Condition assessment of the Lyme Bay Annex I reef habitats in the Lyme Bay and Torbay cSAC

Commissioned by Natural England

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1 Introduction

Lyme Bay, located in the south west of the UK, is home to reef habitats that are considered to be both nationally and internationally important in ecological and conservation terms. The bay is an important fishing area for fishes, crustaceans and molluscs. Fishing methods include mobile gear such as scallop dredges and trawlers, and static gear such as pots and nets. Lyme Bay also supports a large number of recreational users, including sea anglers and divers. In 2008, a proportion of the reefs were protected from towed demersal fishing gear (Defra 2008), designated under a UK Government (Defra) Statutory Instrument (SI) 'The Lyme Bay Designated Area (Fishing Restrictions) Order' (2008), to envelop four areas that were previously closed to towed demersal fishing gear under voluntary agreements in 2001 and expanded in 2006 (Figure 1.1). In 2011, the SI was encompassed by the Lyme Bay portion of the Lyme Bay and Torbay candidate Special Area of Conservation (cSAC), (Defra 2011) designated under the Habitats Directive (92/43/EEC) to incorporate additional reef habitat (Figure 1.1).

As part of the new cSAC designation, an experimental area was established to test new inshore Vessel Monitoring System (iVMS) technology within the cSAC but outside of the boundaries of the SI. Vessels taking part in the trial were still permitted to fish using towed demersal gear in these areas with the exception of identified 'sensitive areas' of reef (See Appendix, Figure A1). All other vessels using towed demersal gear were excluded from the entire cSAC, although, as with the SI it remained open to those using static gear, to SCUBA divers hand-collecting scallops, and to all recreational activities.

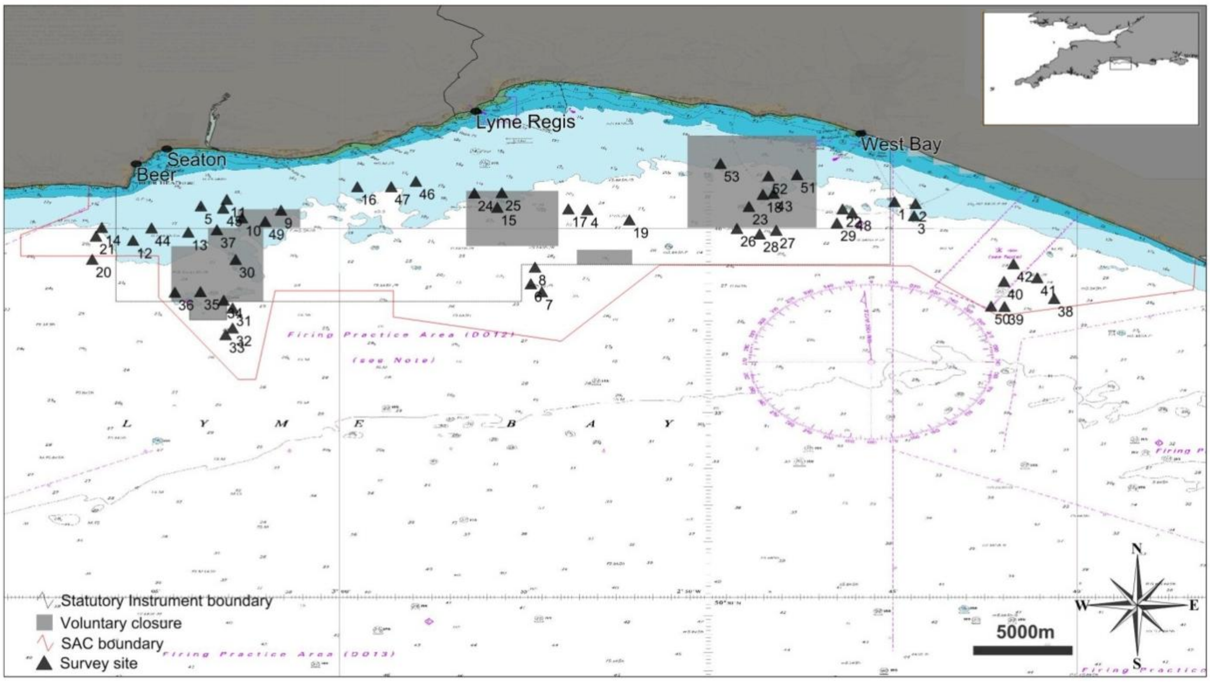

Figure 1.1 Lyme Bay MPA designations and site locations

The site was designated as a candidate Special Area of Conservation for its 'features of European interest' (JNCC). These included:

- Annex I Reefs, defined as 'habitats where animal and plant communities develop on rock or stable boulders and cobbles' (Jackson and Mcleod 2000) which extend over a large area demonstrating particularly high species richness. These areas have been previously identified as a marine biodiversity 'hot spot', supporting species including *Eunicella verrucosa,* a UK Biodiversity Action Plan (BAP) species*.*

Geogenic reefs may be classed as bedrock, or stony reef. Bedrock reef occurs where bedrock arises from the surrounding seabed, and stony reef is a habitat which is topographically distinct from the surrounding sea floor, with a total minimum area of 25 m^2. Stony reef comprises at least 10% particles which are greater than 64 mm in diameter and has a supporting matrix of smaller material (Irving 2009).

Previous data gathered from benthic surveys in Lyme Bay (Cork et al. 2008; Vanstaen & Eggleton 2011) were used to inform the Natural England Lyme Bay and Torbay candidate Special Area of Conservation advice document (Defra 2011) and these noted the following biotopes on bedrock reef and stony reef:

1.1 Bedrock reef

- **CR.HCR.XFa.ByErSp.Eun *Eunicella verrucosa* and *Pentapora fascialis* on wave-exposed circalittoral rock**
  http://www.jncc.gov.uk/marine/biotopes/biotope.aspx?biotope=JNCCMNCR00002135

- **CR.FCR.Cv.SpCup Sponges, cup corals and anthozoans on shaded or overhanging circalittoral rock**
  http://www.jncc.gov.uk/marine/biotopes/biotope.aspx?biotope=JNCCMNCR00000662

- **CR.HCR.XFa.ByErSp Bryozoan turf and erect sponges on tide-swept circalittoral** rock LEVEL 5 NOT 6
  http://www.jncc.gov.uk/marine/biotopes/biotope.aspx?biotope=JNCCMNCR00002134

- **IR.HIR.KFaR.FoR Foliose red seaweeds on exposed lower infralittoral rock**
  http://www.jncc.gov.uk/marine/biotopes/biotope.aspx?biotope=JNCCMNCR00000228

- **IR.HIR.KFaR.Lhyp.R Kelp with cushion fauna and/or foliose red seaweeds**
  http://www.jncc.gov.uk/marine/biotopes/biotope.aspx?biotope=JNCCMNCR00001529

1.2 Stony reef

- **CR.HCR.XFa.ByErSp Bryozoan turf and erect sponges on tide-swept circalittoral rock**

http://www.jncc.gov.uk/marine/biotopes/biotope.aspx?biotope=JNCCMNCR0000213
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The main species found by Cork et al. (2008) and Vanstaen & Eggleton (2011) to occur throughout these biotopes were dead man's fingers *Alcyonium digitatum,* erect sponges *Axinella dissimilis, Raspailia spp.* and *Stelligera spp.,* Devonshire cup coral *Caryophyllia smithii,* parchment worm *Chaetopterus variopedatus,* pink sea fan *Eunicella verrucosa*, ross coral *Pentapora fascialis* and sea squirt *Phallusia mammillata* (Cork et al. 2008; Vanstaen & Eggleton 2011).

Species observed in the biotopes identified on bedrock included anemones *Aiptasia mutabilis, Actinothoe sphyrodeta, Metridium senile* and *Urticina felina,* dead man's fingers *A. digitatum,* sea squirt *Ascidiella aspersa,* erect sponges *A. dissimilis,* cup corals *C. smithii* and *Leptopsammia pruvoti,* boring sponge *Cliona celata,* pink sea fan *E. verrucosa,* macroalgae *Laminaria hyperborea,* hydroid *Nemertesia ramosa,* ross coral *P. fascialis* and sea squirt *P. mammillata.*

Species observed in the biotopes identified on stony reef included dead man's fingers *A. digitatum,* erect sponges *A. dissimilis, Raspailia spp.* and *Stelligera spp,* cup coral *C. smithii,* parchment worm *C. variopedatus,* pink sea fan *E. verrucosa*, ross coral *P. fascialis* and sea squirt *P. mammillata.*

SACs are European Marine Sites (EMS), designated under the requirements of the Habitats Directive (92/43/EEC), and, as such, the UK government is committed to reporting their condition once every 6 years. Natural England is the relevant authority for this work, and cost effective methodologies are being developed to facilitate monitoring efforts. This condition assessment documents the distribution and extent of biotopes on bedrock reef and stony reef in Lyme Bay in the summer of 2012 and highlights the dominant species present in each biotope and site. The results are intended for use by Natural England to determine whether the condition of the cSAC meets the requirements of the Habitats Directive, and to enable effective management of the site to ensure that its conservation objectives are met. Following the designation of the SI in 2008, the Marine Institute, Plymouth University (MI) and project partners, the Marine Biological Association of the United Kingdom (MBA), Plymouth Marine Laboratory Limited (PML) and Marine Bio-images were commissioned to undertake a comprehensive study of the SI (MB0101) with the aim of assessing its ecological and socio-economic impacts over a three year period.

The initial project was formed around seven key objectives, as defined by Defra (see Attrill et al. 2011), involving:

- the identification of suitable reef indicator species that could signify changes within the reef ecosystem;
- a desk based assessment of the long-term effects of fisheries closures on long-lived and sessile benthic species (both led by the MBA, see Jackson et al (2008) and Langmead et al (2010));
- the development of a cost effective ecological monitoring programme;
- quantification of the effects of the closure on epibenthic and necktonic reef species (both led by the MI with benthic monitoring also including Marine Bio-images, see Attrill et al. (2011));

- the assessment of any socio-economic changes resulting from the closure restrictions (led by PML, see Mangi et al (2011)).

Following the completion of the initial project period, funding was granted for the continuation of key aspects of the biodiversity and socio-economic monitoring. The cost effective ecological monitoring programme developed has continued annually to quantify the effects of the closure on epibenthic and necktonic reef species. The data collected in the epibenthic survey in the summer of 2012 was intended for use in the biodiversity monitoring report and this condition assessment, increasing cost-effectiveness. The survey design remained unchanged, which therefore does not permit quantification of extent of representative/ notable bedrock and stony species. The data is applicable for the additional purpose of a condition assessment due to the extensive design of the epibenthic survey. It is a balanced survey design with replication across the bay in all management areas (pre-existing voluntary closures, SI, sensitive areas and the SAC). The survey methods therefore remain unchanged from the MB101 Lyme Bay monitoring project but the video analysis methods are altered and these changes are explained in the methods.

This report aims to:

1. Design a method for analysing data gathered that will allow an assessment of the attributes listed below (based on Common Standards Monitoring (CSM) guidance (JNCC (2004)) for bedrock and stony sub-features to inform the baseline condition assessment of the Lyme Bay unit of the Lyme Bay and Torbay cSAC and in the future.
2. Analyse and interpret existing data gathered from the on-going Lyme Bay recovery study to establish, and subsequently assess, metrics relevant to specifically to assess the condition of the following 6 attributes for each sub-feature (bedrock reef and stony reef):

i. Biotope composition of bedrock and stony reefs
ii. Distribution and spatial pattern of bedrock and stony reef biotopes
iv. Presence of representative / notable bedrock and stony reef biotopes
v. Species composition of representative or notable bedrock and stony reef biotopes
vi. Presence and/or abundance of specified bedrock and stony reef species

NB. iii. Extent of representative / notable bedrock and stony reef biotopes is not included as the survey design does not permit calculation of extent.

2 Methods

2.1 Survey method

The survey employed methods as described in (Sheehan et al. 2010), adapted from (Stevens & Connolly 2005), which involved flying a towed HD video over the seabed, close enough to identify pre-selected indicator species (see Figure 2.1). The HD video system comprises a camera (Surveyor-HD-J12 colour zoom titanium camera, 6000 m depth rated, 720p) positioned at a 45˚ angle to the seabed, three LED lights (Bowtech Products limited, LED-1600-13, 1600 Lumen underwater LED) fixed to the array in front of the camera to provide improved image definition and colour, a mini CTD profiler (Valeport Ltd) and two laser pointers (wavelength 532 nm Green) set 30 cm apart. The umbilical was connected topside to a Bowtech System power supply/control unit. This allowed control of the camera, focus, zoom and aperture, and intensity of the lights. The camera system was mounted on a towed flying array to glide the camera over the seabed in order to sample sessile and sedentary taxa. This allowed the sampling of a variety of habitats without snagging on rocks or boulders.

Sites surveyed were those selected for the Lyme Bay monitoring project in which survey locations were selected to control for habitat and fishing effort variability. Fishing data were gathered from Devon Sea Fisheries Committee (DSFC) patrols and Marine Fisheries Agency over-flight data and habitat information was derived from Devon Wildlife Trust (DWT) substrate/biotope maps. At each preselected site the flying array was deployed and towed slowly behind the boat (0.3 - 0.5 knots) to film a 200 m transect.

This method is appropriate for condition assessments as data is collected quickly and cost efficiently. The HD video collected provides a permanent record of the visible condition of the reefs in Lyme Bay in 2012.

2.2 Video analysis

A standard operating protocol for video analysis can be found in Appendix B.

Video analysis was conducted in two stages as per the annual monitoring project; video transect analysis and frame grab analysis. In the video analysis, video transects were viewed in full at normal speed and paused when a species was observed. Substrate was recorded as per the MB101 methods but for the purpose of the condition assessment, biotope and Annex I reef type were also recorded. Substrate type was recorded under the three categories; Rock (bedrock), Boulders (larger than ~256 mm) cobbles (~64-256 mm) pebbles (~16-64 mm) and Pebbly sand (Wentworth, 1922). Annex I habitat type was recorded under the categories; Bedrock reef, Stony reef and not able to assign Annex I habitat. Bedrock reef was defined as bedrock which arises from the surrounding seabed to provide habitat (Irving 2009). To qualify as stony reef, 10% or more of the seabed substratum should be composed of particles greater than 64 mm across ie cobbles and boulders, it should have a 'matrix' of supporting smaller material, have epifaunal species, must arise from the seafloor and must have a minimum extent 25 m^2 (or total of patchy reef). Where boulders and cobbles were present overlying bedrock reef, the habitat was recorded as Rock and as Annex I Bedrock reef. This process was repeated until the end of the transect was reached. It was not always possible to confidently assign habitat type as Annex I reef, in this event the biotope was assigned but not associated to a specific habitat. For this condition assessment this method was used to provide a qualitative description of communities observed, assign biotopes, and quantify the distribution and spatial pattern of biotopes, presence of notable and/or representative biotopes and species composition of representative and/or notable biotopes. This method was also used to assess the presence or absence and abundance of specified species (where video analysis was deemed the most appropriate method in Attrill et al. 2011).

In the frame grab analysis, the video was cut into frame grabs using frame extractor software (Cybertronix, UK). Frames were deleted if they were out of focus, the seabed was obscured or the array was flying too close or far away from the seabed. 30 frames were quantified for all species present including 'indicator species' (Jackson et al. 2008), to provide abundance and species richness data. The decision to use a subset of frames for analysis was taken in 2008 at the start of the monitoring project as extracting data from individual high-definition frame grabs is particularly time consuming. A series of analyses was therefore conducted to determine the number of frames per transect needed to provide robust biological information without sacrificing accuracy. A subset of 12 transects (3 from each treatment), each represented by 100 frames (close to the maximum number of frames per transect without overlap or poor quality images) was selected for this analysis. Multivariate ordination techniques in the Primer v.6 software were used to quantify the resemblance between the full dataset and progressively reduced portions of it (50%, 33%, and 25%). The reduced fractions 50% and 33% performed well in approximating the 100% dataset. It was therefore determined that 33% would be the most time effective and suitable proportion to quantify, which is equivalent to 30 frames per transect. The data collected in this format for the annual epibenthic survey is appropriate to use as part of the condition assessment as it provides accurate species and assemblage data across Lyme Bay. For this condition assessment frame grab analysis was used to assess the presence or absence and abundance of specified species (where frame grabs were deemed the most appropriate method in Attrill et al. 2011) and species richness in areas. All other attributes were assessed using the video analysis method and it will be implicitly stated where frame grab data were used.

In 2008 at the start of the annual monitoring study of Lyme Bay certain species were selected as Indicators (Figure 2.1). These were selected to be representative of the range of fauna found in Lyme Bay and were preselected (Jackson et al. 2008) to assess recovery and changes in ecosystem structure. Selection was both subjective (ie species were chosen by Defra for perceived reasons of economic value, public interest and ecological role) and objective, through assessment of the range biological traits (biological characteristics exhibited by species, relating to life history and mode of life) relevant to recoverability and/or function (Jackson et al. 2008). These species, found in Lyme Bay reef habitats, were selected to cover a range of reproductive and susceptibility traits (Jackson et al. 2008) and are therefore suitable to assess condition of reefs for the purpose of a condition assessment. The abundance of these indicator species has been assessed annually in the monitoring survey (Attrill et al. 2010). In addition, some of these species are relevant to biotope identification; branching sponges, dead man's fingers *Alcyonium digitatum,* pink sea fans *Eunicella verrucosa,* ross coral *Pentapora fascialis* and large sea squirts *Phallusia mammillata.*

The presence or absence of the indicator species including the response metric Species richness (number of species) at each site is shown in Table 3.1 For the complete assemblage analysis of all species please refer to the main Lyme Bay monitoring study report (Sheehan et al *2013 in prep*).

Figure 2.1 Indicator species; a) Branching sponges, b) *Alcyonium digitatum*, c) *Eunicella verrucosa*, d) Grouped hydroids, e) Grouped anemones, f) *Chaetopterus variopedatus*, g) *Cancer pagurus*, h) *Necora puber*, i) *Pecten maximus*, j) *Cellepora pumicosa*, k) *Pentapora fascialis*, l) *Asterias rubens*, m) *Phallusia mammillata*, n) *Ctenolabrus rupestris*, o) Grouped gobies *(Source: MARLIN & Keith Hiscock)*

2.3 Design of method for assessing condition of attributes

The design of future surveys for assessing the condition of attributes in Lyme Bay should repeat the methods outlined in this report, annually re-surveying the same suite of sites.

Univariate and multivariate analyses could then be conducted using Permutational Multivariate Analysis of Variance (PERMANOVA, Anderson 2001) based on similarity matrices. The null hypothesis of no difference among species assemblages over time could then be tested. Metrics of species richness, abundance and assemblage composition should be compared between years to assess change in condition over time using PERMANOVA multivariate analysis. The SIMPER routine could be used to assess changes in the species contribution to sites across the bay. These statistical methods are described in full in Attrill et al (2011).

A conjoining dive study or ROV survey could be undertaken to assess the assemblages that the towed video survey cannot, such as rocky overhangs. It should be replicated across the bay with at least three sites per area as per the main assessment and the same statistical routines applied.

2.4 Assigning biotopes

Before the video analysis was undertaken, previous knowledge of the assemblages of species seen in Lyme Bay over the course of the Lyme Bay monitoring project was applied to an initial assessment of the JNCC biotopes found nationally (Connor et al. 2004). This led to the selection of a number of potential biotopes which could be seen during the video analysis.

Biotopes were assigned using species composition as the determining factor over substrate and abiotic factors. Species presence was prioritised over substrate type when biotopes were assigned.

Biotopes were assigned during the video analysis process and assigned when the video was paused to record a species. Biotopes were assigned based on the species present that characterise level 5 or 6 biotopes. For example the biotope CR.MCR.EcCR.FaAlCr.Adig was assigned when *A. digitatum* was dominant, despite *Pomatoceros triqueter* also being a notable species as it could not be positively identified in the video. The biotope CR.HCR.Xfa.ByErSp.Eun was assigned when *E. verrucosa* and *P. fascialis* were the equal dominant species present in that section of the video. *E. verrucosa* was also observed in other areas but was only recorded as CR.HCR.Xfa.ByErSp.Eun when it was the dominant species. For example an area dominated by *A. digitatum* was recorded as the biotope CR.MCR.EcCR.FaAlCr if there were also *E. verrucosa* individuals present but they were not the dominant species.

The biotope SS.SMx.CMx.OphMx was assigned when brittle stars *Ophiothrix fragilis* and *Ophiocomina nigra* were the most abundant species, forming beds. According to the JNCC biotope classification description this biotope is typically assigned in areas where the substratum consists of mixed sediment. In Lyme Bay this biotope was assigned where it best describes the assemblages observed, irrespective of substratum type.

The biotope CR.LCR.BrAs.LgAsSp was assigned when large solitary ascidians (predominantly *P. mammillata*) and erect sponges were the most abundant taxa. According to the JNCC biotope classification description this biotope is typically assigned in areas with sheltered wave climates. Lyme Bay has a moderate wave climate yet aside from wave exposure this biotope best describes the assemblages observed.

CR.HCR.XFa.ByErSp.DysAct was assigned when the assemblage predominantly comprised patchy branching sponges and abundance of the hydroid species *Nemertesia* spp. and bryozoan species *Alcyonidium diaphanum* were frequent. Although when observed on the video with sponges the presence of *Nemertesia* spp. and *Alcyonidium diaphanum* indicated the presence of CR.HCR.XFa.ByErSp.DysAct, these species were noted but not quantified here as quantification is more effective using the digital overlay in the frame grab methodology used in the Lyme Bay monitoring survey (Attrill et al. 2010).

Biotopes were generally assigned at EUNIS level 5 (for example CR.LCR.BrAs.LgAsSp), but when possible level 6 was used (CR.HCR.Xfa.ByErSp.Eun, CR.MCR.EcCR.FaAlCr.Adig, CR.HCR.XFa.ByErSp.DysAct). For example, when species such as *E. verrucosa* could be identified it was deemed more appropriate to assign level 6 rather than 'Bryozoan turf and erect sponges on tide-swept circalittoral rock' as per the level 5 classification.

Biotopes were assigned on bedrock reef, stony reef and also in cases where Annex I habitat could not be allocated.

For areas where hermit crabs *Pagurus bernhardus,* queen scallops *Aequipecten opercularis* and/or starfish *Asterias rubens* were dominant, no biotope could be assigned as there is not an appropriate biotope for this assemblage.

The dominant species that most often resulted in the described biotopes being assigned were therefore *Alcyonidium diaphanum, Alcyonium digitatum,* Anemones (grouped), Branching sponges (grouped), *Eunicella verrucosa, Nemertesia antennina, Nemertesia ramosa, Pentapora fascialis* and *Phallusia mammillata.* The abundance of these species within areas will be presented in the results section of this assessment.

2.5 Limitations

The towed video analysis method was designed to fly over benthic communities and was not set up to look up. It therefore does not allow the quantification of cup corals which occur on rocky overhangs and consequently the biotope CR.FCR.Cv.SpCup could not be included here.

While the towed video method can identify organisms with distinctive classification features some organisms cannot be identified to species level such as sponges. Erect sponges such as *Axinella dissimilis*, *Raspailia* spp. and *Stelligera* spp., which were found in the previous studies, were grouped for the video analysis method as sponges can appear similar and have been classed as taxonomically difficult (Ackers et al. 2007). Identification of most species requires examination under high magnification (Kessler 1985).

At the scale of the field of view of the video it was not always possible to confidently identify Annex I reef under the JNCC definition (10 % of the seabed to be covered in cobbles with a diameter of at least 64 mm or that the area used was a minimum of 25 m^2) (Irving 2009).

These limitations could be alleviated in future condition assessments if a diver or ROV survey was completed alongside the towed video survey. Divers/ROV would be able to complete a more accurate assessment of the abundance of cup corals and therefore the CR.FCR.Cv.SpCup biotope. Divers/ROV could also take samples of erect sponges that are difficult to identify in order to accurately identify these taxa to species level. However the towed video method is able to provide detailed information on the benthic assemblages for a considerably larger area than divers could and so is more appropriate for the main survey

3 Results

Existing video data from the Lyme Bay monitoring project were used to assess the condition of the Lyme Bay bedrock and stony reefs. Results discuss: i The Biotope composition of bedrock and stony reefs, ii Distribution and spatial pattern of bedrock and stony reef biotopes, iv Presence of representative / notable bedrock and stony reef biotopes, v Species composition of representative or notable (indicator) bedrock and stony reef biotopes and vi Presence and/or abundance of specified bedrock and stony reef species are presented at the habitat and site level.

3.1 Description of communities observed

One of the most common assemblages observed is *Pagurus bernhardus*, *Aequipecten opercularis* and sponges on pebbly sand, seen with a variety of other species including *Lanice conchilega*, *Asterias rubens* and grouped hydroid species. This community does not resemble any biotope so none was given for assemblages like this. However, this assemblage often included *Cerianthid* spp in which case the biotope SS.S.Mx.CMx.ClloMx could be assigned.

Alcyonium digitatum was often seen with sponges, *A. rubens*, *Inachus* spp, *Ophiothrix fragilis* and *P. bernhardus* on boulders, cobbles and pebbly sand. The species in this community could be attributed to a number of different biotopes including CR.MCR.EcCR.FaAlCr.Adig, CR.MCR.EcCR.FaAlCr and CR.HCR.XFa.ByErSp.DysAct depending on the abundances of each species in the assemblage.

The large solitary ascidian *Phallusia mammillata* was observed with branching sponges, *Asterias rubens* and *Cellepora pumicosa* on rock and mixed habitat with boulders and cobbles. This community could be attributed to the biotope CR.LCR.BrAs.LgAsSp.

Pentapora fascialis and *Eunicella verrucosa* were often found together, along with a combination of *Cellepora pumicosa*, sponges and nudibranch species on a mixture of silt and rock substratum. This community composition was most often associated with the biotope CR.HCR.Xfa.ByErSp.Eun. *A. digitatum* was also often seen in this assemblage.

O. fragilis and *Ophiura ophiura* were often found with *P. bernhardus*, grouped hydroid species and *A. opercularis* on pebbly sand. This assemblage is characteristic of the biotope SS.SMx.CMx.OphMx. Large aggregations of brittlestars *O. fragilis* and *O. ophiura* were also seen on bedrock reef in a discrete area of the Pre-existing Voluntary Closure near to the area known as Beer Home Ground (Figure 3.2). They were forming a dense bed overlying reef where *A. digitatum* individuals were observed to protrude from underneath the bed formed by the echinoderms.

3.2 Biotope composition of bedrock and stony reefs

Six biotopes were identified; five on ‘bedrock’ and four on ‘stony’ reef. The most abundant biotopes were **CR.MCR.EcCR.FaAlCr.Adig** (*Alcyonium digitatum, Pomatoceros triqueter,* algal and bryozoan crusts on wave-exposed circalittoral rock) and **CR.HCR.Xfa.ByErSp.Eun** (*Eunicella verrucosa* and *Pentapora fascialis* on wave-exposed circalittoral rock) (Figure 3.1).

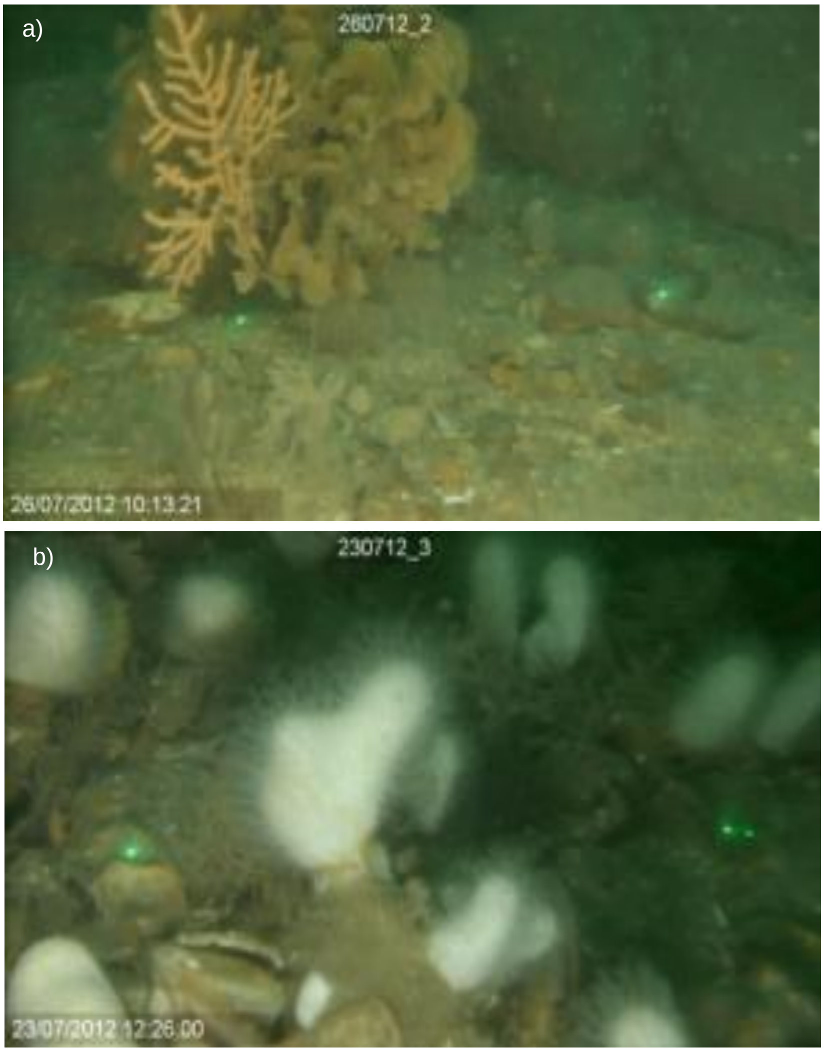

Figure 3.1 Examples of biotopes observed; a) CR.HCR.Xfa.ByErSp.Eun- *Eunicella verrucosa* and *Pentapora fascialis*, b) CR.MCR.EcCR.FaAlCr.Adig *Alcyonium digitatum, Pomatoceros triqueter,* algal and bryozoan crusts

3.3 Distribution and spatial pattern of bedrock and stony reef biotopes

The biotope Bryozoan and Erect branching sponges (CR.HCR.XFa.ByErSp) was found across the entire bay, occurring in tandem with species characteristic of other biotopes for example CR.HCR.Xfa.ByErSp.Eun. This biotope is therefore not plotted, but can be considered present across the bedrock and stony reefs of Lyme Bay that were closed to towed demersal fishing.

Below is a map, showing the biotopes present at sites across the bay (Figures 3.2). Each individual coloured symbol on the biotope map represents a biotope, plotted every minute along the transect. Where no species were present or no species which denote the presence of a biotope were present, no symbol is presented hence gaps within transects can be seen.

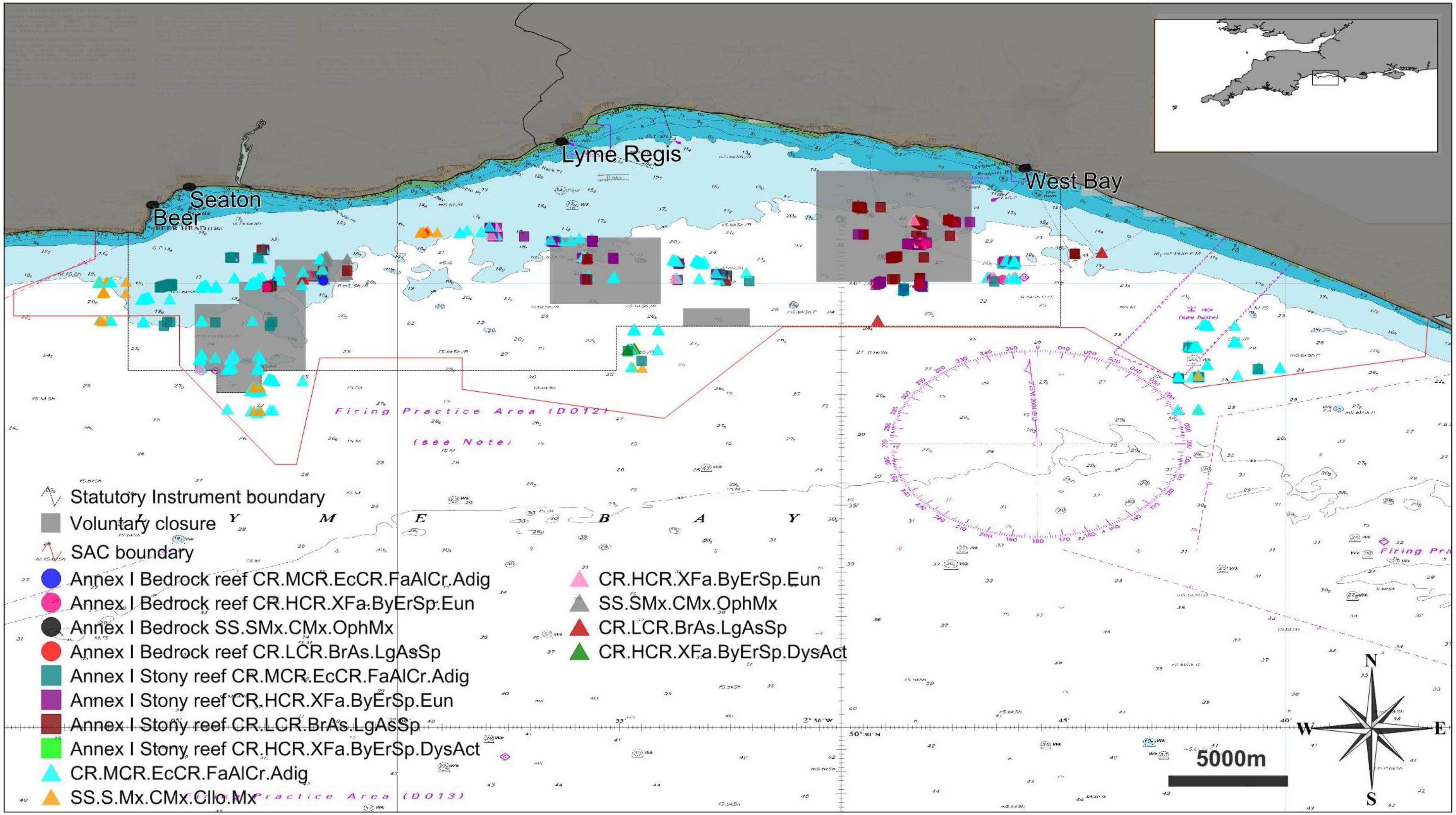

Figure 3.2 Distribution of biotopes within the Lyme Bay cSAC

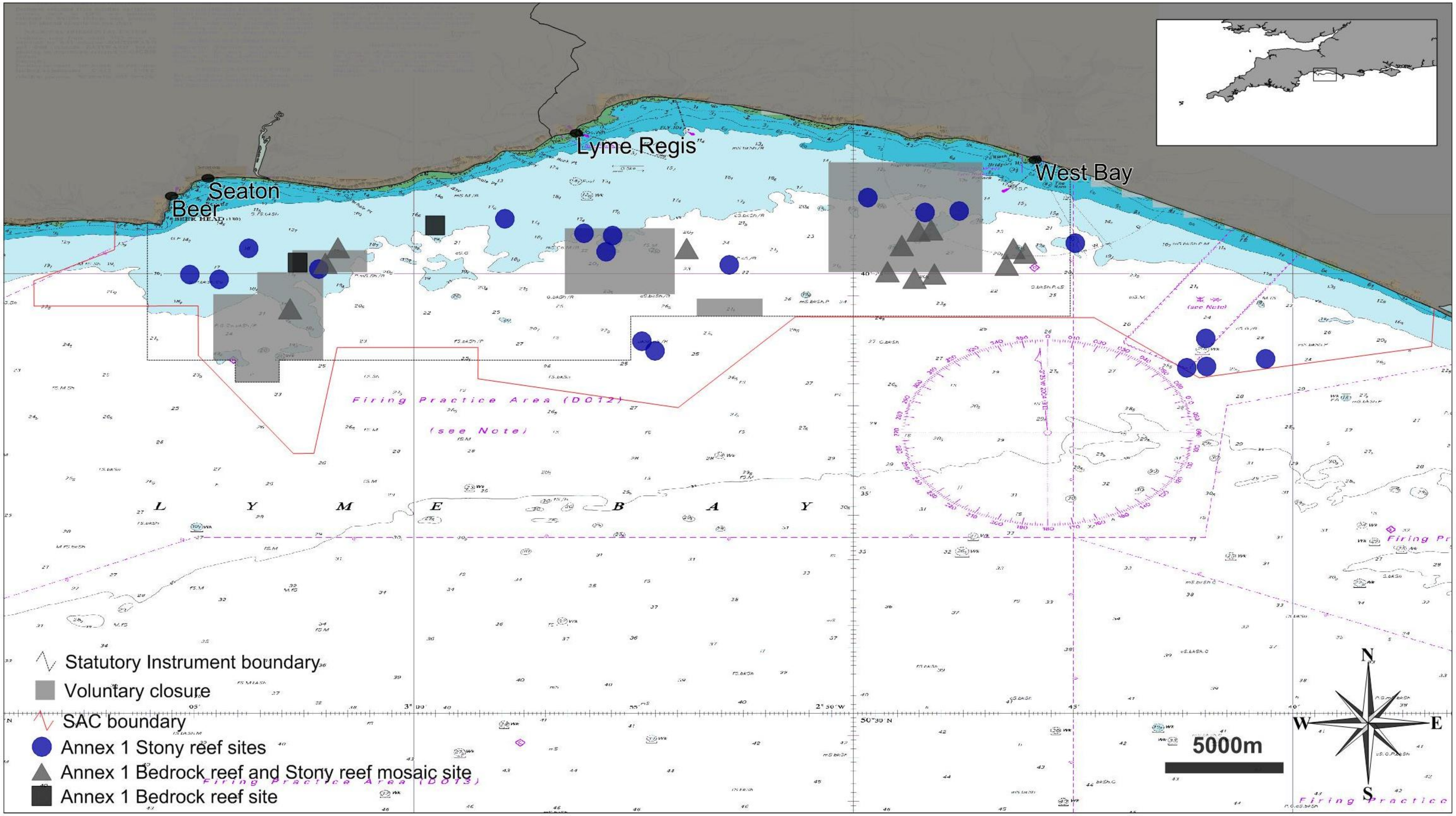

Figure 3.3 Distribution of survey sites with Annex 1 stony and bedrock reef

3.4 Bedrock reef

3.4.1 Biotope composition of bedrock reefs

Bedrock reefs were found to be composed of the following biotopes:

- **CR.MCR.EcCR.FaAlCr.Adig** *Alcyonium digitatum, Pomatoceros triqueter,* algal and bryozoan crusts on wave-exposed circalittoral rock
- **CR.HCR.Xfa.ByErSp.Eun** *Eunicella verrucosa* and *Pentapora fascialis* on wave-exposed circalittoral rock
- **SS.SMx.CMx.OphMx** *Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment (observed here on bedrock)
- **CR.LCR.BrAs.LgAsSp** Large solitary ascidians and erect sponges on wave-sheltered circalittoral rock

A list of the main contributing species for each bedrock reef biotope is summarised in Annex A, Table A1 for ease of future reference.

3.4.2 Distribution and spatial pattern of bedrock reef biotopes

E. verrucosa and *P. fascialis* on wave-exposed circalittoral rock (**CR.HCR.Xfa.ByErSp.Eun**) was the most abundant biotope on bedrock reef with 27 recordings, and was found across the cSAC but mostly in the south east of the SI (Figure 3.2). *A. digitatum, P. triqueter,* algal and bryozoan crusts on wave-exposed circalittoral rock (**CR.MCR.EcCR.FaAlCr.Adig**) was the second most abundant biotope on bedrock reef with 12 recordings and was also identified across the SI. The biotope Large solitary ascidians and erect sponges on wave-sheltered circalittoral rock (**CR.LCR.BrAs.LgAsSp**) was the third most abundant biotope on bedrock reef with six recordings and was distributed sparsely across the SI (Figure 3.2). Two incidences of *O. fragilis* and/or *O. nigra* brittlestar beds on sublittoral mixed sediment (**SS.SMx.CMx.OphMx**) were also found on bedrock reef. These beds were seen in the west of the cSAC (Figure 3.2), within the previous voluntary closure nearest Beer Home Ground and were observed smothering boulders, pink sea fans and dead man's fingers. Although this biotope is described in the standard biotope description on mixed sediment, bed-forming brittlestars have been observed in this assessment on bedrock reef and SS.SMx.CMx.OphMx is therefore included as a biotope on bedrock reef in this assessment.

3.4.3 Presence of representative and/or notable biotopes on bedrock reef

The towed video survey found bedrock reef was characterised by the following biotopes:

- **CR.MCR.EcCR.FaAlCr.Adig (Representative)** *Alcyonium digitatum, Pomatoceros triqueter,* algal and bryozoan crusts on wave-exposed circalittoral rock
- **CR.HCR.Xfa.ByErSp.Eun (Notable and Representative)** *Eunicella verrucosa* and *Pentapora fascialis* on wave-exposed circalittoral rock

Biotopes were considered to be representative if recordings of that biotope consisted of more than 25% of the total biotope recordings on bedrock reef. **CR.MCR.EcCR.FaAlCr.Adig** was recorded 27 times out of a total 47 biotope recordings on bedrock reef (57%) and **CR.HCR.Xfa.ByErSp.Eun** was recorded 12 times out of a total 47 biotope recordings on bedrock reef (25.5%).

Biotopes were considered to be notable if they included a BAP species as a dominant species (*Eunicella verrucosa*).

3.4.4 Species composition of representative and/or notable bedrock reef biotopes

A summary of this information may be found in Appendix Table A1.

- The biotope **CR.MCR.EcCR.FaAlCr.Adig** (*A. digitatum, P. triqueter,* algal and bryozoan crusts on wave-exposed circalittoral rock) on bedrock reef was found to mostly comprise; *A. digitatum, E. verrucosa*, branching sponges and *Asterias rubens*.
- The biotope **CR.HCR.Xfa.ByErSp.Eun** (*E. verrucosa* and *P. fascialis* on wave-exposed circalittoral rock) on bedrock reef was found to mainly comprise *E. verrucosa*, branching sponges, *P. fascialis, Pecten maximus, A. rubens* and *Phallusia mammillata*.

3.4.5 Presence and/or abundance of specified bedrock reef species

The presence and/or abundance of specified bedrock reef species are discussed in conjunction with those for stony reef species, after the attributes for stony reef species.

3.5 Stony reef

3.5.1 Biotope composition of stony reefs

Stony reefs were found to be composed of the following biotopes:

- **CR.MCR.EcCR.FaAlCr.Adig** *Alcyonium digitatum, Pomatoceros triqueter,* algal and bryozoan crusts on wave-exposed circalittoral rock
- **CR.HCR.Xfa.ByErSp.Eun** *Eunicella verrucosa* and *Pentapora fascialis* on wave-exposed circalittoral rock
- **CR.LCR.BrAs.LgAsSp** Large solitary ascidians and erect sponges on wave-sheltered circalittoral rock
- **CR.HCR.XFa.ByErSp.DysAct** Mixed turf of bryozoans and erect sponges with *Dysidia fragilis* and *Actinothoe sphyrodeta* on tide-swept wave-exposed circalittoral rock

A list of the main contributing species for each stony reef biotope is summarised in Annex A, Table A2 for ease of future reference.

3.5.2 Distribution and spatial pattern of biotopes on stony reef

A. digitatum, P. triqueter, algal and bryozoan crusts on wave-exposed circalittoral rock (**CR.MCR.EcCR.FaAlCr.Adig)** was recorded 65 times across the cSAC, and was found most often on the west side of the SI (Figure 3.2). The circle and square versions of this biotope shows where Annex I reef habitats could be positively identified. Annex I and non-Annex I versions of this biotope were interspersed when recorded along the video transect, suggesting that at the scale of an entire transect, as opposed to the area of the field of view when recording on the video, the area surveyed is Annex I reef.

The biotope *E. verrucosa* and *P. fascialis* on wave-exposed circalittoral rock **(CR.HCR.Xfa.ByErSp.Eun**) was the most abundant on stony reef; recorded 88 times. The biotope Large solitary ascidians and erect sponges on wave-sheltered circalittoral rock **(CR.LCR.BrAs.LgAsSp**) was recorded 62 times. Both of these biotopes were found across the cSAC, particularly in the area previously protected under voluntary agreements to the east nearest to the area known as Sawtooth Ledges (boxed area on chart shaded in grey) (Figure 3.2). The biotope Mixed turf of bryozoans and erect sponges with *Dysidia fragilis* and *Actinothoe sphyrodeta* on tide-swept wave-exposed circalittoral rock **(CR.HCR.XFa.ByErSp.DysAct)** was only noted once, but as with this biotope on bedrock, sponges, *Nemertesia* spp. and *A. diaphanum* were found throughout the areas surveyed. This biotope was underrepresented as other species present commanded different biotopes to be assigned (Figure 3.2).

3.5.3 Presence of representative and/or notable stony reef biotopes

The towed video survey found stony reef was characterised by the following biotopes:

- **CR.MCR.EcCR.FaAlCr.Adig (Representative)** *Alcyonium digitatum, Pomatoceros triqueter,* algal and bryozoan crusts on wave-exposed circalittoral rock
- **CR.HCR.Xfa.ByErSp.Eun (Representative and notable)** *Eunicella verrucosa* and *Pentapora fascialis* on wave-exposed circalittoral rock
- **CR.LCR.BrAs.LgAsSp (Representative)** Large solitary ascidians and erect sponges on wave-sheltered circalittoral rock

Biotopes were considered to be representative if recordings of that biotope consisted of more than 25% of the total biotope recordings on stony reef. **CR.MCR.EcCR.FaAlCr.Adig** was recorded 65 times out of a total 216 biotope recordings on stony reef (30%), **CR.HCR.Xfa.ByErSp.Eun** was recorded 88 times out of a total 216 biotope recordings on stony reef (40.7%) and **CR.LCR.BrAs.LgAsSp** was recorded 62 times out of a total 216 biotope recordings on stony reef (28.7%).

Biotopes were considered to be notable if they included a BAP species as a dominant species (*Eunicella verrucosa*).

3.5.4 Species composition of representative or notable stony reef biotopes

A summary of this information may be found in Appendix Table A2.

- The biotope **CR.MCR.EcCR.FaAlCr.Adig** (*A. digitatum, P. triqueter,* algal and bryozoan crusts on wave-exposed circalittoral rock) on stony reef mainly comprised; *A. digitatum, A. opercularis, A. rubens, P. maximus, E. verrucosa, Inachus* spp., branching sponges, *P. bernhardus, P. mammillata* and *P. fascialis*.
- The biotope **CR.HCR.Xfa.ByErSp.Eun** (*E. verrucosa* and *P. fascialis* on wave-exposed circalittoral rock) on stony reef mostly comprised: *E. verrucosa*, *P. fascialis, A. rubens, P. mammillata,* branching sponges, *P. maximus, A. digitatum*, *Ctenolabrus rupestris, Labrus mixtus* and *N. puber*.
- The biotope **CR.LCR.BrAs.LgAsSp** (Large solitary ascidians and erect sponges on wave-sheltered circalittoral rock) on stony reef mostly comprised: branching sponges, *P. mammillata, P. fascialis*, *E. verrucosa, A. digitatum, A. rubens, P. maximus*, *C. rupestris* and *A. opercularis*.

3.5.5 Presence and/or abundance of specified stony reef species

The presence and/or abundance of specified stony reef species is discussed in conjunction with those for bedrock reef species, in the following section.

3.6 Presence and/or abundance of specified bedrock and stony reef species

Multiple biotopes were recorded at each site (200 m x 0.5 m transect), and the presence of indicator species was noted (Table 3.1), with between 8 and 39 taxa recorded per m^2 per site. Hydroids, dead man's fingers, and king scallops were found at every site across the cSAC, branching sponges were present in 75 % of the sites and *E. verrucosa*, *P. mammillata* and *P. fascialis* in approximately 50 % of the sites. A full species assemblage analysis can be found in the sister report to this document (Sheehan et al. *in prep* (2013 Natural England report)). Presence or absence of reef associated species at each site is presented in Table 3.1. Metrics could not be attained from site 49 due to the presence of brittlestar beds. Abundance of biotope notable species within areas of the bay and the number of occurrences of biotopes in that area are presented in Table 3.2. Occurrences of biotopes and species within biotopes are presented for areas as sites should be considered replicates in areas. It is not expected that in future assessments the exact same transect will be repeated but that sites are located within the same areas. These tables therefore provide a baseline for future condition assessments. This attribute was assessed using either video data or frame grabs depending on which was deemed the most appropriate method for each species in Attrill et al. 2011.

3.7 Distribution and spatial pattern of biotopes on 'Annex I could not be confidently assigned'

A. digitatum, P. triqueter, algal and bryozoan crusts on wave-exposed circalittoral rock (**CR.MCR.EcCR.FaAlCr.Adig)** was the most abundant biotope recorded where the habitat could not be confidently identified as Annex I reef, recorded 398 times across the cSAC. The only area

it was absent from was the previous voluntary closure to the east of the SI nearest to Sawtooth Ledges (Figure 3.2). The biotope *Cerianthus lloydii* and other burrowing anemones in circalittoral muddy mixed sediment (**SS.S.Mx.CMx.Cllo.MX**) was recorded 66 times on habitat that could not be confidently assigned as Annex I reef. It was recorded mostly outside of the SI within the cSAC, to the west and south of the previous voluntary closure to the west of the bay nearest Beer Home ground, outside of the SI, in the cSAC south of the port of Lyme Regis and within the SI, close to the coast between Seaton and Lyme Regis (Figure 3.2). The biotope *E. verrucosa* and *P. fascialis* on wave-exposed circalittoral rock **(CR.HCR.Xfa.ByErSp.Eun**) was recorded 35 times on ground that could not be confidently assigned as Annex I reef, distributed sparsely across the SI. The biotope *O. fragilis* and/or *O. nigra* brittlestar beds on sublittoral mixed sediment was observed 24 times on habitat that could not be confidently assigned as Annex I within the north eastern corner of the previous voluntary closure known as Beer Home Ground. The biotope Large solitary ascidians and erect sponges on wave-sheltered circalittoral rock **(CR.LCR.BrAs.LgAsSp**) was recorded 25 times across the bay, with the distribution mostly centred within the previous voluntary closures. The biotope Mixed turf of bryozoans and erect sponges with *Dysidia fragilis* and *Actinothoe sphyrodeta* on tide-swept wave-exposed circalittoral rock **(CR.HCR.XFa.ByErSp.DysAct)** was noted five times on ground that was not assigned as Annex I reef, with recordings seen mostly outside of the SI, south of Lyme Regis. As with this biotope on bedrock, and stony reef sponges, *Nemertesia* spp. and *A. diaphanum* were found throughout the areas surveyed. This biotope was underrepresented as other species present commanded different biotopes to be assigned (Figure 3.2).

Table 3.1 Indicator species (as selected by Jackson et al. 2008) presence and richness for each site. Grey fill indicates species presence. These metrics were compiled using either video data or frame grabs depending on which was deemed the most appropriate method for each species in Attrill et al. 2011

	Porifera	Cnidaria				Annelida	Arthro-poda		Mollusca	Bryozoa		Echino-dermata	Ascidians	Fishes		
Site No.	Branching sponges	*Alcyonium digitatum*	*Eunicella verrucosa*	Grouped hydroids	Grouped anemones	*Chaetopterus variopedatus*	*Cancer pagurus*	*Necora puber*	*Pecten maximus*	*Cellepora pumicosa*	*Pentapora fascialis*	*Asterias rubens*	*Phallusia mammillata*	*Ctenolabrus rupestris*	Grouped gobies	Species Richness
1	■	■		■		■			■	■					■	27
2		■		■		■			■	■						12
3		■		■					■	■					■	24
4		■		■	■				■			■			■	27
5	■	■		■					■	■	■	■			■	24
6	■	■		■	■			■	■	■	■	■			■	29
7		■		■	■				■			■			■	31
8		■		■					■			■				31
9	■	■	■	■		■	■		■	■	■	■	■	■	■	32
10	■	■	■	■	■				■	■	■	■	■			25
11	■	■		■		■			■	■	■	■	■		■	24
12	■	■		■	■	■			■			■				28
13		■		■		■			■			■				23
14		■		■	■				■			■				24

Site No.	Branching sponges	*Alcyonium digitatum*	*Eunicella verrucosa*	Grouped hydroids	Grouped anemones	*Chaetopterus variopedatus*	*Cancer pagurus*	*Necora puber*	*Pecten maximus*	*Cellepora pumicosa*	*Pentapora fascialis*	*Asterias rubens*	*Phallusia mammillata*	*Ctenolabrus rupestris*	Grouped gobies	Species Richness
15	■	■	■	■		■		■	■		■	■	■	■	■	24
16	■	■		■	■	■			■			■	■			16
17	■	■		■	■				■	■	■	■	■	■		22
18	■	■	■	■	■	■		■	■	■	■		■	■		35
19	■	■	■	■				■	■	■		■	■	■	■	18
20		■		■	■			■	■		■	■		■	■	33
21		■		■	■				■			■				27
22	■	■	■	■	■				■	■		■	■	■	■	22
23	■	■	■	■					■	■	■	■	■	■	■	21
24	■	■		■		■			■		■	■	■		■	39
25	■	■		■		■		■	■	■	■	■	■	■	■	19
26	■	■	■	■	■			■	■	■	■	■	■	■	■	19
27	■	■	■	■				■	■	■	■	■	■	■	■	14
28	■	■	■	■		■		■	■	■	■	■			■	16
29	■	■	■	■			■		■	■	■	■	■	■	■	20
30	■	■	■	■		■			■	■	■	■	■	■		20
31		■		■	■	■	■		■			■				20

Site No.	Branching sponges	*Alcyonium digitatum*	*Eunicella verrucosa*	Grouped hydroids	Grouped anemones	*Chaetopterus variopedatus*	*Cancer pagurus*	*Necora puber*	*Pecten maximus*	*Cellepora pumicosa*	*Pentapora fascialis*	*Asterias rubens*	*Phallusia mammillata*	*Ctenolabrus rupestris*	Grouped gobies	Species Richness
32	■	■		■	■	■	■		■			■			■	21
33	■	■		■	■	■	■	■	■			■			■	19
34	■	■	■	■	■	■		■	■		■	■		■		13
35	■	■	■	■	■	■		■	■			■		■	■	17
36	■	■	■	■		■	■		■			■			■	14
37	■	■	■	■		■	■		■		■	■	■	■	■	33
38	■	■	■	■					■	■		■			■	16
39	■	■		■	■	■			■	■		■			■	14
40	■	■		■	■	■		■	■	■		■			■	14
41	■	■		■	■	■			■	■	■	■			■	13
42		■		■		■			■			■			■	18
43	■	■	■	■	■	■			■	■	■		■	■	■	8
44		■		■					■			■			■	9
45		■		■					■	■		■			■	15
46	■	■	■	■		■			■	■	■	■	■		■	13
47	■	■		■	■	■			■	■		■			■	9
48	■	■	■	■					■	■	■	■	■	■	■	13
50	■	■		■	■				■	■		■			■	18

51															22
52															12
53															17

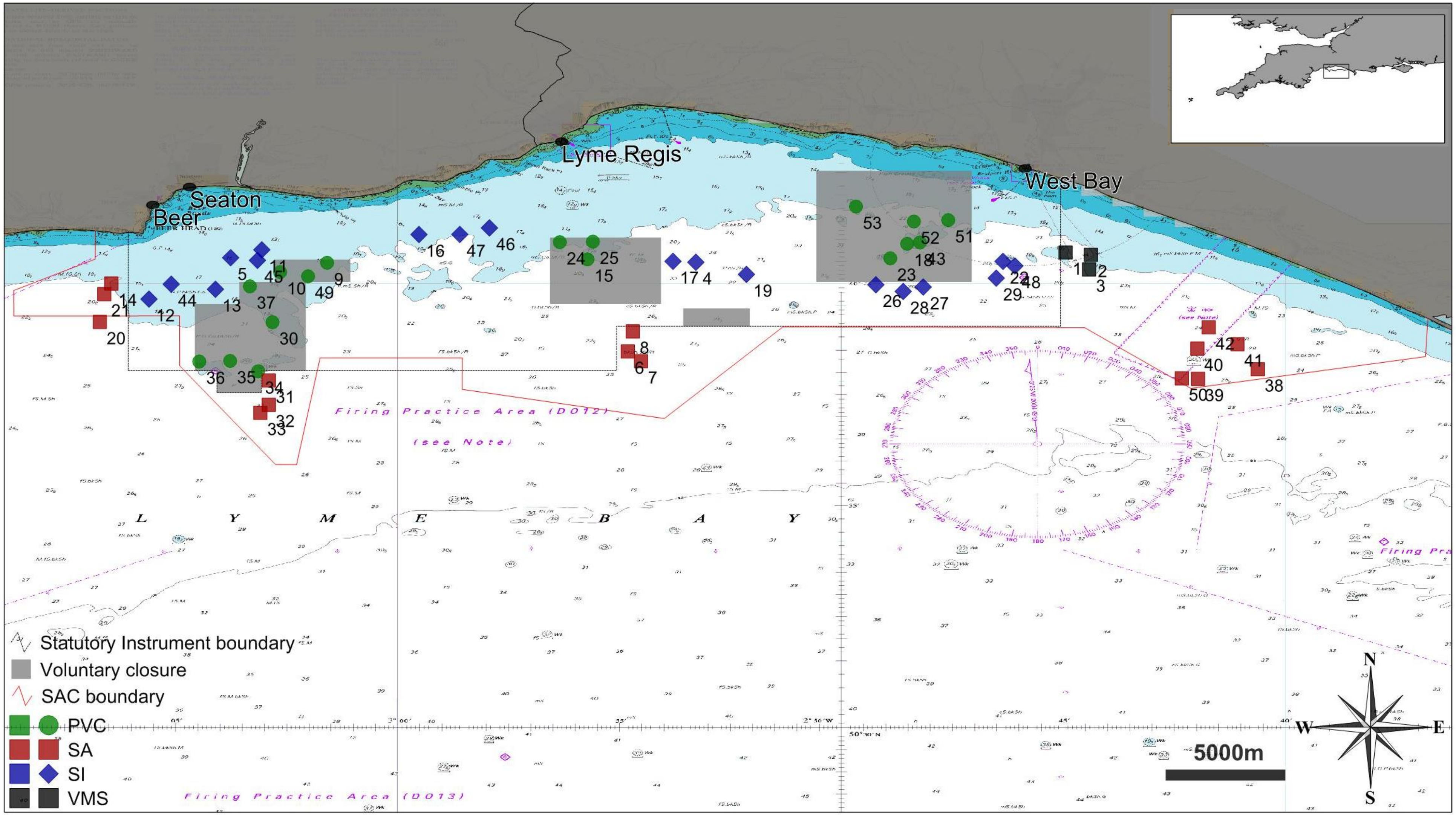

Figure 3.4 Chart to show sites surveyed, colour coded for treatment. PVC= Pre-existing Voluntary Closure, SA= Sensitive Area, SI= Statutory Instrument, VMS= Vessel Monitoring System

Table 3.2 Biotope occurrence and abundance of biotope notable species (species that denote the presence of a biotope). Biotopes highlighted in grey are further explained in the text. Areas comprise three sites which are indicated in Figure 3.4. Average abundance and standard error are calculated using either video data or frame grabs depending on which was deemed the most appropriate method for each species in Attrill et al. 2011

Area	Sites	Biotopes	Number of occurrences of biotope	Species/ Taxa	Average abundance	Standard Error
PVC 1	34, 35 & 36	CR.MCR.EcCr.FaAlCr.Adig	54	*Alcyonidium diaphanum*	0.89	0.35
		ByErSp.Eun	4	*Alcyonium digitatum*	2.23	0.25
		SS.S.Mx.CMx.ClloMx	1	Anemones (grouped)	1.19	0.62
				Branching sponges (grouped)	0.23	0.05
				Eunicella verrucosa	0.02	0.00
				Nemertesia antennina	2.12	0.64
				Nemertesia ramosa	0.00	0.00
				Pentapora fascialis	0.03	0.00
				Phallusia mammillata	0.00	0.00
PVC 2	30 & 37	CR.MCR.EcCr.FaAlCr.Adig	39	*Alcyonidium diaphanum*	2.52	0.83
		CR.LCR.BrAs.LgAsSp	6	*Alcyonium digitatum*	3.56	2.32
		ByErSp.Eun	2	Anemones (grouped)	0.59	0.59
				Branching sponges (grouped)	0.60	0.03
				Eunicella verrucosa	0.20	0.15
				Nemertesia antennina	3.63	1.04
				Nemertesia ramosa	0.00	0.00
				Pentapora fascialis	0.13	0.04
				Phallusia mammillata	0.43	0.41
PVC 3	9 & 10	CR.MCR.EcCr.FaAlCr.Adig	27	*Alcyonidium diaphanum*	2.59	0.79
		SS.S.Mx.CMx.OphMx	21	*Alcyonium digitatum*	6.32	4.30
		CR.LCR.BrAs.LgAsSp	7	Anemones (grouped)	0.00	0.00
		ByErSp.Eun	1	Branching sponges (grouped)	0.31	0.29
				Eunicella verrucosa	0.15	0.11
				Nemertesia antennina	2.30	0.53
				Nemertesia ramosa	0.00	0.00
				Pentapora fascialis	0.05	0.02
				Phallusia mammillata	0.33	0.17
PVC 4	15, 24 & 25	ByErSp.Eun	99	*Alcyonidium diaphanum*	1.68	0.59
		CR.LCR.BrAs.LgAsSp	39	*Alcyonium digitatum*	1.01	0.46
		CR.MCR.EcCr.FaAlCr.Adig	38	Anemones (grouped)	3.21	1.03
				Branching sponges (grouped)	0.44	0.16
				Eunicella verrucosa	0.03	0.03
				Nemertesia antennina	0.44	0.20
				Nemertesia ramosa	0.00	0.00
				Pentapora fascialis	0.71	0.09
				Phallusia mammillata	0.45	0.15
PVC 5	51, 52 & 53	CR.LCR.BrAs.LgAsSp	55	*Alcyonidium diaphanum*	0.79	0.36
		ByErSp.Eun	19	*Alcyonium digitatum*	0.42	0.11

		CR.MCR.EcCr.FaAlCr.Adig	1	Anemones (grouped)	0.20	0.12
				Branching sponges (grouped)	1.44	0.21
				Eunicella verrucosa	0.47	0.19
				Nemertesia antennina	3.83	0.70
				Nemertesia ramosa	0.35	0.22
				Pentapora fascialis	0.21	0.10
				Phallusia mammillata	0.14	0.02
PVC 6	18, 23 & 43	ByErSp.Eun CR.LCR.BrAs.LgAsSp CR.HCR.XFa.ByErSp.DysAct	79 36 1	*Alcyonidium diaphanum*	0.64	0.30
				Alcyonium digitatum	0.05	0.01
				Anemones (grouped)	0.79	0.34
				Branching sponges (grouped)	2.02	0.44
				Eunicella verrucosa	1.01	0.14
				Nemertesia antennina	3.60	0.65
				Nemertesia ramosa	0.00	0.00
				Pentapora fascialis	0.54	0.13
				Phallusia mammillata	0.17	0.05
SA 1	14, 20 & 21	SS.S.Mx.CMx.ClloMx CR.MCR.EcCr.FaAlCr.Adig	37 12	*Alcyonidium diaphanum*	0.30	0.17
				Alcyonium digitatum	0.44	0.13
				Anemones (grouped)	6.22	1.38
				Branching sponges (grouped)	0.00	0.00
				Eunicella verrucosa	0.00	0.00
				Nemertesia antennina	0.00	0.00
				Nemertesia ramosa	0.00	0.00
				Pentapora fascialis	0.02	0.02
				Phallusia mammillata	0.00	0.00
SA 2	31, 32 & 33	CR.MCR.EcCr.FaAlCr.Adig SS.S.Mx.CMx.ClloMx	57 15	*Alcyonidium diaphanum*	0.40	0.24
				Alcyonium digitatum	2.45	0.19
				Anemones (grouped)	2.96	0.63
				Branching sponges (grouped)	0.16	0.14
				Eunicella verrucosa	0.00	0.00
				Nemertesia antennina	0.52	0.27
				Nemertesia ramosa	0.00	0.00
				Pentapora fascialis	0.00	0.00
				Phallusia mammillata	0.00	0.00
SA 3	6, 7 & 8	CR.MCR.EcCr.FaAlCr.Adig site 9 only	1	*Alcyonidium diaphanum*	1.19	0.83
				Alcyonium digitatum	0.74	0.36
				Anemones (grouped)	1.78	0.71
				Branching sponges (grouped)	0.12	0.12
				Eunicella verrucosa	0.00	0.00
				Nemertesia antennina	0.49	0.40
				Nemertesia ramosa	0.00	0.00
				Pentapora fascialis	0.02	0.02
				Phallusia mammillata	0.00	0.00
SA 4	39, 40 & 50	CR.MCR.EcCr.FaAlCr.Adig	48	*Alcyonidium diaphanum*	1.43	0.53
		SS.S.Mx.CMx.ClloMx	2	*Alcyonium digitatum*	2.41	0.42

				Anemones (grouped)	0.00	0.00
				Branching sponges (grouped)	0.12	0.09
				Eunicella verrucosa	0.00	0.00
				Nemertesia antennina	0.79	0.29
				Nemertesia ramosa	0.00	0.00
				Pentapora fascialis	0.00	0.00
				Phallusia mammillata	0.00	0.00
SA 5	38, 42 & 42	CR.MCR.EcCr.FaAlCr.Adig	33	*Alcyonidium diaphanum*	1.54	0.50
				Alcyonium digitatum	19.21	2.95
				Anemones (grouped)	0.74	0.53
				Branching sponges (grouped)	0.06	0.03
				Eunicella verrucosa	0.01	0.01
				Nemertesia antennina	0.69	0.28
				Nemertesia ramosa	0.00	0.00
				Pentapora fascialis	0.04	0.03
				Phallusia mammillata	0.00	0.00
SI 1	12, 13 & 44	CR.MCR.EcCr.FaAlCr.Adig	60	*Alcyonidium diaphanum*	0.40	0.19
				Alcyonium digitatum	6.92	1.03
				Anemones (grouped)	0.20	0.14
				Branching sponges (grouped)	0.03	0.03
				Eunicella verrucosa	0.00	0.00
				Nemertesia antennina	0.25	0.15
				Nemertesia ramosa	0.00	0.00
				Pentapora fascialis	0.01	0.01
				Phallusia mammillata	0.00	0.00
SI 2	5, 11 & 45	CR.MCR.EcCr.FaAlCr.Adig	19	*Alcyonidium diaphanum*	3.21	0.92
		ByErSp.Eun	3	*Alcyonium digitatum*	1.50	0.96
		CR.LCR.BrAs.LgAsSp	1	Anemones (grouped)	10.57	6.38
				Branching sponges (grouped)	0.20	0.11
				Eunicella verrucosa	0.00	0.00
				Nemertesia antennina	0.05	0.05
				Nemertesia ramosa	0.00	0.00
				Pentapora fascialis	0.12	0.06
				Phallusia mammillata	0.02	0.02
SI 3	16, 46 & 47	ByErSp.Eun	15	*Alcyonidium diaphanum*	2.12	0.51
		CR.MCR.EcCr.FaAlCr.Adig	10	*Alcyonium digitatum*	0.44	0.23
		SS.S.Mx.CMx.ClloMx	9	Anemones (grouped)	0.05	0.05
		CR.LCR.BrAs.LgAsSp	1	Branching sponges (grouped)	0.05	0.02
				Eunicella verrucosa	0.01	0.01
				Nemertesia antennina	0.20	0.12
				Nemertesia ramosa	0.00	0.00
				Pentapora fascialis	0.28	0.28
				Phallusia mammillata	0.06	0.04
SI 4	4, 17 & 19	CR.MCR.EcCr.FaAlCr.Adig	47	*Alcyonidium diaphanum*	0.59	0.27
		ByErSp.Eun	14	*Alcyonium digitatum*	0.67	0.30

		CR.LCR.BrAs.LgAsSp	9	Anemones (grouped)	0.05	0.05
				Branching sponges (grouped)	0.12	0.07
				Eunicella verrucosa	0.15	0.15
				Nemertesia antennina	0.25	0.13
				Nemertesia ramosa	0.05	0.05
				Pentapora fascialis	0.04	0.02
				Phallusia mammillata	0.11	0.10
SI 5	26, 27 & 28	ByErSp.Eun CR.MCR.EcCr.FaAlCr.Adig CR.LCR.BrAs.LgAsSp	46 45 7	*Alcyonidium diaphanum*	0.89	0.47
				Alcyonium digitatum	2.93	2.77
				Anemones (grouped)	3.06	0.96
				Branching sponges (grouped)	0.56	0.29
				Eunicella verrucosa	1.76	0.51
				Nemertesia antennina	2.67	0.68
				Nemertesia ramosa	0.00	0.00
				Pentapora fascialis	0.12	0.07
				Phallusia mammillata	0.16	0.11
SI 6	22, 29 & 48	CR.MCR.EcCr.FaAlCr.Adig ByErSp.Eun SS.S.Mx.CMx.OphMx CR.LCR.BrAs.LgAsSp	57 26 6 2	*Alcyonidium diaphanum*	1.19	0.43
				Alcyonium digitatum	3.31	1.36
				Anemones (grouped)	0.40	0.18
				Branching sponges (grouped)	0.46	0.11
				Eunicella verrucosa	1.31	0.31
				Nemertesia antennina	0.74	0.26
				Nemertesia ramosa	0.00	0.00
				Pentapora fascialis	0.03	0.01
				Phallusia mammillata	0.03	0.01
VMS	1, 2 & 3	CR.LCR.BrAs.LgAsSp CR.MCR.EcCr.FaAlCr.Adig	2 1	*Alcyonidium diaphanum*	3.11	1.00
				Alcyonium digitatum	0.18	0.05
				Anemones (grouped)	0.05	0.05
				Branching sponges (grouped)	0.06	0.06
				Eunicella verrucosa	0.00	0.00
				Nemertesia antennina	0.69	0.35
				Nemertesia ramosa	0.00	0.00
				Pentapora fascialis	0.00	0.00
				Phallusia mammillata	0.00	0.00

4 Discussion

The earlier Lyme Bay biotope surveys (Cork et al. 2008; Vanstaen & Eggleton 2011) used different locations and methods to the 2012 survey, and so observed different biotopes, all of which are relevant to monitor for future condition assessments (Table 4.1). The previous surveys included shallower sites with brown algae, and sites with rocky overhangs where cup corals were present that were not recorded here. These differences should not, however, be attributed to change over time, rather to the different survey methods and locations used (Table 4.1).

Only one of the biotopes previously selected as representative/notable on bedrock reef was found in the towed video survey; **CR.HCR.Xfa.ByErSp.Eun** *Eunicella verrucosa* and *Pentapora fascialis* on wave-exposed circalittoral rock (Figures 3.2 to 3.14) Although sponges and anthozoans were recorded in the towed video, cup corals were not, resulting in the second previously selected biotope; **CR.FCR.Cv.SpCup** Sponges, cup corals and anthozoans on shaded or overhanging circalittoral rock not being noted. Monitoring of these types of habitats requires the use of SCUBA divers or Remote Operated Vehicles.

The third biotope to be previously selected as representative/notable; **CR.HCR.XFa.ByErSp** Bryozoan turf and erect sponges on tide-swept circalittoral rock was not recorded in the towed video survey as biotopes were recorded at level 6 on the EUNIS scale, not level 5. These were noted as **CR.HCR.Xfa.ByErSp.Eun.**

The last two biotopes that were previously selected as representative/notable; **IR.HIR.KFaR.FoR** and **IR.HIR.KFaR.Lhyp.R** were not seen in the towed video survey as these assemblages are found at shallower depths than in the 2012 survey.

In 2011, the dead man's fingers on the west side of the SI were populated by small sea cucumbers *Cucumaria frondosa*. This species can reach a considerable size, < 0.5 m, but were only observed here as juveniles. The average abundance of the species in the SAC in 2011 was 21.03 m^{-2} (SE ± 3.64) and 0.31 m^{-2} (SE ± 0.13) in 2012. Echinoderms are known for their 'boom – bust' population densities (Uthicke et al. 2009). The implications for the dramatic increase then decrease in abundance of this species with regards to the condition of the reefs are unclear and its abundance should be monitored in future assessments.

Table 4.1 Comparison of biotopes found in previous surveys (outlined in Lyme Bay & Torbay cSAC conservation advice) and the 2012 survey

Biotope	**Bedrock/ stony reef**	**Recorded in 2012?**	**Possible reasons for not recording in 2012**	**Continue to use?**
CR.HCR.XFa.ByErSp	Bedrock and Stony	No	Replaced with Level 6 biotopes	Yes
CR.HCR.XFa.ByErSp.Eun	Bedrock and Bedrock and Stony in 2012	Yes	N/A	Yes
CR.HCR.XFa.ByErSp.DysAct	Stony	Yes	N/A	Yes
CR.FCR.Cv.SpCup	Bedrock	No	Cup corals cannot be recorded from towed video	Yes- ground truth with divers or ROV
CR.LCR.BrAs.LgAsSp	Bedrock and stony	Yes	N/A	Yes
IR.HIR.KFaR.FoR	Bedrock	No	Found at shallower depths than surveyed in 2012	Yes- larger survey needed
SS.SMx.CMx.OphMx	Bedrock	Yes	N/A	Yes
CR.MCR.EcCR.FaAlCr.Adig	Bedrock and Stony	Yes	N/A	Yes
IR.HIR.KFaR.Lhyp.R	Bedrock	No	Found at shallower depths than surveyed in 2012	Yes- larger survey needed

4.1 Future monitoring recommendations

Biotopes identified by previous studies are still present in the bay; the differences identified here are likely the consequence of different site locations (with the previous surveys including shallower sites) and different survey methods used.

We would recommend that to monitor the fauna of Lyme Bay, the present survey should be repeated to assess any changes in species richness, abundance and assemblage composition in communities in the Lyme Bay cSAC. Due to natural variability of species and habitats across Lyme Bay, we would recommend that a software package, such as PERMANOVA be used to analyse future datasets. Analysis focused on the Indicator Species selected (Jackson et al. 2008) would provide an overview of changes at the species level. These species have been pre-selected to ensure that they are representative of the species present within the bay, covering a range of phyla and life history traits which are vital to the functioning of the reef ecosystem. To accurately record these species across a large area requires cost and time effective non-destructive survey methods. It is therefore also important that indicator species can be surveyed using methods like the towed array, rather than relying on divers or ROVs.

A conjoining dive/ROV study should be undertaken to assess the assemblages that the towed video survey cannot, such as rocky overhangs.

Annex I and non-Annex I habitat were interspersed when recorded along the video transect. It is suggested that for future monitoring Annex I habitat should be identified at the scale of an entire transect, as opposed to the area of the field of view when recording on the video.

The tables presented here provide a baseline from which the presence or absence of key species can be compared to in future, forming the basis of a condition assessment. If a certain species which is recorded as present here is not present in a future assessment, it could suggest that the condition of the site has declined. Equally if the abundance of species at each site presented here changes dramatically it could suggest that the assemblage has altered over time.

Future surveys should provide a biotope map comparable to Figure 3.2 in order to demonstrate an overview of the assemblages. These maps could be compared visually to assess major changes in the assemblages.

The presence of reef associated species such as *Alcyonium digitatum* on habitat in Lyme Bay was noted in 2011 (Attrill et al. 2012). Further investigation of the communities that have settled on inter-reef areas since the cessation of bottom towed fishing is underway (Sheehan et al. *in prep.*) but it is thought that once allowed to recover these habitats can support reef associated species.

4.2 Anthropogenic impacts observed

In 2012, ross coral were observed underneath large boulders and damaged individuals were seen (Figure 4.1). This may be attributed to illegal fishing activity as we are not aware of any other activities that could have caused this type of damage. It is important that these impacts are recorded as part of any condition assessment, as illegal activities within a cSAC will compromise its ability to meet its conservation objectives. No other anthropogenic impacts were observed in 2012 although in the annual monitoring study other impacts have been observed including fishing line from angling or rod and line fishing wrapped around pink sea fans. Future condition assessments should record the occurrence of impacts such as these so that any increase in the incidence of such impacts may be quantified and considered as part of the condition of the reefs.

Figure 4.1 Images showing an upturned boulder and a damaged ross coral

4.3 Comparison between bedrock reef and stony reef assemblages

Most of the sites surveyed comprise a combination of stony and bedrock reef. In Lyme Bay these two features are interconnected habitats and share many of the same species. Formal comparison at minute scales would not make ecological sense as species are interacting with their environment at scales of kilometres rather than a 0.25 m^2 quadrat. Bedrock reef and stony reef features in Lyme Bay should therefore be managed and monitored as one habitat type.

5. Blue Marine Foundation

Blue Marine Foundation BMF is a charity that is using Lyme Bay to pilot a scheme that brings together fishers, scientists and regulators. One of the projects in Lyme bay aims to demonstrate the benefits of no take areas to commercial fisheries and to quantify the impact of potting. By manipulating fishing effort in experimental areas within the cSAC the project will determine impacts of potting density on target species and benthic communities. Another BMF project involves introducing lobster spat within the cSAC. The Lyme Bay recovery monitoring project team are also involved with the potting density experiment. Future video surveys to monitor recovery in the Bay can therefore be shared with BMF to measure impact. While this will provide efficiencies to both projects, it will also allow us to determine whether BMF projects are affecting benthic habitats that would influence future assessment in the cSAC.

6 Conclusions

The biotopes in Lyme Bay in 2012 were identified and mapped. In order to assess the condition of the Lyme Bay reefs in the future, sites reported here should be resurveyed and quantitative comparisons made. We suggest that the most suitable response metrics to assess change between sampling periods, would be Species richness, Overall abundance, Assemblage composition and populations of the pre-defined indicator species (Jackson et al. 2008) (see Attrill et al. 2011).

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Appendix A

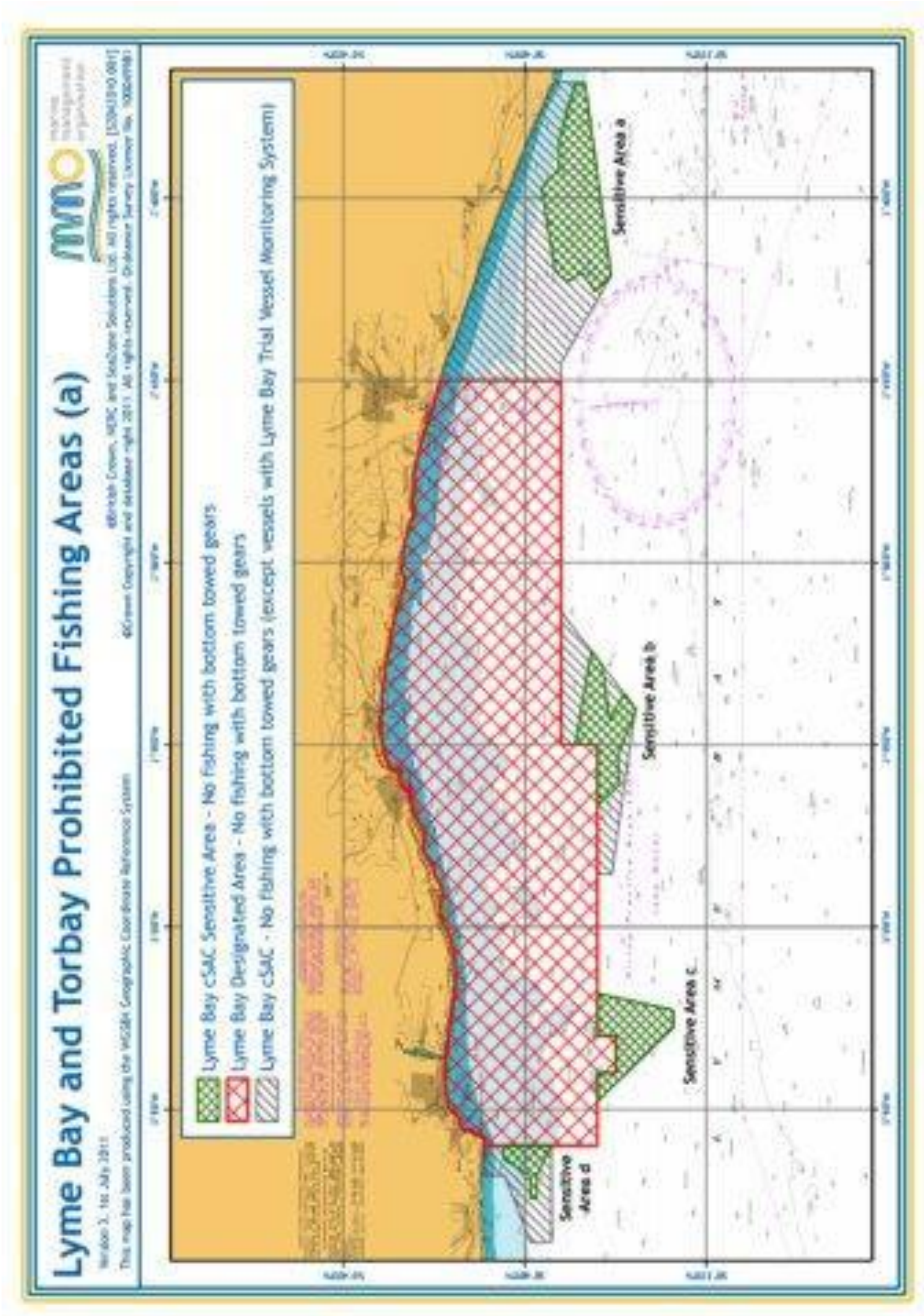


Figure A1 Designated protected areas in Lyme Bay

Table A1 Bedrock biotopes and their main contributing species

Biotope	Main contributing species/ taxa in 2012 survey
CR.MCR.EcCR.FaAlCr.Adig	*Alcyonium digitatum* *Eunicella verrucosa* Branching sponges
CR.HCR.Xfa.ByErSp.Eun	*Eunicella verrucosa* Branching sponges *Pentapora fascialis* *Phallusia mammillata*
SS.SMx.CMx.OphMx	*Ophiothrix fragilis* *Eunicella verrucosa* *Phallusia mammillata*
CR.LCR.BrAs.LgAsSp	Branching sponges *Phallusia mammillata* *Eunicella verrucosa*
CR.HCR.XFa.ByErSp.DysAct	Branching sponges *Alcyonidium diaphanum* *Nemertesia* spp.

Table A2 Stony reef biotopes and their main contributing species

Biotope	Main contributing species/ taxa in 2012 survey
CR.MCR.EcCR.FaAlCr.Adig	*Alcyonium digitatum*
	Eunicella verrucosa
	Branching sponges
	Phallusia mammillata
	Pentapora fascialis
CR.HCR.Xfa.ByErSp.Eun	*Eunicella verrucosa,*
	Pentapora fascialis
	Phallusia mammillata
	Branching sponges
	Alcyonium digitatum
CR.LCR.BrAs.LgAsSp	*Phallusia mammillata*
	Pentapora foliacea
	Eunicella verrucosa
	Alcyonium digitatum
CR.HCR.XFa.ByErSp.DysAct	Branching sponges
	Alcyonidium diaphanum
	Nemertesia spp.

Appendix B - Standard operating protocol

Frames analysis

Still frames are extracted from the 20 minute HD videos using the frame extractor software from Cybertronix (created by John Hawker) at five second intervals.

The frames are passed through a quality control process whereby every frame is viewed to get a feel for the overall quality of the transect. Before any deletions are made, the entire folder is duplicated and renamed ‘copy’. The frames in the copy file are viewed and any particularly poor images are deleted. These may be frames where silt, algae or an organism are obscuring the field of view or the image is particularly out of focus. The entire set of frames are viewed for a second time and any frames where the sled is flying too far away (position 3) or too close (position -2) to the seabed are deleted (Figure B1). Ideal laser positions are -1, 0 and 1 however if very few of these frames are left after the first stage of the quality control process are left, those with position 2 may be accepted.

In cases where more than 50% of the frame is obscured by brittlestars, the frame is deleted.

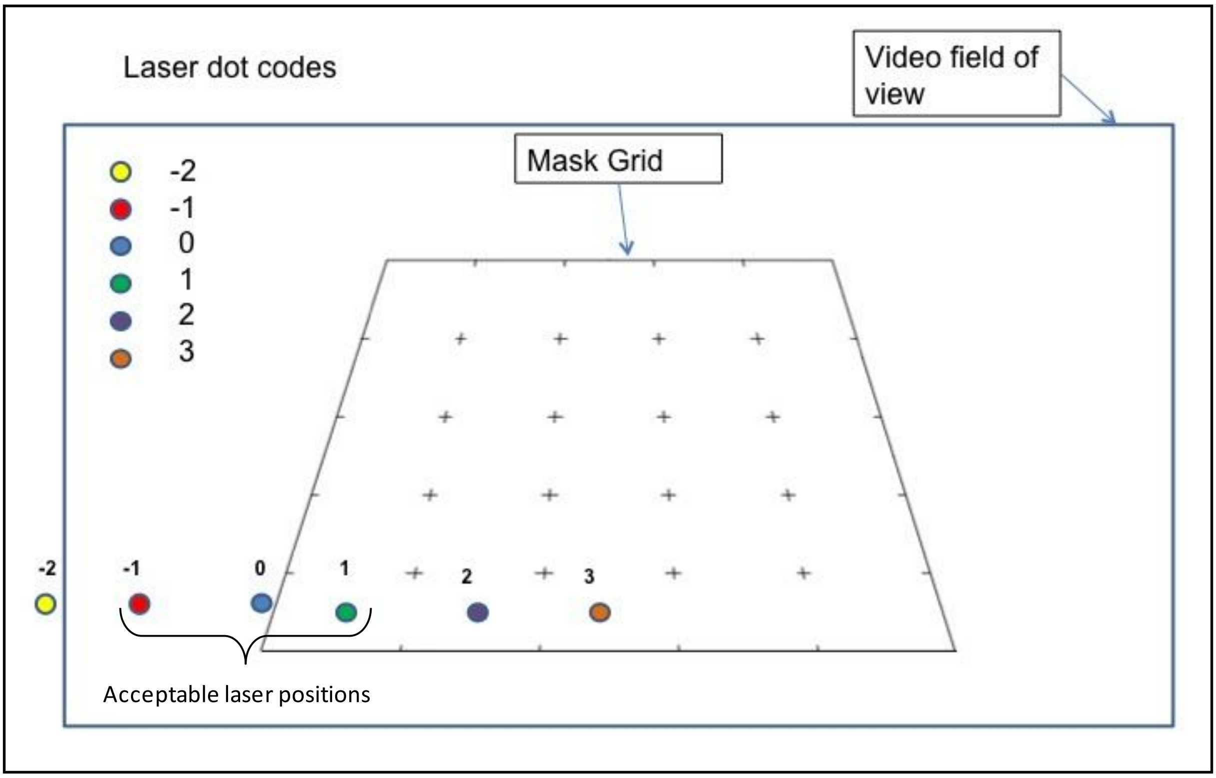


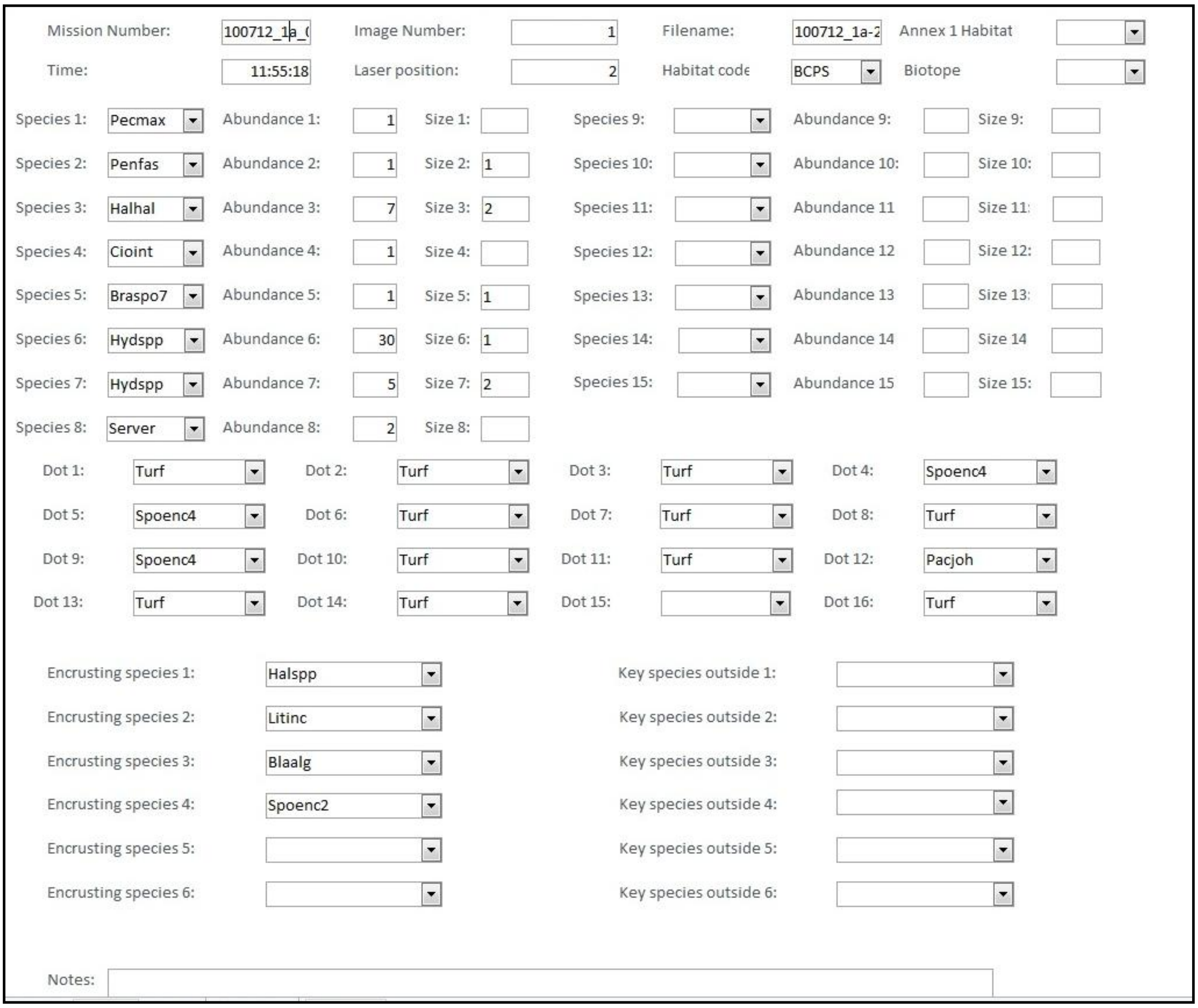
Figure B1 Diagrammatic representation of a frame grab with laser positions marked and numbered

Next, any frames where is it clear that the sled has got stuck and there are multiple copies of the same image are deleted. The full set of frames are viewed again in turn and if there are still over 100 frames, any poor quality images that remain are deleted.

Images are viewed as large icons in a window (Windows PC) and the window reduced in size so that the first row consists of four images. The first image is highlighted and all of those below in the first position in every row are highlighted. If the highlighted images total 30, the frames are copied and pasted into a new folder entitled ‘30’. If more than 30 frames are selected by this process, ‘control’ is held on the keyboard whilst images are haphazardly unselected throughout the frame until 30 frames are reached. If less than 30 frames are selected by highlighting the first row, images in position 3 are highlighted and then haphazardly unselected if more than 30 frames are highlighted after this process.

The images now pasted into the folder entitled ‘30’ are viewed and any images which are not of as good quality as the rest (ie organisms cannot easily be identified) are replaced with a frame close to it from the ‘copy’ folder. Images are viewed along with the video to ensure that there is no overlap between frames, which is most likely to occur in transects where a high number of images were deleted due to poor visibility. If images overlap, one is deleted and another selected from the ‘copy’ folder.

Analysis should be completed on a computer with two screens where possible. The image should be opened in a full screen and the video open in another window set to the same time as the frame (each frame shows the time on the video). The Access database prepared for frame analysis (Figure B2) should also be open and ID books to hand.



Mission Number:	100712_1a_(	Image Number:	1	Filename:	100712_1a-2	Annex 1 Habitat	
Time:	11:55:18	Laser position:	2	Habitat code	BCPS	Biotope	

Species 1:	Pecmax	Abundance 1:	1	Size 1:		Species 9:		Abundance 9:		Size 9:	
Species 2:	Penfas	Abundance 2:	1	Size 2:	1	Species 10:		Abundance 10:		Size 10:	
Species 3:	Halhal	Abundance 3:	7	Size 3:	2	Species 11:		Abundance 11		Size 11:	
Species 4:	Cioint	Abundance 4:	1	Size 4:		Species 12:		Abundance 12		Size 12:	
Species 5:	Braspo7	Abundance 5:	1	Size 5:	1	Species 13:		Abundance 13		Size 13:	
Species 6:	Hydspp	Abundance 6:	30	Size 6:	1	Species 14:		Abundance 14		Size 14	
Species 7:	Hydspp	Abundance 7:	5	Size 7:	2	Species 15:		Abundance 15		Size 15:	
Species 8:	Server	Abundance 8:	2	Size 8:							

Dot 1:	Turf	Dot 2:	Turf	Dot 3:	Turf	Dot 4:	Spoenc4
Dot 5:	Spoenc4	Dot 6:	Turf	Dot 7:	Turf	Dot 8:	Turf
Dot 9:	Spoenc4	Dot 10:	Turf	Dot 11:	Turf	Dot 12:	Pacjoh
Dot 13:	Turf	Dot 14:	Turf	Dot 15:		Dot 16:	Turf

Encrusting species 1:	Halspp	Key species outside 1:	
Encrusting species 2:	Litinc	Key species outside 2:	
Encrusting species 3:	Blaalg	Key species outside 3:	
Encrusting species 4:	Spoenc2	Key species outside 4:	
Encrusting species 5:		Key species outside 5:	
Encrusting species 6:		Key species outside 6:	

Notes:

Figure B2 Example of the Access database prepared for frame analysis

Mission number (tow number), Image number (1-30), the Filename of the image and the Time on the video are recorded in order to identify the frame being analysed. Laser position (derived from Figure B1) and Habitat code are noted (Table B1). The fields Annex I Habitat and Biotope are left blank for the frames analysis. The frame is viewed and the most obvious species recorded first using a code within the Species 1 to Species 15 fields in the database (more fields can be added if more than 15 species are found in a frame). Using the video to play through the frame, the abundance of each species within the frame is recorded in the abundance field next to the species. (For example seven *Halicium halicinium* Halhal were recorded in the example in Figure B2). The image is used in conjunction with the video which is played in slow motion as less accurate analysis will be achieved from the frame alone. The sizes of certain preselected species are recorded as per the categories given in Table B2. Organisms should only be recorded if they fall within the overlaid frame, adopting the tennis analogy “if it’s on the line it’s in”; if an organism occurs half in and half out of the frame it is recorded as present. If confident species identification cannot be achieved within around 5 minutes, it is recorded under a taxa or generic grouping. For example if a fish moves too quickly under a rock and cannot be identified, it is recorded as ‘Fish’. Similarly, as sponges are taxonomically difficult (Ackers et al. 2007) they are recorded under colour and shape morphs if they cannot be identified with confidence. It will be recorded for example as ‘Branching sponge 1 – branching yellow sponge with long tapering upward growing branches’.

For hydroids growing in dense aggregations where individuals cannot be counted, a best estimate is used. Similarly, where brittlestars are found aggregating a best estimate based on the number or bodies or legs is used.

Table B1 Habitat codes and their definitions

Habitat code	Definition
BCPS	Mixture of boulders, cobbles, pebbles and sand
R	Rock
PS	Pebbles and sand

Table B2 Categories used to determine the size of certain preselected species

Size category	Number of boxes on frame
1	<0.5
2	1
3	2
4	3
5	4

If one species/ taxa in the frame is observed within two size classes it is recorded twice (as shown in Figure B2); 30 Unidentified grouped hydroids Hydspp were observed of size class one and five of size class two).

The presence of encrusting species is recorded under the ‘dots’ (16 crosses on the overlaid frame) (Figure B3). If there is no encrusting species directly under the dot then the field is left blank. These will be used to estimate percentage cover. Any other encrusting species which are present within the frame but did not occur under a dot are recorded in the fields ‘Encrusting species 1-6’. Finally, any key species that occur in the field of view, but not within the frame, are noted in the ‘Key species outside’ field. For example if a pink sea fan occurs outside of the overlaid frame but not within it, it should be recorded in the ‘Key species outside’ field. Any observations such as damage to organisms, presence of anthropogenic objects or eggs are recorded in the ‘Notes’ field and the recorders name noted in the final ‘Name’ field (out of view in Figure B2). A new record is created for the next image and so on until 30 frames have been analysed for that tow.

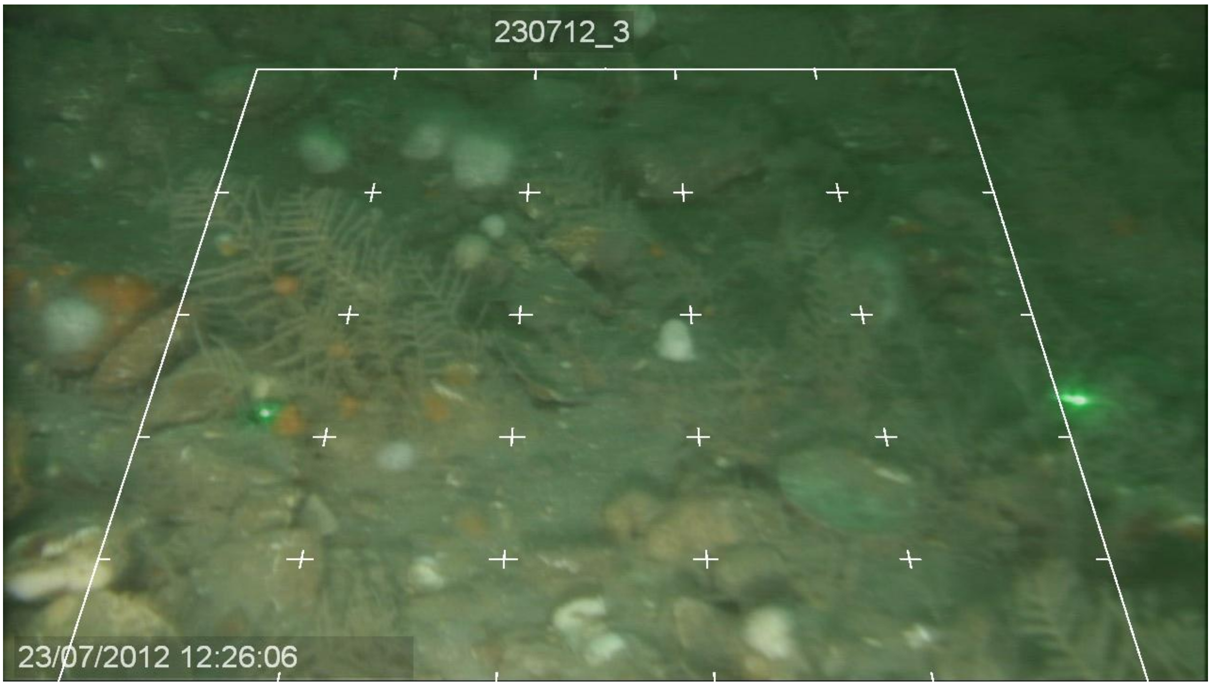


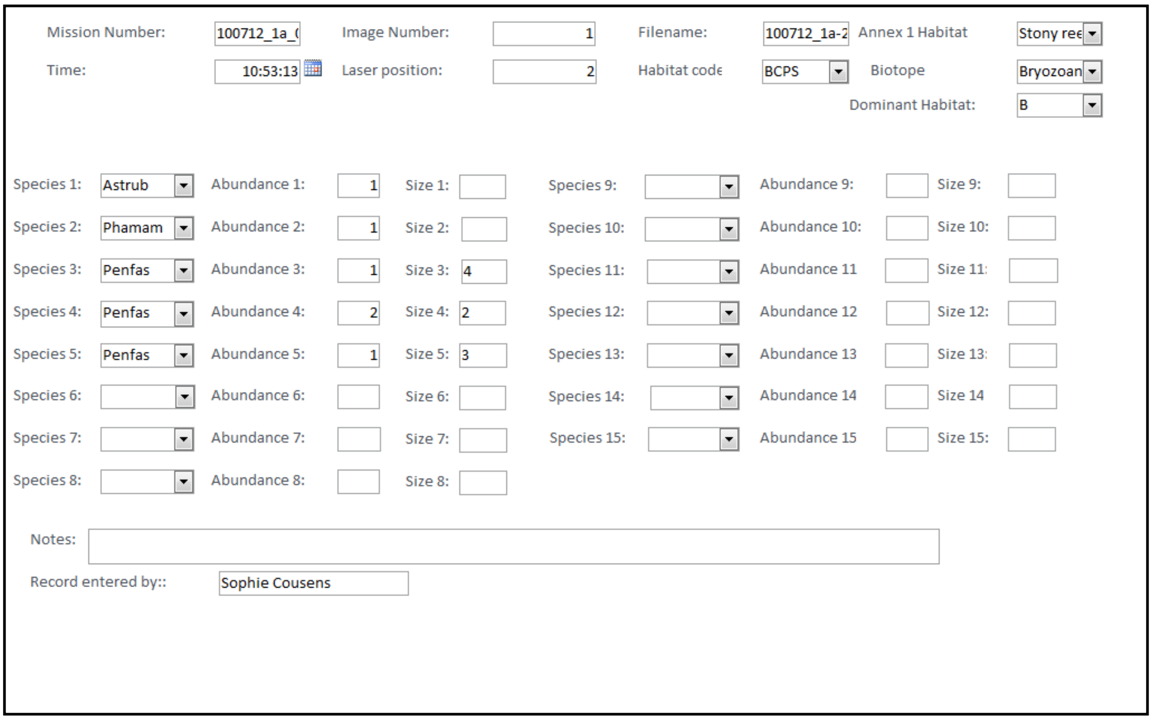
Figure B3 Overlaid frame showing mask grid, lasers and the 16 crosses used to record encrusting species

Video analysis

In the video analysis the video is viewed at normal speed from start to finish and paused to record every time a species is seen. Time, Laser position and Habitat code are recorded as per the frames analysis. However information is also added to the additional fields 'Annex I Habitat', 'Biotope' and 'Dominant Habitat' (Figure B4). Annex I habitat type is recorded under the categories Bedrock reef, Stony reef and not able to assign Annex I habitat. Bedrock reef is defined as bedrock which arises from the surrounding seabed to provide habitat (Irving 2009). To qualify as stony reef, 10% or more of the seabed substratum should be composed of particles greater than 64mm across (ie cobbles and boulders), it should have a 'matrix' of supporting smaller material, have epifaunal species, must arise from the seafloor and must have a minimum extent of 25m^2 (or total of patchy reef). If the analyser is not confident enough to assign an Annex I habitat, perhaps because it is not clear from the field of view of the camera that there is a supporting matrix or that it arises from the sea floor, the field is left blank. Similarly if the habitat observed contains no Annex I reef, it is left blank.

The species present are considered and a biotope is chosen from the dropdown list of pre-selected biotopes that have been previously seen by the Plymouth University team in Lyme Bay. A biotope is assigned based on the dominant species present. For example, where *Eunicella verrucosa* and *Pentapora fascialis* are the dominant species present, CR.HCR.Xfa.ByErSp.Eun is selected. For (infrequent) cases where two species denoting the presence of two different biotopes are present in the same frame with equal abundance, for example *Alcyonium digitatum* and *E. verrucosa*, no biotope is assigned as neither is dominant. For cases where a variety of species from an array of different biotopes are present, but none were dominant, no biotope is assigned. For example, if three branching sponges and one *Phallusia mammillata* are observed alongside four *P. fascialis* and four *A. digitatum* individuals, no biotope is assigned as none of the three biotopes that could be assigned are dominant. If there are no species present which denote a biotope category, no biotope is assigned.

In the field ‘Dominant habitat’ the most dominant substratum type is recorded, from sand to boulders, in order to add more detail to the categories in the Habitat code field. Organisms observed in the same field of view are recorded in the same record of the database. A new record is created for every cluster of species observed in the same field of view and every time the habitat or biotope changes.



Mission Number: 100712_1a_(
Image Number: 1
Filename: 100712_1a-2
Annex 1 Habitat: Stony ree
Time: 10:53:13
Laser position: 2
Habitat code: BCPS
Biotope: Bryozoan
Dominant Habitat: B

Species 1:	Astrub	Abundance 1:	1	Size 1:		Species 9:		Abundance 9:		Size 9:	
Species 2:	Phamam	Abundance 2:	1	Size 2:		Species 10:		Abundance 10:		Size 10:	
Species 3:	Penfas	Abundance 3:	1	Size 3:	4	Species 11:		Abundance 11		Size 11:	
Species 4:	Penfas	Abundance 4:	2	Size 4:	2	Species 12:		Abundance 12		Size 12:	
Species 5:	Penfas	Abundance 5:	1	Size 5:	3	Species 13:		Abundance 13		Size 13:	
Species 6:		Abundance 6:		Size 6:		Species 14:		Abundance 14		Size 14	
Species 7:		Abundance 7:		Size 7:		Species 15:		Abundance 15		Size 15:	
Species 8:		Abundance 8:		Size 8:							

Notes:

Record entered by:: Sophie Cousens

Figure B4 Example of the Access database prepared for video analysis

Further information

Natural England evidence can be downloaded from our **Access to Evidence Catalogue**. For more information about Natural England and our work see **Gov.UK**. For any queries contact the Natural England Enquiry Service on 0300 060 3900 or e-mail **enquiries@naturalengland.org.uk**.

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