differences in A4.2 Moderate energy circalittoral rock assemblages between 2010 and 2018 at Lands End and Cape Bank SAC. Based on SIMPER analysis of presence-absence data to identify the taxa driving the differences. For each taxon, the contribution ± SD to between group dissimilarity is provided. For each taxon the highest values between the two years is highlighted. Cumulative contributions are provided for the taxa that contribute 60% of the calculated difference between years.

Taxon	Contribution ± SD	Mean 2010	Mean 2018	Cumulative %
Faunal turf	0.04 ± 0.01	0	0.94	4.45
Hydrozoa (turf)	0.03 ± 0.01	0.91	0	8.69
Hydrozoa	0.03 ± 0.01	0	0.85	12.59
Caryophyllia (Caryophyllia) smithii	0.03 ± 0.02	0	0.77	16.21
Alcyonidium diaphanum	0.03 ± 0.02	0.13	0.87	19.8
Clathria (Microciona)	0.03 ± 0.02	0.69	0	23.03
Pholadinae	0.02 ± 0.02	0.69	0	26.14
Serpulidae	0.02 ± 0.02	0.09	0.66	29.01
Corynactis viridis	0.02 ± 0.02	0.66	0.4	31.49
Crisiidae	0.02 ± 0.02	0.59	0.36	33.91
Nemertesia antennina	0.02 ± 0.02	0.56	0.4	36.31
Tubularia indivisa	0.02 ± 0.02	0.06	0.53	38.69
Bryozoa (turf)	0.02 ± 0.02	0.28	0.49	40.95
Crisularia plumosa	0.02 ± 0.02	0.5	0.28	43.19
Urticina felina	0.02 ± 0.02	0.22	0.47	45.39
Porifera (crust)	0.02 ± 0.02	0.63	0.64	47.57
Bryozoa (encrusting)	0.02 ± 0.02	0.63	0.72	49.75
Rhodophyta (foliose)	0.02 ± 0.02	0	0.43	51.72
Porella compressa	0.02 ± 0.02	0.44	0	53.65
Nemertesia	0.01 ± 0.02	0	0.40	55.46
Corallinaceae	0.01 ± 0.02	0	0.38	57.2
Asterias rubens	0.01 ± 0.02	0.38	0	58.86
Plumularioidea	0.01 ± 0.02	0	0.34	60.42

Table 24. Contribution of major taxonomic groups to differences in A5.1 Subtidal coarse sediment assemblages between 2010 and 2018 at Lands End and Cape Bank SAC. Based on SIMPER analysis of absence data to identify the taxa driving the differences. For each taxon, the contribution ± SD to between group dissimilarity is provided. For each taxon the highest values between the two years is highlighted. Cumulative contributions are provided for the taxa that contribute 60% of the calculated difference between years.

Taxon	Contribution ± SD	Mean 2010	Mean 2018	Cumulative %
Serpulidae	0.06 ± 0.06	0.29	0.93	6.41
Faunal turf	0.05 ± 0.04	0	0.76	11.76
Bryozoa (encrusting)	0.04 ± 0.04	0.19	0.75	16.81
Alcyonidium diaphanum	0.04 ± 0.04	0.37	0.63	21.1
Hydrozoa	0.04 ± 0.03	0	0.62	25.27
Crisiidae	0.03 ± 0.04	0.37	0.24	28.63
Porifera (crust)	0.03 ± 0.04	0.14	0.45	31.85
Polychaeta	0.03 ± 0.05	0.35	0	34.98
Hydrozoa (turf)	0.03 ± 0.04	0.40	0	38.1
Bryozoa (turf)	0.03 ± 0.04	0.27	0.33	41.12
Thoracica	0.02 ± 0.03	0	0.38	43.82
Sabella pavonina	0.02 ± 0.04	0.29	0	46.08
Clathria (Microciona)	0.02 ± 0.04	0.27	0	48.33
Alcyonium digitatum	0.02 ± 0.04	0.19	0.15	50.52
Rhodophyta (foliose)	0.02 ± 0.03	0	0.30	52.7
Cirripedia	0.02 ± 0.04	0.24	0	54.61
Corallinaceae	0.02 ± 0.03	0	0.26	56.51
Paguridae	0.02 ± 0.03	0	0.28	58.25
Caryophyllia (Caryophyllia) smithii	0.01 ± 0.03	0.08	0.23	59.86
Actiniaria	0.01 ± 0.03	0	0.25	61.44

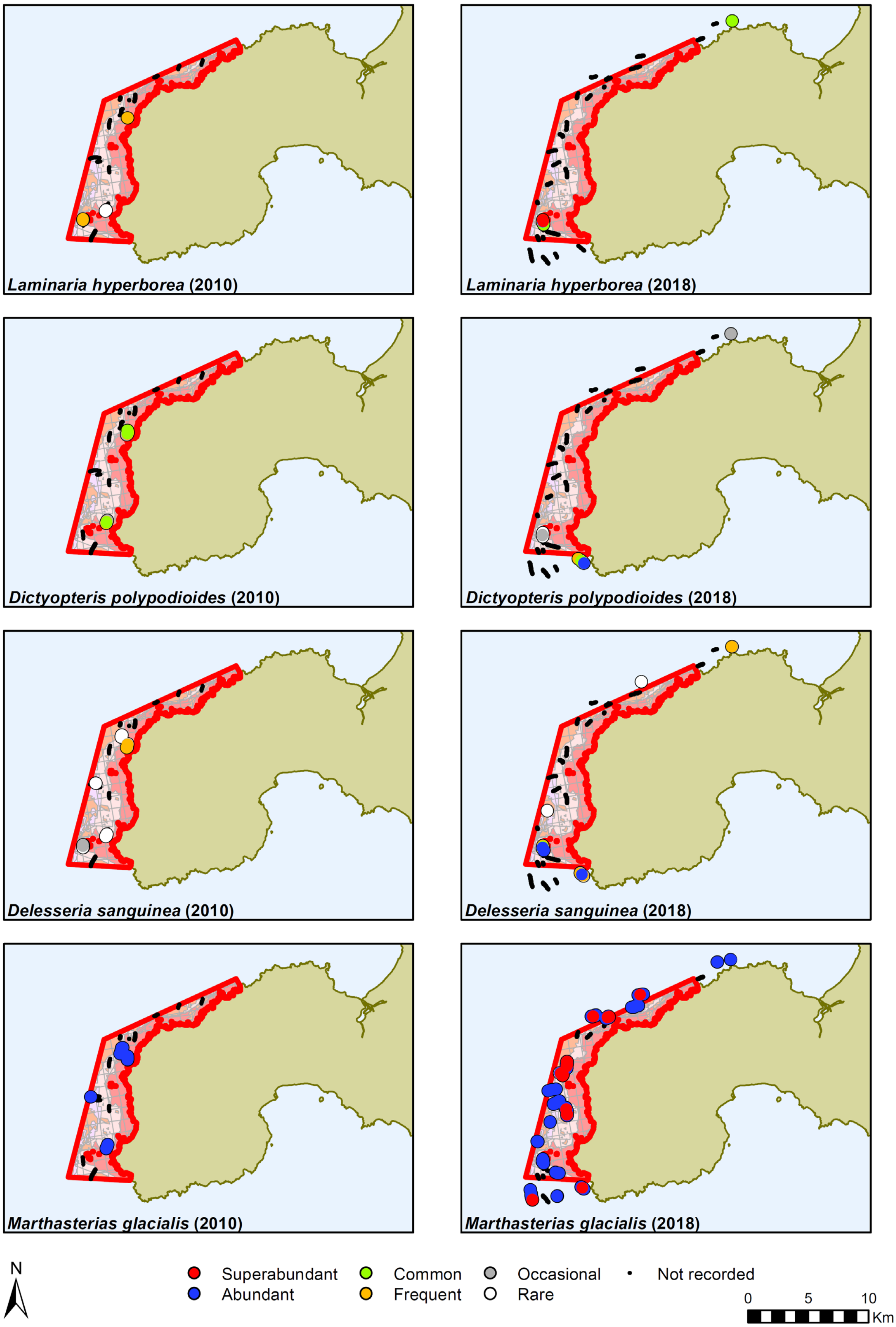
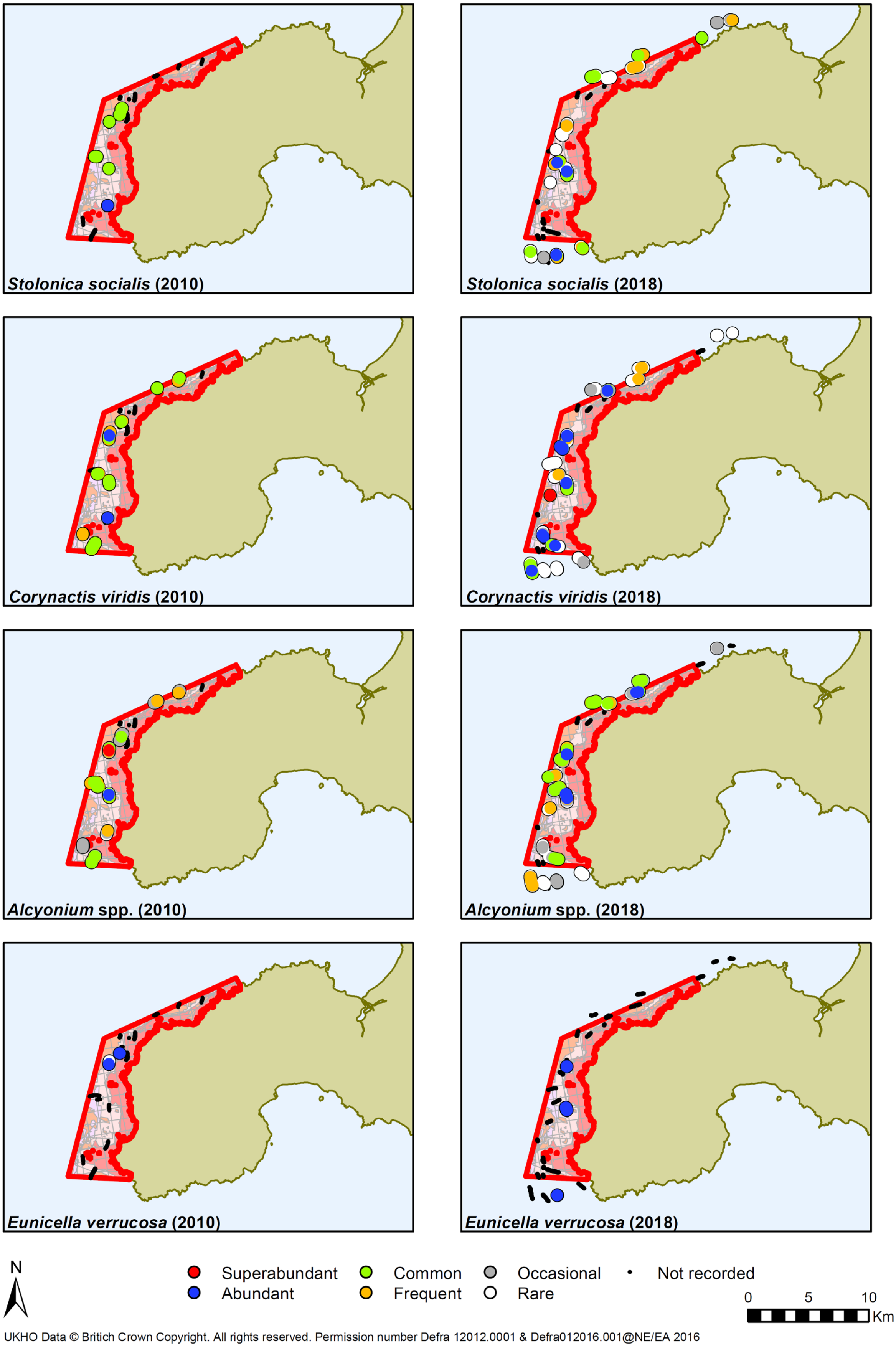


Figure 17 (continued overleaf)



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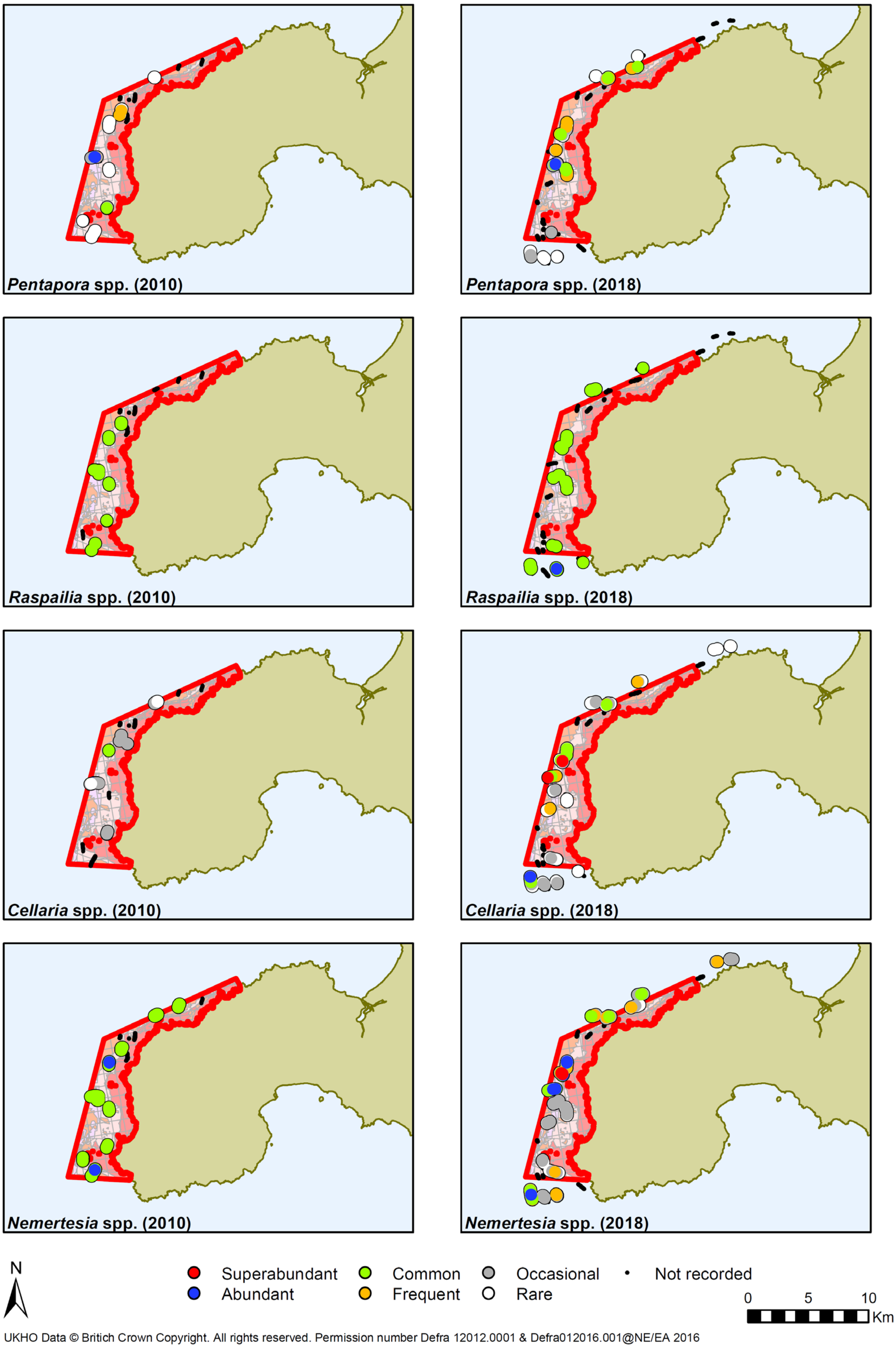

Figure 17. Comparison of the distribution of selected key taxa within Lands End and Cape Bank SAC in the 2010 and 2018 surveys. These taxa are considered either characteristic of the SAC or vulnerable to human activity (refer to Section 1.1). Background polygons are the modelled broadscale habitats taken from the Marine Evidence database.

Appendix 2 Non-indigenous species

Priority taxa listed as non-indigenous species (present and horizon) which have been selected for assessment of Good Environmental Status in GB waters under UKMS (formerly MSFD) Descriptor 2 (GB Non-Native Species Secretariat, 2021).

Species	List 2020-2021	AphiaID
Acartia tonsa	Present	345943
Agarophyton vermiculophyllum	Present	1327786
Arcuatula senhousia	Present (new addition)	505946
Alexandrium catenella	Horizon	231873
Amphibalanus amphitrite	Present	421137
Amphibalanus reticulatus	Horizon	421140
Asparagopsis armata	Present	144438
Asterias amurensis	Horizon	254497
Asterocarpa humilis	Present	250047
Boccardia proboscidea	Present (new addition)	327249
Bonnemaisonia hamifera	Present	144442
Botryocladia wrightii	Present (new addition)	1313615
Caprella mutica	Present	146768
Caulacanthus okamurae	Present	496188
Caulerpa racemosa	Horizon	144472
Caulerpa taxifolia	Horizon	144476
Celtodoryx ciocalyptoides	Horizon	559274
Cephalothrix simula	Present (new addition)	573293
Ciona savignyi	Horizon (new addition)	250292
Corella eumyota	Present (new addition)	173223
Crepidula fornicata	Present	138963
Diadumene lineata	Present	395099
Didemnum vexillum	Present	25012
Dyspanopeus sayi	Horizon	107412
Ensis leei	Present	876640
Eriocheir sinensis	Present	107451
Ficopomatus enigmaticus	Present	130988
Grateloupia turuturu	Present	295880
Hemigrapsus sanguineus	Present	158417

Species	List 2020-2021	AphiaID
Hemigrapsus takanoi	Present	389288
Hesperibalanus fallax	Present	733520
Heterosigma akashiwo	Present	160585
Homarus americanus	Horizon	156134
Megabalanus coccopoma	Horizon	149682
Magallana gigas	Present	836033
Megabalanus tintinnabulum	Horizon (new addition)	106225
Megabalanus zebra	Horizon	394986
Mizuhopecten yessoensis	Horizon	393716
Mnemiopsis leidyi	Present	106401
Mulinia lateralis	Horizon (new addition)	156870
Ocinebrellus inornatus	Horizon	578702
Paralithodes camtschaticus	Horizon	233889
Polysiphonia subtilissima	Horizon	144674
Pseudochattonella verruculosa	Horizon	531446
Pseudodiaptomus marinus	Present (new addition)	360352
Rapana venosa	Horizon	140416
Rhopilema nomadica	Horizon	232032
Sargassum muticum	Present	494791
Schizoporella japonica	Present	470388
Styela clava	Present	103929
Telmatogeton japonicus	Present	118154
Undaria pinnatifida	Present	145721
Urosalpinx cinerea	Present	140429
Watersipora subatra	Present	816025

List of abbreviations

BSH	Broadscale Habitats
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CHP	Civil Hydrography Programme
CP2	Charting Progress 2
CSA	Case Study Area
Defra	Department for Environment, Food and Rural Affairs
DORIS	Dorset Integrated Seabed survey
EA	Environment Agency
EUNIS	European Nature Information System
FLAG	Fisheries Local Action Group
FOCI	Feature of Conservation Interest
GES	Good Environmental Status
GMA	General Management Approach
SOIFCA	Southern Inshore Fisheries and Conservation Authority
JNCC	Joint Nature Conservation Committee
NMBAQC	North East Atlantic Marine Biological Analytical Quality Control Scheme
MarLIN	Marine Life Information Network
MBES	Multibeam echosounder
MCZ	Marine Conservation Zone
MonCoG	Monitoring Coordination Group
MPA	Marine Protected Area
NE	Natural England
NIS	Non-Indigenous Species

nmMDS	Non-metric Multidimensional Scaling
OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic
PCA	Principal Components Analysis
PSA	Particle Size Analysis
PSD	Particle Size Distribution
RV	Research Vessel
SAC	Special Area of Conservation
SACFOR	Superabundant-Abundant-Common-Frequent-Occasional-Rare scale
SACO	Supplementary Advice on Conservation Objectives
SIMPER	Similarity Percentages analysis
SIMPROF	Similarity Percentages analysis
SNCB	Statutory Nature Conservation Body
SOCI	Species of Conservation Interest
SSS	Sidescan sonar
UKMS	UK Marine Strategy

Glossary

Definitions signified by an asterisk (*) have been sourced from Natural England and JNCC Ecological Network Guidance (NE and JNCC, 2010).

Activity	A human action which may have an effect on the marine environment; e.g. fishing, energy production (Robinson, Rogers and Frid, 2008).*
Assemblage	A collection of plants and/or animals characteristically associated with a particular environment that can be used as an indicator of that environment. The term has a neutral connotation and does not imply any specific relationship between the component organisms, whereas terms such as 'community' imply interactions (Allaby, 2015).
Benthic	A description for animals, plants and habitats associated with the seabed. All plants and animals that live in, on or near the seabed are benthos (e.g. sponges, crabs, seagrass beds).*
Biotope	The physical habitat with its associated, distinctive biological communities. A biotope is the smallest unit of a habitat that can be delineated conveniently and is characterised by the community of plants and animals living there.*
Broadscale Habitats	Habitats which have been broadly categorised based on a shared set of ecological requirements, aligning with level 3 of the EUNIS habitat classification. Examples of Broadscale Habitats are protected across the MCZ network.
Community	A general term applied to any grouping of populations of different organisms found living together in a particular environment; essentially the biotic component of an ecosystem. The organisms interact and give the community a structure (Allaby, 2015).
Conservation Objective	A statement of the nature conservation aspirations for the feature(s) of interest within a site, and an assessment of those human pressures likely to affect the feature(s).*
EC Habitats Directive	The EC Habitats Directive (Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora)

requires Member States to take measures to maintain natural habitats and wild species of European importance at, or restore them to, favourable conservation status.

Epifauna	Fauna living on the seabed surface.
EUNIS	A European habitat classification system, covering all types of habitats from natural to artificial, terrestrial to freshwater and marine.*
Favourable Condition	When the ecological condition of a species or habitat is in line with the conservation objectives for that feature. The term 'favourable' encompasses a range of ecological conditions depending on the objectives for individual features.*
Feature	A species, habitat, geological or geomorphological entity for which an MPA is identified and managed.*
Feature Attributes	Ecological characteristics defined for each feature within site-specific Supplementary Advice on Conservation Objectives (SACO). Feature Attributes are monitored to determine whether condition is favourable.
Features of Conservation Importance (FOCI)	Habitats and species that are rare, threatened or declining in Secretary of State waters.*
General Management Approach GMA)	The management approach required to achieve favourable condition at the site level; either maintain in, or recover to favourable condition.
Habitats of Conservation Importance (HOCI)	Habitats that are rare, threatened, or declining in Secretary of State waters.*
Impact	The consequence of pressures (e.g. habitat degradation) where a change occurs that is different to that expected under natural conditions (Robinson, Rogers and Frid, 2008).*

Infauna	Fauna living within the seabed sediment.
Inshore Fisheries and Conservation Authority (IFCA)	The lead authority for managing inshore fisheries, securing the right balance between social, economic and natural benefits for a sustainable marine environment.
Joint Nature Conservation Committee (JNCC)	The statutory advisor to Government on UK and international nature conservation. Its specific remit in the marine environment ranges from 12 - 200 nautical miles offshore.
Marine Conservation Zone (MCZ)	MPAs designated under the Marine and Coastal Access Act (2009). MCZs protect nationally important marine wildlife, habitats, geology and geomorphology, and can be designated anywhere in English and Welsh inshore and UK offshore waters.*
Marine Protected Area (MPA)	A generic term to cover all marine areas that are ‘A clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values’ (Dudley, 2008).*
MNCR	The Marine Habitat Classification for Britain and Ireland lists all seafloor habitats currently known to occur in UK waters and was developed by JNCC's Marine Nature Conservation Review.
Natura 2000	The EU network of nature protection areas (classified as Special Areas of Conservation and Special Protection Areas), established under the 1992 EC Habitats Directive.*
Natural England	The statutory conservation advisor to Government, with a remit for England out to 12 nautical miles offshore.
NMBAQC	The North-East Atlantic Marine Biological Analytical Quality Control Scheme provides a source of external Quality Assurance (QA) for laboratories engaged in the production of marine biological data.

Non-indigenous Species	A species that has been introduced directly or indirectly by human agency (deliberately or otherwise) to an area where it has not occurred in historical times and which is separate from and lies outside the area where natural range extension could be expected (Eno et al., 1997).*
Pressure	The mechanism through which an activity has an effect on any part of the ecosystem (e.g. physical abrasion caused by trawling). Pressures can be physical, chemical or biological, and the same pressure can be caused by a number of different activities (Robinson, Rogers and Frid, 2008).*
Special Areas of Conservation	Protected sites designated under the European Habitats Directive for species and habitats of European importance, as listed in Annex I and II of the Directive.*
Species of Conservation Importance (SOCI)	Habitats and species that are rare, threatened or declining in Secretary of State waters.*
Supplementary Advice on Conservation Objectives (SACO)	Site-specific advice providing more detailed information on the ecological characteristics or 'attributes' of the site's designated feature(s). This advice is issued by Natural England and/or JNCC.
UK Marine Strategy (UKMS)	The UK Marine Strategy now enshrines the principles of the EU's Marine Strategy Framework Directive in to UK law.

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