ENVISION

EMFF - Protecting Our Seas

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Cardigan Bay Final Report

Site

Cardigan Bay

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1. Executive Summary

The Welsh Government, in partnership with its statutory nature conservation advisors Natural Resource Wales (NRW), is evaluating the interaction of fishing activities with conservation features of Welsh Marine Protected Areas (MPAs). Mobile fishing gear interacting with Annex I boulder and cobble reef (stony reef) within Cardigan Bay/Bae Ceredigion SAC is categorised as a 'high' risk, 'purple' interaction within the Assessing Welsh Fishing Activities (AWFA)[1] project matrix. The objectives of the project were to survey areas of seabed adjacent to locations with existing evidence of 'medium' quality (or 'reefiness') reef to the west of the seasonally open area within Cardigan Bay/Bae Ceredigion SAC, to establish the extent of boulder/cobble reef habitat at these locations.

A drop-down video survey was undertaken at 'priority 1' sample stations located at a distance of 400m at cardinal points around the existing sample points where 'medium' quality reef has been recorded in previous studies, and 'priority 2' sample stations at a further 400m distance to establish extent of any reef features encountered. At each sampling station the camera system was lowered to the seabed and allowed to drift, or be towed, behind the vessel for approximately 5 minutes. The position of each drop was located using a dGPS and plotting system.

Video and still images were reviewed, processed and analysed in accordance with national guidelines and standards for analysis, to identify what fauna and broadscale habitats exist in a video record or still image and provide quantitative data. The imagery was also reviewed and analysed in accordance with current UK guidelines to identify potential Annex I features.

A total of 28 video tows and associated still images (168) were analysed, from 28 stations. Video footage was split into segments where habitats changed, resulting in a total of 35 segments analysed from the imagery. The imagery quality ranged from 'good' to 'poor', with a minimum of five still images analysed for each station, or a minimum of two still images analysed per segment. The quality control process showed that whilst there were minor variations in some of the taxa recorded, there were no major discrepancies between the analysts in the analysis.

Four biotopes/habitats, including "Sublittoral coarse sediment" (SS.SCS), "Circalittoral coarse sediment" (SS.SCS.CCS), "Moderate energy circalittoral rock" (CR.MCR) and "*Neopentadactyla mixta* in circalittoral shell gravel or coarse sand" (SS.SCS.CCS.Nmix), were allocated to the 35 video segments analysed from the imagery from these stations, including eleven segments with two of these biotopes/habitats allocated as a mosaic. A total of 59 taxa or morphologies were observed in the footage, and an item of potential anthropogenic origin was observed at one station.

Annex I features were assessed, and distributions plotted with GIS, along with habitat distributions. In summary, the majority of habitats observed in the imagery from the sample stations in Cardigan Bay were sedimentary with some infauna apparent, often interspersed with patchy cobbles and boulders with epifauna that could be indicative

[1] *https://naturalresources.wales/about-us/our-projects/marine-projects/assessing-welsh-fishing-activities/*

of reef environments. Whilst there are several areas showing 'Low' resemblance to Annex I stony reef, these are very patchy in distribution. Only one video segment was assessed as showing 'Medium' resemblance to Annex I stony reef, and this was a short segment, with segments on either side assessed as 'Not Reef'. This evidence would suggest that it is not possible to define extents of areas with 'medium' resemblance to Annex I stony reef within the areas surveyed.

2. Background

The Welsh Government (WG), in partnership with its statutory nature conservation advisors Natural Resource Wales (NRW), is evaluating the interaction of fishing activities with conservation features of Welsh Marine Protected Areas (MPAs). Mobile fishing gear interacting with Annex I boulder and cobble reef (stony reef) within Cardigan Bay/Bae Ceredigion SAC is categorised as a 'high' risk, 'purple' interaction within the Assessing Welsh Fishing Activities (AWFA) project matrix.

The management options within Cardigan Bay/Bae Ceredigion SAC are considered regularly by NRW/WG and information regarding the status of conservation features which may be affected by fishing activity is necessary for assessment.

A structured data collection survey was proposed to update the information on boulder/cobble reefs within Cardigan Bay SAC. Drop-down video was deployed to collect data from outside the area seasonally open to scallop dredging activities shown in Figure 1. The 'reefiness' of stony/cobble reefs has been assessed using the guidance and definitions within Irving (2009) and Golding *et al.* (2020).

The primary goal of the survey was to determine the presence of Annex I features and identify extents of the feature using underwater camera systems (Figure 1).

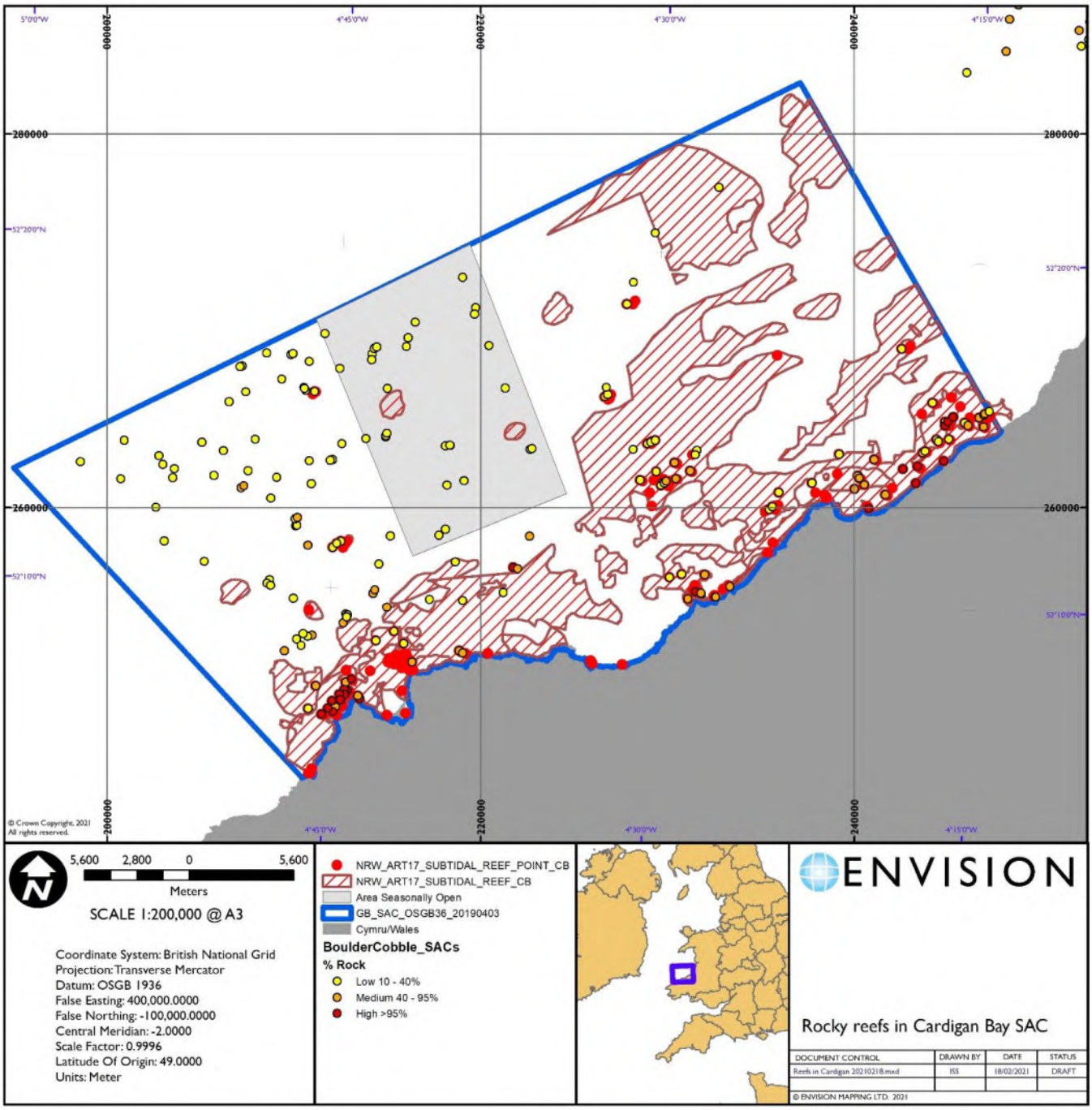


Figure 1.

Cardigan Bay SAC showing area seasonally open to scallop fishing and rocky reefs in the area.

2.1. Fishing and Rocky Reefs in Cardigan Bay

Currently Cardigan Bay/Bae Ceredigion SAC is closed to scallop dredging with the exception of a seasonally open area which is shown in Figure 2. Figure 2 presents the current knowledge of distribution and extent of rocky reefs within Cardigan Bay SAC, showing location of sample points of cobble/boulder reef ('low'/'medium'/'high 'reefiness') and from Article 17 reef points in the seasonally open area, and an adjacent

area of research known as the 'Lambert Box'. Within the 'Lambert Box' there are three sample points with evidence of 'medium' quality (or 'reefiness') reef from previous studies, which may be considered within management decisions for Cardigan Bay/Bae Ceredigion SAC.

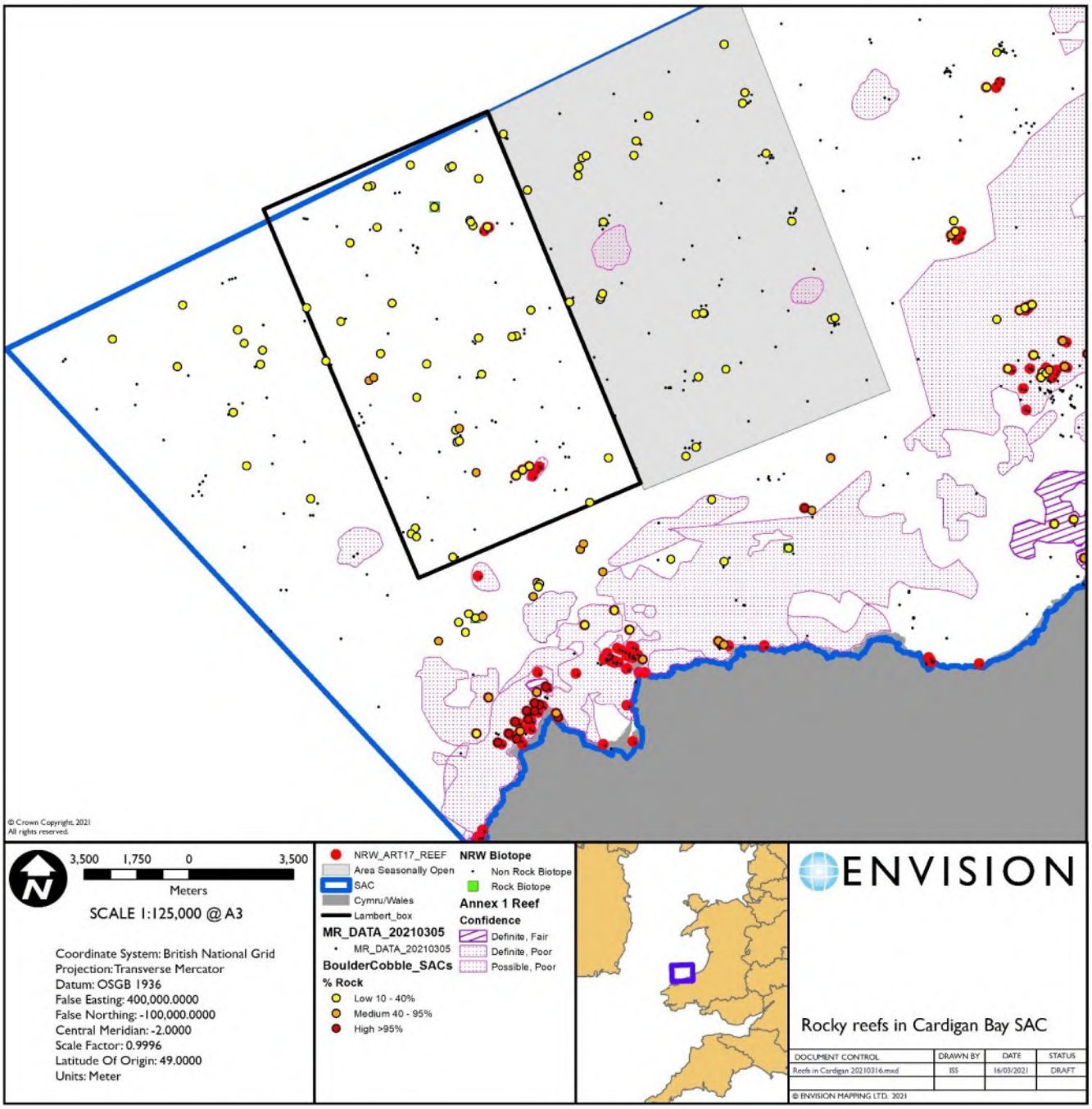


Figure 2.

NRW 'reef' points ('NRW_ART17_REEF', 'Boulder/Cobble_SACs', 'Annex 1 Reef Confidence') within the Cardigan Bay SAC, along with Marine Recorder sample points ('MR_DATA_20210305') and more recent NRW surveys ('NRW Biotope)'.

2.2. Objectives

The objectives of the project were to survey areas of seabed adjacent to locations with existing evidence of 'medium' quality (or 'reefiness') reef in the 'Lambert Box' within Cardigan Bay SAC, to establish the extent of boulder/cobble reef habitat at these locations.

3. Methods

3.1. DDV Methodology

A DDV camera was deployed to collect information on the biology of the seabed and to verify the physical and biological nature of the seabed. ENVISION designs, builds and operates a range of camera systems tailored to the local environmental conditions within the proposed survey areas. The system used on this survey was built specifically for benthic survey in rugged environments and is shown in Figure 3. Its robust structure was designed to enable it to maintain position in strong current as well as to glide easily over a variety of substrates without snagging.

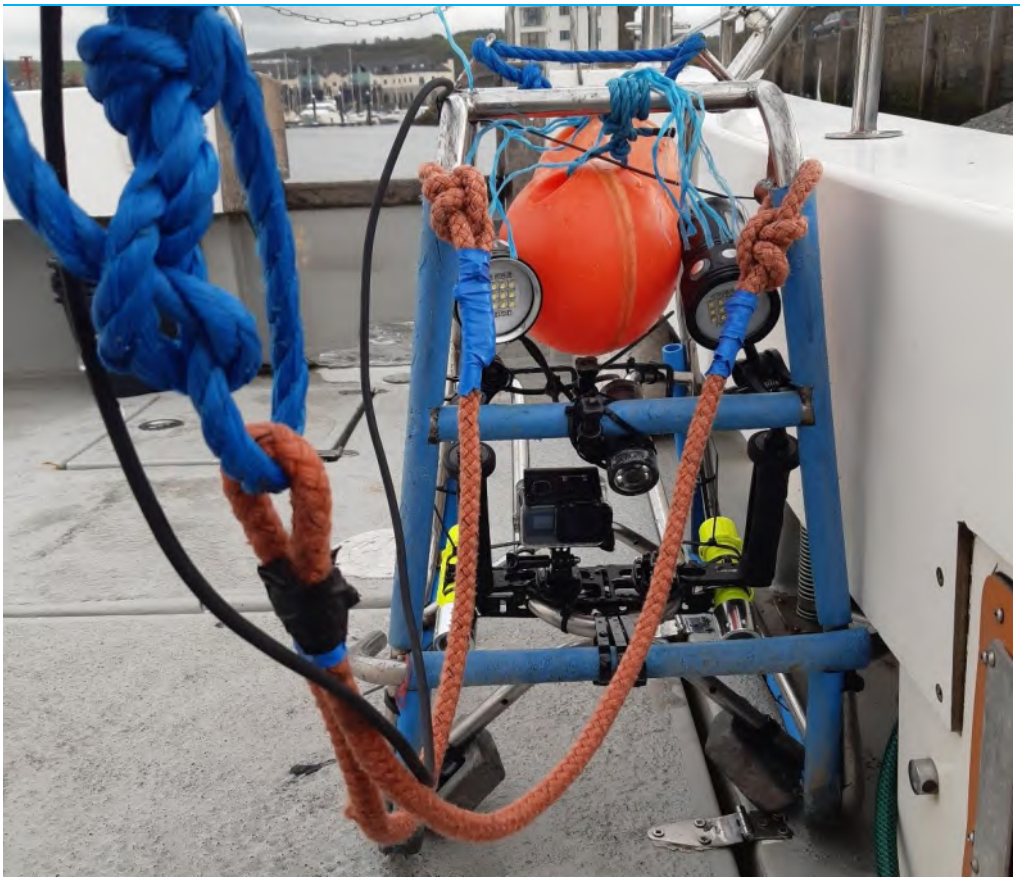


Figure 3.
The camera system designed by ENVISION for benthic survey.

The system comprised two video cameras: a high resolution CCTV camera connected to the surface via an umbilical and a high definition (HD) camera. The CCTV camera was connected to a screen and a digital capture device and was used primarily for real-time viewing, allowing the operator of the camera frame to view its progress and adjust height and speed over the seabed as required. Figure 4 shows an example of the topside equipment.

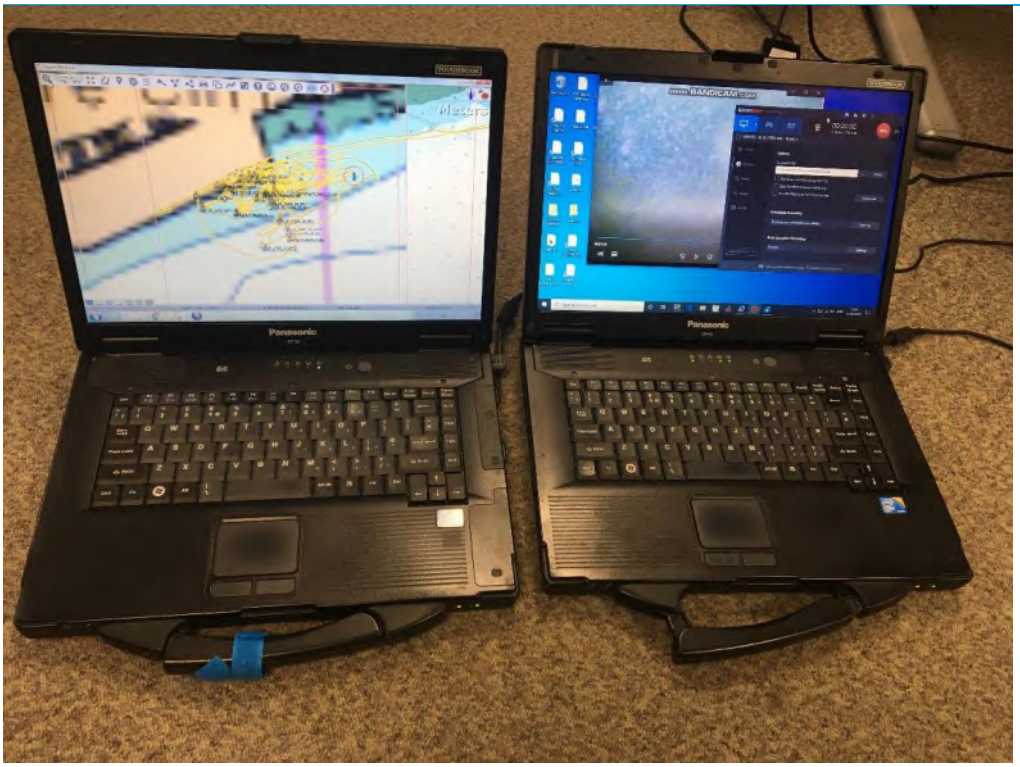


Figure 4.
Video and position fixing surface equipment.

The digital capture device also provided a back-up system in case of any problem with the high definition camera. However, the main camera used for recording video was a small solid state HD camera which produced high quality images.

At each sampling station the camera system was lowered to the seabed and allowed to drift, or be towed, behind the vessel for approximately 5 minutes. The position of each drop was located using a dGPS and plotting system.

The system was operated so that the camera frame periodically remained stationary on the seabed. These stops provide the opportunity to capture high quality still images. The still images and video footage will be reviewed to identify biota and to gather substrate information.

Each video drop was numbered and recorded using a digital capture device, for subsequent analysis, and the position and time at the start and end of each deployment were logged. The positions were recorded using a differentially corrected GPS (dGPS) system. These were displayed on the video capture system. A written record of positions for the takes was recorded during the survey as part of the survey log.

3.2. Survey Strategy

It was proposed that drop-down video survey was undertaken at 'priority 1' sample stations located at a distance of 400m at cardinal points around the existing sample points where 'medium' quality reef has been recorded in previous studies, samples were adjusted to account for any existing data/samples stations (Figure 5). The rationale for this methodology was to use a standard buffer distance (400m) which may be applied to existing reef locations for protection from fishing or other activities (based on sea depth and trawl sweep measurements) in the absence of further data in the area.

Should reef of 'medium' or 'high' quality (over 40% boulder or cobble substrate composition) be encountered at any of the 'priority 1' sample stations, the sampling process was then expanded to establish further reef extent, by surveying 'priority 2' sample stations located in cardinal points around the observed reef location at a further 400m distance.

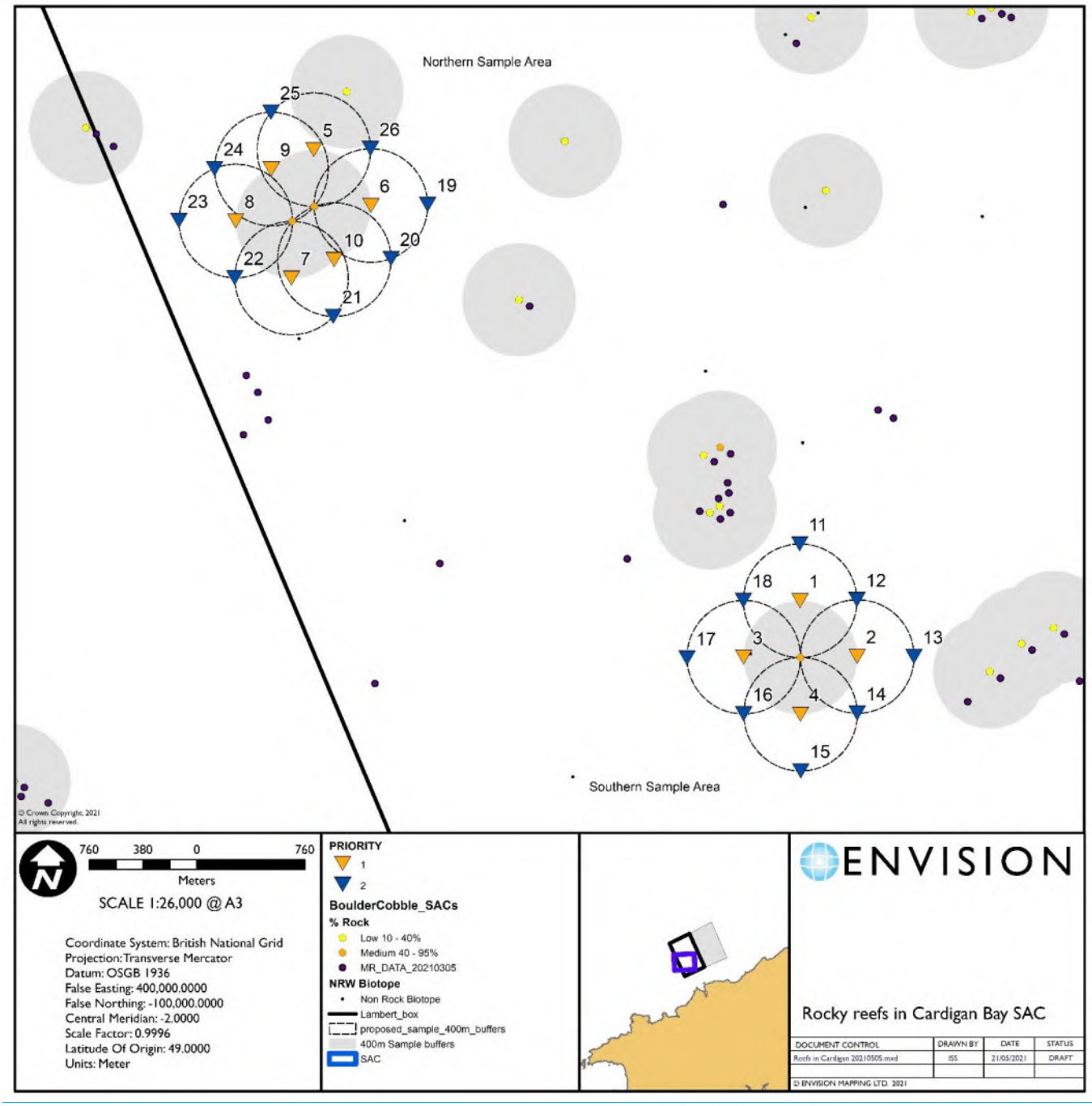


Figure 5.

Proposed sample stations in area within the 'Lambert Box' in Cardigan Bay SAC, alongside existing sample data

3.3. Imagery Analysis

Video and still images were reviewed, processed and analysed in accordance with national guidelines, such as the standards for analysis in Visual Seabed Surveys (BS EN 16260:2012) and Turner *et al*., 2016[2]. Imagery analysis was undertaken to identify what fauna and broadscale habitats exist in a video record or still image, provide quantitative data and to note where one substrate type changes to another. The imagery has also been reviewed for Annex I reef assessment following the appropriate JNCC guidance notes (Gubbay, 2007[3]; Irving, 2009[4]; Golding et al., 2020[5]).

The video record was initially viewed rapidly in order to segment it into sections representing different substrates. At normal speed, the start and end points of each segment were logged, and each segment treated as a separate record and subsequently subjected to more detailed analysis. Brief changes in substrate type lasting less than 5m were considered as incidental patches are recorded as part of the habitat description, or as a 'habitat mosaic'.

The video footage was then viewed at normal or slower than normal speed, noting the physical and biological characteristics, such as substrate type and percent cover (in line with MNCR guidelines), seabed character, conspicuous taxa and life forms along with any modifiers or visible impacts present. Taxa are identified to the most detailed taxonomic level possible, and quantified with abundance counts for erect species and percent cover for colonial/encrusting species. Where appropriate, any relevant features of conservation interest or Habitats Directive Annex I Habitats were noted at each sample location.

All data was recorded as each video clip or still image was analysed and a proforma spreadsheet was used to input imagery data and metadata, with reference to the latest species dictionary from the World Register of Marine Species (WoRMS) database. Abundance counts for solitary and erect taxa were added as point annotations in BIIGLE for still images, but for video analysis these counts were performed manually and recorded directly in the proforma spreadsheet. Where percentage covers of colonial/encrusting taxa or cobbles/boulders were to be recorded, polygon annotations were attached to still images in BIIGLE and the data exported. For video analysis, these categories were estimated visually for each video segment. Annotations from BIIGLE were exported in Excel spreadsheets and translated into the results proforma spreadsheet as required.

[2] *Turner, J.A., Hitchin, R., Verling, E., van Rein, H. 2016. Epibiota remote monitoring from digital imagery: Interpretation guidelines.*

[3] *GUBBAY, S. 2007. Defining and managing Sabellaria spinulosa reefs. Report of an interagency workshop. JNCC Report No. 405.*

[4] *Irving, R. 2009. The identification of the main characteristics of stony reef habitats under the Habitats Directive. Summary report of an inter-agency workshop 26-27 March 2008. JNCC Report No. 432*

[5] *Golding. N., Albrecht. J., McBreen. F. 2020. Refining criteria for defining areas with a 'low resemblance' to Annex I stony reef; Workshop Report. JNCC Report No. 656, JNCC, Peterborough, ISSN 0963-8091.*

A reference collection was built as the analysis progressed with good quality images noted and collated to aid consistency and quality of analysis, with each taxon or species highlighted. In addition to a species/taxon reference collection, a habitat/biotope reference collection was also built with good images of each habitat or biotope and for reference purposes.

3.4. Annex I and Feature Assessment

The imagery has been reviewed and analysed in accordance with current UK guidelines (Turner *et al.* 2016[6], Gubbay, 2007[7]; Irving, 2009[8]; Golding et al., 2020[9]) and any potential Annex I features assessed, and distributions plotted with GIS.

In summary, from the overarching principles outlined in Golding et al., (2020), for areas of *hard, compact substrata (either on solid or soft seabed)* on the seabed to be considered Annex I stony reef, they must fulfil four criteria, summarised in Figure 6 and described below:

Characteristic	Not a 'stony reef'	'Resemblance' to being a 'stony reef'		
		Low[2]	Medium	High
Composition:	**<10%**	10-40% Matrix supported	**40-95%**	**>95% Clast supported**
Notes: *Diameter of cobbles / boulders being greater than 64mm.* *Percentage cover relates to a minimum area of 25m².* *This 'composition' characteristic also includes 'patchiness'.*				
Elevation:	**Flat seabed**	<64mm	**64mm-5m**	**>5m**
Notes: *Minimum height (64mm) relates to minimum size of constituent cobbles.* *This characteristic could also include 'distinctness' from the surrounding seabed.* *Note that two units (mm and m) are used here.*				
Extent:	**<25m²**	←	**>25m²**	→
Biota:	**Dominated by infaunal species**			**>80% of species present composed of epifaunal species**

Figure 6.
Table 3, from Irving (2009)

1. **Composition** across the entire area being considered should be at least 10% cobbles (greater than 64mm in minimum diameter) or boulders (greater than 256mm in diameter).

2. **Elevation** of the area under consideration should generally be greater than 64mm (matrix supported may have an elevation less than 64mm).

[6] *Turner, J.A., Hitchin, R., Verling, E., van Rein, H. 2016. Epibiota remote monitoring from digital imagery: Interpretation guidelines.*

[7] *GUBBAY, S. 2007. Defining and managing Sabellaria spinulosa reefs. Report of an interagency workshop. JNCC Report No. 405.*

[8] *Irving, R. 2009. The identification of the main characteristics of stony reef habitats under the Habitats Directive. Summary report of an inter-agency workshop 26-27 March 2008. JNCC Report No. 432*

[9] *Golding. N., Albrecht. J., McBreen. F. 2020. Refining criteria for defining areas with a 'low resemblance' to Annex I stony reef; Workshop Report. JNCC Report No. 656, JNCC, Peterborough, ISSN 0963-8091.*

3. **Extent** of the area under consideration should be greater than 25m^2 (e.g. 5m x 5m / 10m x 2.5m).

4. **Biota** associated with the area should typically be dominated by epifaunal species.

Meeting the above four criteria (as a minimum) means that the area meets the minimum requirement to be considered as having a 'low resemblance' to Annex I stony reef. Where 'low' was scored for any of these four criteria (composition, elevation, extent or biota), a **strong justification** will be required to consider the area as Annex I stony reef. However, if the majority of the four criteria exceed 'low', then this strong justification could result in classifying the area as having a 'medium resemblance' to Annex I stony reef.

4. Results

4.1. Imagery Analysis

A total of 28 video tows and associated still images (168) were analysed, from 28 stations. Figure 7 and Figure 8 show the location of the video stations for which data were collected during the survey. The imagery quality ranged from 'good' to 'poor', with reduction in quality scores due the presence of suspended sediment and lower illumination at some video stations.

A minimum of five still images were analysed for each station, or where a video was segmented due to changes in habitat, a minimum of two still images were analysed per segment. The imagery from three of the video stations was split into two segments, and the imagery from a further two video stations was split into three segments, resulting in a total of 35 segments analysed from the imagery (Figure 7 and Figure 8).

The imagery has been reviewed and selected still images are shown in Table 6 (Appendix A), associated geographic and recording notes shown in Table 7 and Table 8 (Appendix A).

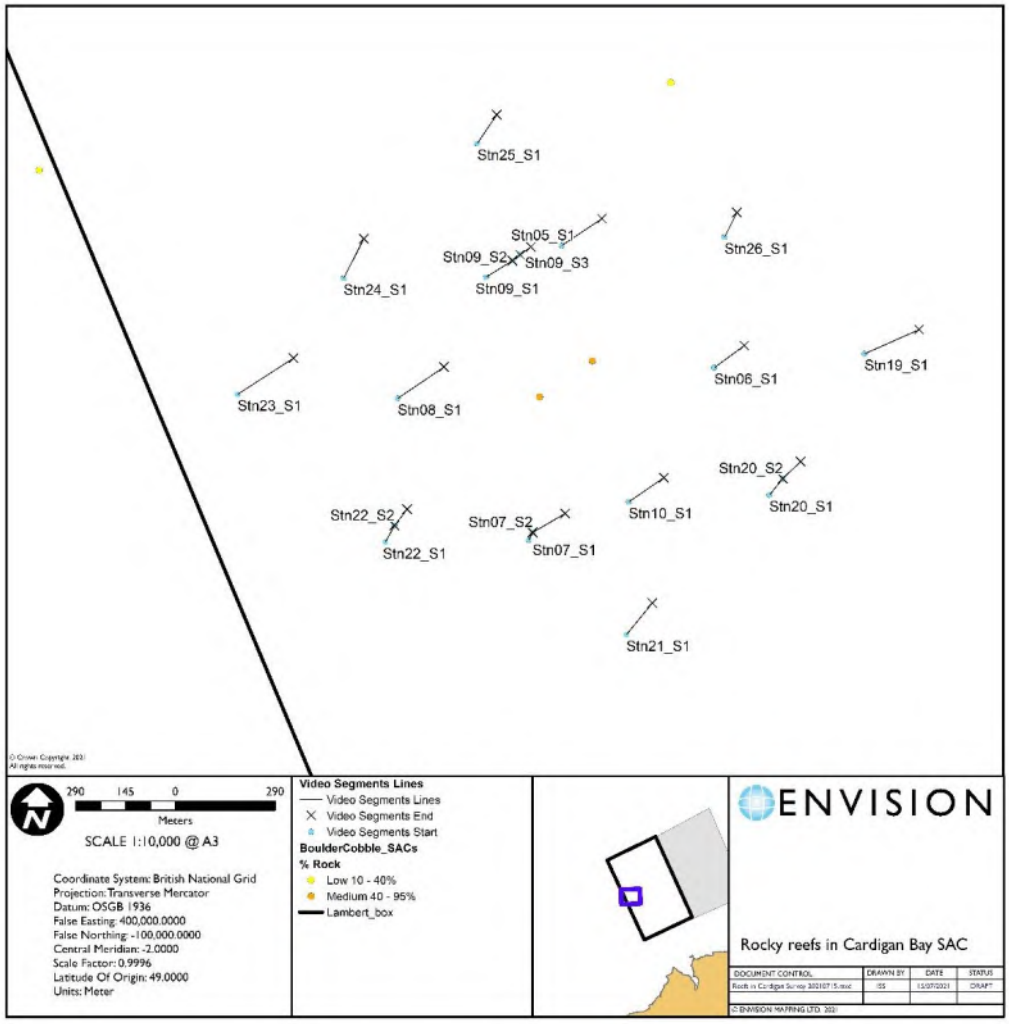


Figure 7.
Location of northern sample stations surveyed in Cardigan Bay, alongside existing sample data, with station and video segment numbers shown along with start and end locations of each video 'tow'.

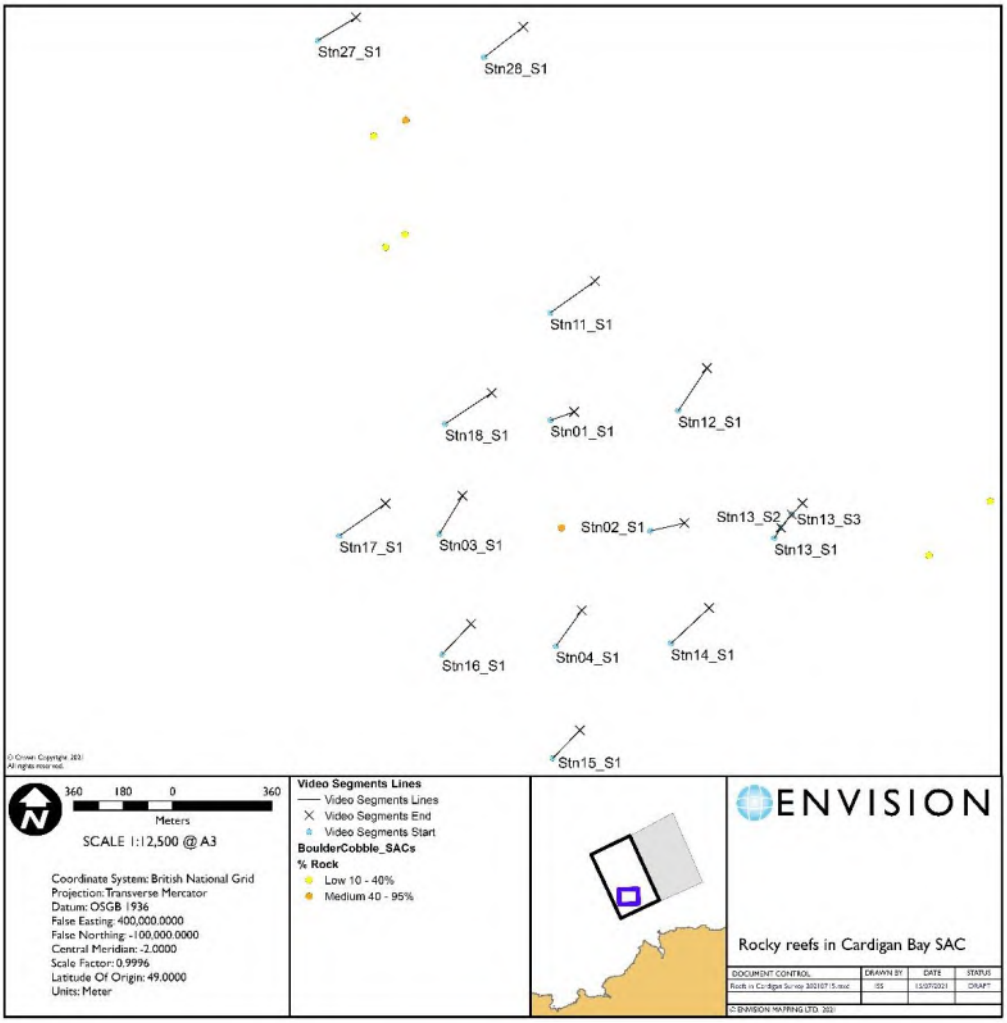


Figure 8.
Location of southern sample stations surveyed in Cardigan Bay, alongside existing sample data, with station and video segment numbers shown along with start and end locations of each video 'tow'.

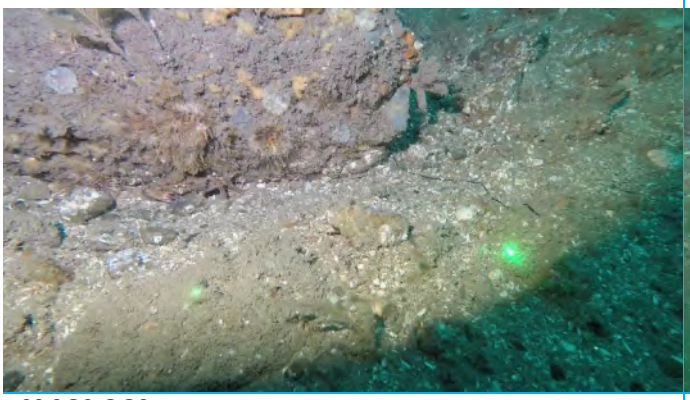
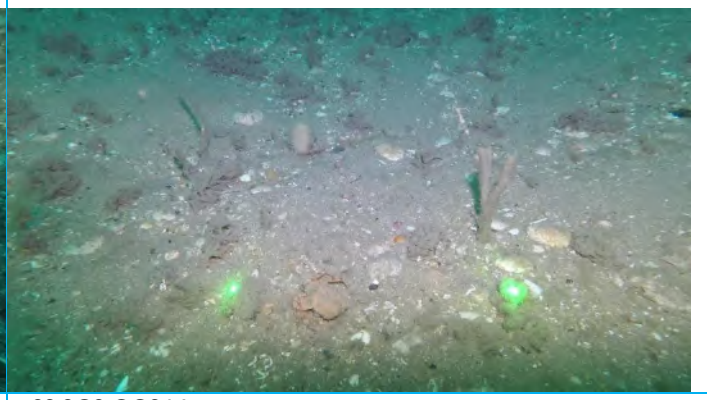
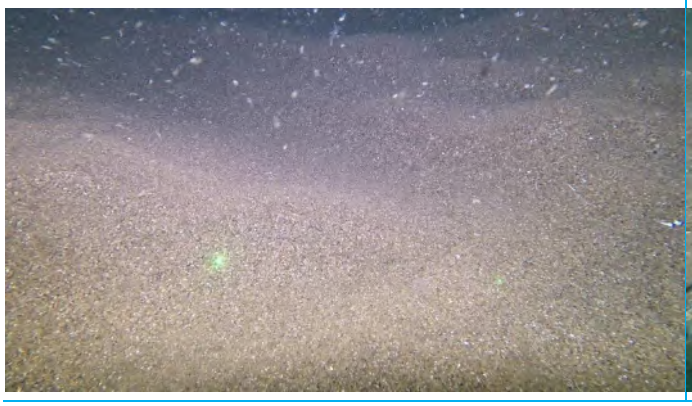
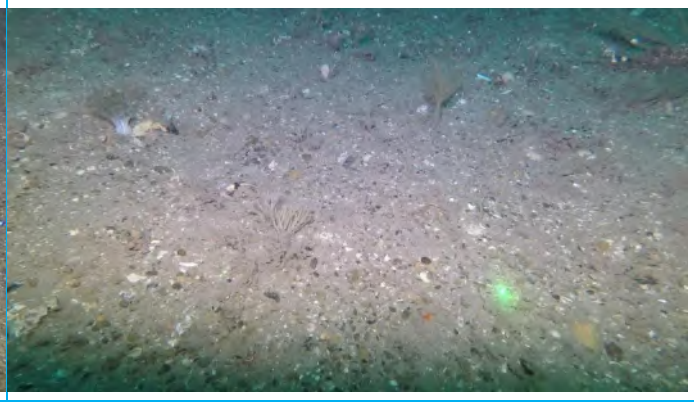
4.1.1. Habitat/Biotope Allocation

Four biotopes/habitats, shown in Table 1 and Table 2, were allocated to the 35 video segments analysed from the imagery from these stations, including eleven segments with two of these biotopes/habitats allocated as a mosaic.

Table 1. *Habitat types identified from the video and still imagery analysis of the imagery collected in Cardigan Bay.*

Biotope/Habitat (MNCR Code)	EUNIS Code	MNCR Classification
CR.MCR	A4.2	Moderate Energy Circalittoral Rock
SS.SCS	A5.1	Sublittoral coarse sediment
SS.SCS.CCS	A5.14	Circalittoral coarse sediment
SS.SCS.CCS.Nmix	A5.144	*Neopentadactyla mixta* in circalittoral shell gravel or coarse sand

Table 2. *Still image captures illustrating the biotope/habitats observed during analysis.*

CR.MCR	SS.SCS
	
SS.SCS.CCS	**SS.SCS.CCS.Nmix**
	

The allocated biotopes are summarised in Table 3 and include:

- Thirteen video segments as "Sublittoral coarse sediment" (SS.SCS)[10],
- Ten video segments as a mosaic of "Sublittoral coarse sediment" and "Moderate energy circalittoral rock" (SS.SCS / CR.MCR),
- Seven video segments as "Circalittoral coarse sediment" (SS.SCS.CCS),
- Three video segments as "Moderate energy circalittoral rock" (CR.MCR),
- One video segment as "Neopentadactyla mixta in circalittoral shell gravel or coarse sand" (SS.SCS.CCS.Nmix),
- One video segment as as a mosaic of "Circalittoral coarse sediment" and "Moderate energy circalittoral rock" (SS.SCS.CCS / CR.MCR),

[10] *video segments were allocated as SS.SCS where cobbles and pebbles were present. SS.SCS has the full title of "Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)", and includes cobbles within the substratum and description (whereas SS.SCS.CCS is described as "coarse sand and gravel with a minor finer sand fraction" and "coarse sands, gravel and shingle)".*

Table 3.
Sample station information, depth, primary broadscale habitat, EUNIS code, MNCR code, Habitat FOCI and presence of Annex I habitats.

STN	Seg	Depth (m)	Primary Broadscale Habitat	EUNIS Code	MNCR Biotope Code	Habitat FOCI	Features
01	1	40.0	Subtidal Coarse Sediment	A5.1	SS.SCS	Subtidal Sands and Gravels	
02	1	37.0	Moderate Energy Circalittoral Rock	A4.2	CR.MCR		Potential Reef
03	1	37.0	Subtidal Coarse Sediment	A5.14	SS.SCS.CCS	Subtidal Sands and Gravels	
04	1	40.0	Subtidal Coarse Sediment	A5.1	SS.SCS	Subtidal Sands and Gravels	
05	1	44.0	Subtidal Coarse Sediment	A5.1 / A4.2	SS.SCS / CR.MCR	Subtidal Sands and Gravels	Potential Reef
06	1	43.0	Subtidal Coarse Sediment	A5.14	SS.SCS.CCS	Subtidal Sands and Gravels	
07	1	44.0	Subtidal Coarse Sediment	A5.14 / A4.2	SS.SCS.CCS / CR.MCR	Subtidal Sands and Gravels	Potential Reef
07	2	44.0	Subtidal Coarse Sediment	A5.1	SS.SCS	Subtidal Sands and Gravels	
08	1	45.0	Subtidal Coarse Sediment	A5.1	SS.SCS	Subtidal Sands and Gravels	
09	1	46.0	Subtidal Coarse Sediment	A5.1	SS.SCS	Subtidal Sands and Gravels	
09	2	46.0	Moderate Energy Circalittoral Rock	A4.2	CR.MCR		Potential Reef
09	3	46.0	Subtidal Coarse Sediment	A5.1 / A4.2	SS.SCS / CR.MCR	Subtidal Sands and Gravels	
10	1	44.0	Subtidal Coarse Sediment	A5.1 / A4.2	SS.SCS / CR.MCR	Subtidal Sands and Gravels	Potential Reef
11	1	40.0	Subtidal Coarse Sediment	A5.14	SS.SCS.CCS	Subtidal Sands and Gravels	
12	1	38.0	Subtidal Coarse Sediment	A5.1 / A4.2	SS.SCS / CR.MCR	Subtidal Sands and Gravels	Potential Reef
13	1	40.0	Subtidal Coarse Sediment	A5.1 / A4.2	SS.SCS / CR.MCR	Subtidal Sands and Gravels	Potential Reef
13	2	40.0	Subtidal Coarse Sediment	A5.1	SS.SCS	Subtidal Sands and Gravels	
13	3	40.0	Subtidal Coarse Sediment	A5.1 / A4.2	SS.SCS / CR.MCR	Subtidal Sands and Gravels	Potential Reef
14	1	38.0	Subtidal Coarse Sediment	A5.1	SS.SCS	Subtidal Sands and Gravels	
15	1	43.0	Subtidal Coarse Sediment	A5.1	SS.SCS	Subtidal Sands and Gravels	
16	1	39.3	Subtidal Coarse Sediment	A5.14	SS.SCS.CCS	Subtidal Sands and Gravels	

STN	Seg	Depth (m)	Primary Broadscale Habitat	EUNIS Code	MNCR Biotope Code	Habitat FOCI	Features
17	1	40.0	Subtidal Coarse Sediment	A5.14	SS.SCS.CCS	Subtidal Sands and Gravels	
18	1	40.0	Subtidal Coarse Sediment	A5.1	SS.SCS	Subtidal Sands and Gravels	
19	1	43.0	Subtidal Coarse Sediment	A5.1 / A4.2	SS.SCS / CR.MCR	Subtidal Sands and Gravels	Potential Reef
20	1	44.0	Subtidal Coarse Sediment	A5.1 / A4.2	SS.SCS / CR.MCR	Subtidal Sands and Gravels	Potential Reef
20	2	44.0	Moderate Energy Circalittoral Rock	A4.2	CR.MCR		Potential Reef
21	1	44.0	Subtidal Coarse Sediment	A5.1	SS.SCS	Subtidal Sands and Gravels	
22	1	45.0	Subtidal Coarse Sediment	A5.14	SS.SCS.CCS	Subtidal Sands and Gravels	
22	2	45.0	Subtidal Coarse Sediment	A5.1 / A4.2	SS.SCS / CR.MCR	Subtidal Sands and Gravels	Potential Reef
23	1	46.0	Subtidal Coarse Sediment	A5.14	SS.SCS.CCS	Subtidal Sands and Gravels	
24	1	45.0	Subtidal Coarse Sediment	A5.1	SS.SCS	Subtidal Sands and Gravels	
25	1	46.0	Subtidal Coarse Sediment	A5.1 / A4.2	SS.SCS / CR.MCR	Subtidal Sands and Gravels	Potential Reef
26	1	43.0	Subtidal Coarse Sediment	A5.1	SS.SCS	Subtidal Sands and Gravels	
27	1	41.0	Subtidal Coarse Sediment	A5.1	SS.SCS	Subtidal Sands and Gravels	
28	1	40.0	Subtidal Coarse Sediment	A5.144	SS.SCS.CCS.Nmix	Subtidal Sands and Gravels	

4.1.2. Epifauna

Within the imagery from the sample stations in Cardigan Bay, the majority of habitats observed were sedimentary with some infauna apparent, often interspersed with patchy cobbles and boulders with abundant epifauna.

Where rock was present, this was often covered by abundant growth of faunal turf (bushy hydroids and bryozoans, such as *Alcyonium digitatum*, *Nemertesia spp., Halecium spp., Flustridae*, and *Pentapora foliacea)* and encrusting fauna such as barnacles, sponges, and serpulid worms. Areas with greater composition of rock (cobbles and boulders) also had greater abundance of crustacea (e.g. *Munida rugosa* and a variety of crabs, including spider crabs), ascidians, anemones (e.g *Urticina spp.* and *Metridium spp.*) and large fish such as *Scyliorhinus* and *Mustelus,* amongst other taxa.

In areas composed of sediments, which were generally coarse, scallops (*Pecten maximus*) and sea cucumbers (*Neopentadactyla mixta*) were common, as well as other infaunal taxa such as Terebellidae (possible *Lanice conchilega*) and polychaete tubes (possible *Chaetopterus variopedatus*).

Some areas were comprised of shelly gravel, pebbles and some cobbles which appeared to be partially embedded within a matrix, with low-lying faunal turf, where scallops (*Pecten maximus*) and sea cucumbers (*Neopentadactyla mixta*) were also common.

4.1.3. Substrate Composition

The majority of habitats observed in the imagery from the sample stations in Cardigan Bay were comprised of coarse sediments (gravel, sand, pebbles, shell), often rippled or in waves, and frequently interspersed with patches of cobbles and boulders. In three of the video segments (Stn02 (all), Stn09 Segment 2, Stn20 Segment 2), the cobble/boulder content was consistently higher (≥30% rock) than other samples and these locations were identified as rock biotopes.

Substrate composition of the still images was recorded in four broad categories, rock (cobbles or boulders), gravel (including shell, gravel, pebbles), sand and mud, with percentages given to the nearest 5 percent. However, the percentage cover of rock (cobble or boulder) was recorded by using the polygon annotation tool in BIIGLE to give more accurate results for this category and the subsequent 'reefiness' assessment. This was exported from BIIGLE and entered into the proforma spreadsheet so that the 'AutoEUNIS' formula could be used to give the broadscale habitat for each of the still images, and necessary adjustments were made to the other categories to ensure that the substrate composition summed to 100% for this formula to function.

4.1.4. Reference Collection

A reference collection of still images or clips from video footage has been compiled to produce example imagery for the species/taxa observed: the collection includes 59 images of 59 taxa or morphologies, one image of anthropogenic material and four images as examples of the four habitat/biotope types identified.

NB: Where taxon have been identified to a high taxonmic level (Family or higher) then an example of that taxon has been provided e.g. *Actiniaria spp*. However, this taxon can cover a wide range of species, and it should not be considered as the only potential example.

4.1.5. Litter or Other Impacts or Modifiers

One video station (Stn07) has been identified as having an item of potential anthropogenic origin in it, which was captured within the still imagery and recorded in the analysis in BIIGLE. The item could not be identified with certainty but resembled a piece of thin black plastic.

4.2. Quality Control of Imagery Analysis

4.2.1. Still Imagery

Quality control (QC) was carried out on 100% of the annotations on the still images with a second analyst reviewing the imagery and results within BIIGLE and using the

LARGO function (Label Review Grid Overview). LARGO[11] allows annotations with the same annotation label to be viewed as thumbnails in a regular grid, which can then be selected to change labels, attach new labels or delete labels more efficiently.

The QC process showed that, whilst there were minor variations in the taxa recorded, there were no major discrepancies between the analysts in the determination of taxa. The checks and amendments made during the QC of the BIIGLE analysis are recorded in a spreadsheet detailing all QC procedures which is also submitted as a deliverable of this work.

Substrate composition was reviewed for different analysts and results were consistent for the majority of still imagery. On some occasions, in more pebbly areas, the 'gravel' category (including gravel, shell, pebbles) was given lower values by one analyst than the second. However, this did not alter the biotope allocation for any of the stills and was considered acceptable within this analysis.

4.2.2. Video Imagery

The degree of consistency in the video analysis results between the original analyst and the QC analyst reflects a confidence in the quality of the analysis. Where there were minor discrepancies between the conclusions of the original analyst and the QC analyst with regard to the video clips and still images, the issues were explored and are discussed below.

4.2.3. Discrepancies

The majority of discrepancies in the video analysis were with taxa of a small size or a cryptic nature, which meant they could be missed during faster moving sections of video, or imagery of lower quality. Examples of such taxa are topshells (small), ascidians (translucent), some anemones (small or partially obscured by rock), brittle stars (cryptic) and Buccinidae (can be mistaken for empty shell).

Scallops (*Pecten maximus*) could be difficult to discern as these were covered in gravel/sediment and often had faunal turf/hydroids attached. Similarly, Terebellidae were difficult to clearly record as these were also covered in faunal turf and obscured by the overgrowth.

With the imagery in general, there were also some discrepancies in the percent cover allocation of faunal turf, with some overlap between categories of hydrozoa, *Nemertesia spp, Nemertesia antennina* and *Nemertesia ramosa*. This was considered acceptable, as the categories are closely linked and could be uncertain due to imagery quality or the view of the taxa within the footage. At some locations, faunal turf was observed to cover the majority of the substrate, but was indistinct and only formed a distinctive turf on occasions. The differences between these two characteristics of the faunal turf may have led to some minor discrepancies in the amount of faunal turf allocated within video segments. More uncertain views of encrusting/colonial fauna

[11] *https://biigle.de/manual/tutorials/largo/largo*

(e.g. sponges, zoanthids, egg cases) may have also resulted in minor discrepancies, with some of these being included within the 'faunal crust'.

4.3. GIS & Map Production

All data were incorporated into an ArcGIS workspace and final maps of sample locations, with the allocated physical and biological habitats and Annex 1 reef at each location, along with distribution maps of these areas, are shown in Figure 9, Figure 10, Figure 11, and Figure 12 and provided digitally with associated metadata.

4.4. Habitat Maps

Figure 9 and Figure 10 present the benthic habitats observed within the survey area from the imagery at each sample station. Analysis of the still imagery resulted in data that broadly supported these findings, although at some stations (Stn02, Stn19 and Stn22) the video footage was allocated as either 'Moderate energy circalittoral rock' (CR.MCR) and/or as potential reef, but the still images for these stations were all allocated as 'Subtidal Coarse Sediment' (SS.SCS). This is likely to result from the patchy nature of the cobbles and boulders at these stations, where the still image captures did not happen to fall within these patches of cobble or boulder.

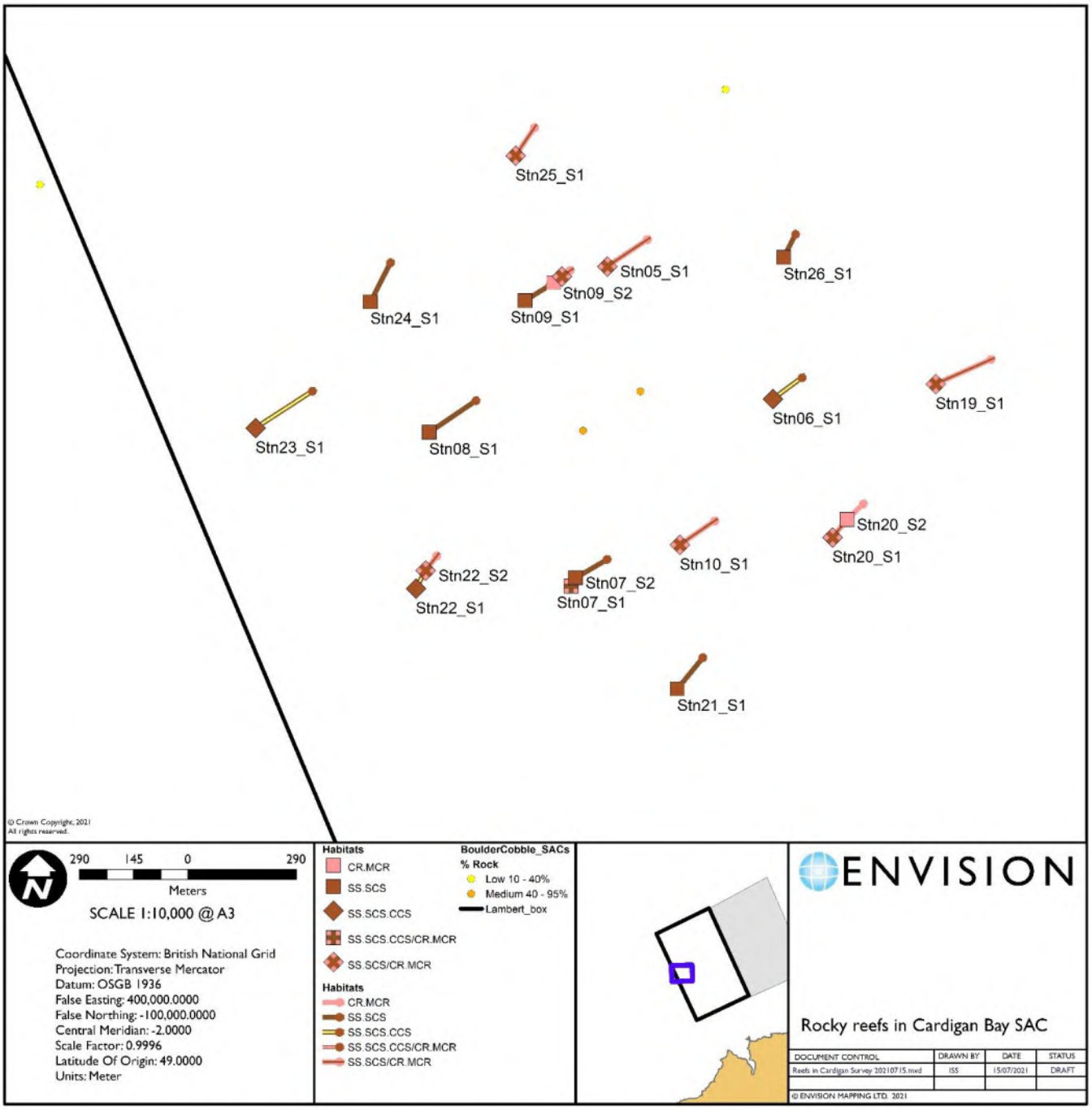


Figure 9.

Benthic habitats observed at northern sample stations within Cardigan Bay, alongside existing sample data.

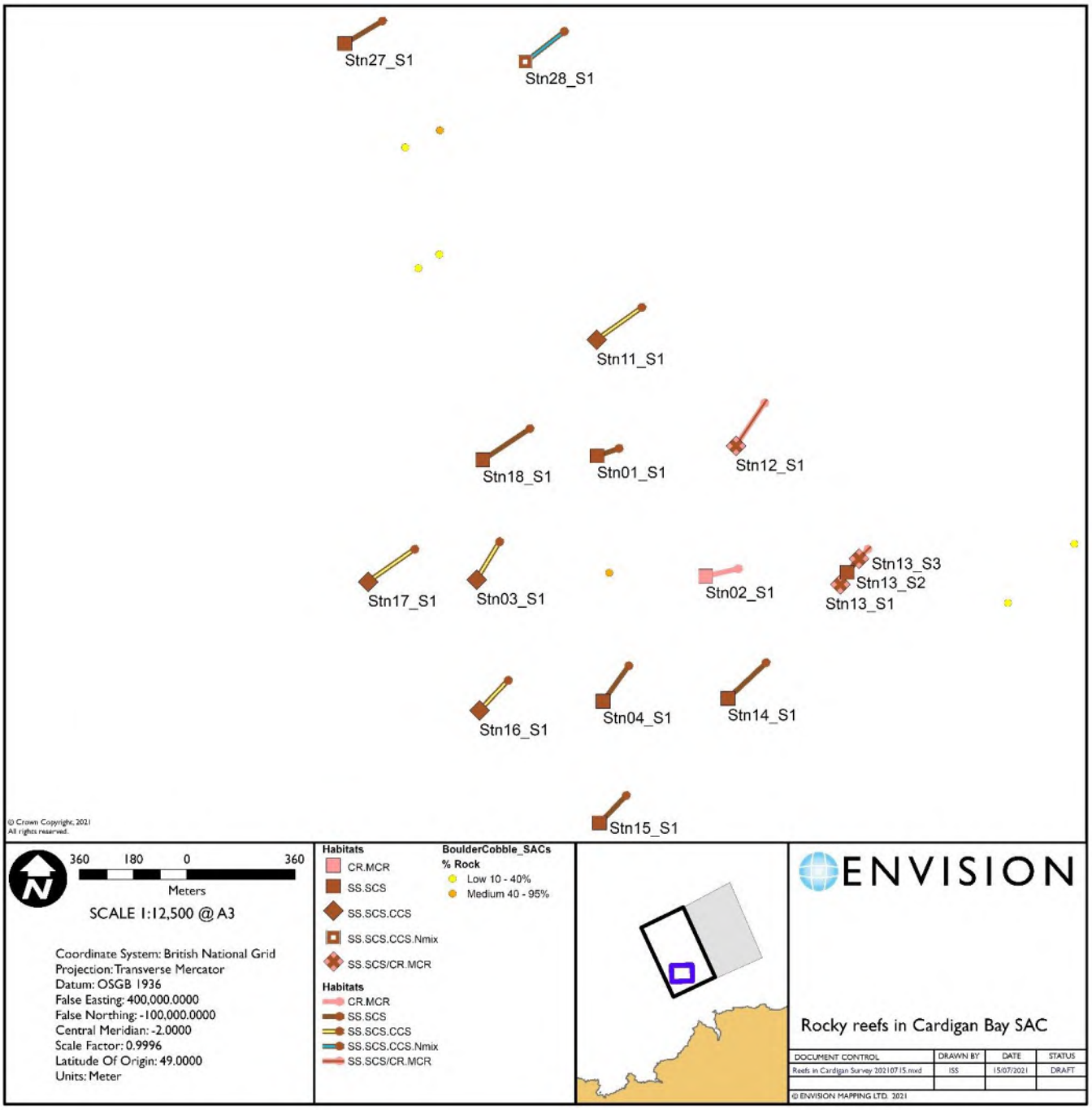


Figure 10.

Benthic habitats observed at northern sample stations within Cardigan Bay, alongside existing sample data.

The distribution of habitats is shown in Figure 9 and Figure 10.

In the northern sample stations, the majority of locations are either "Sublittoral coarse sediment" (SS.SCS) or "Circalittoral coarse sediment" (SS.SCS.CCS) with no particular patterns visible. There are also several locations where "Moderate Energy Circalittoral Rock" (CR.MCR) was allocated as a secondary MNCR biotope to the

primary sedimentary biotope, which indicates a habitat mosaic and the patchy nature of the rock seen in this area. There are two video segments in this area which were allocated "Moderate Energy Circalittoral Rock" (CR.MCR) as a primary biotope, one to the north and one to the east of the site, but these are segments of video tows where the other segments were allocated with primary biotopes of "Sublittoral coarse sediment" (SS.SCS) and also indicates a patchy distribution of rock habitats.

In the southern sample stations, "Sublittoral coarse sediment" (SS.SCS) was found throughout the area. There are several stations allocated as "Circalittoral coarse sediment" (SS.SCS.CCS) to the west of the site, which may indicate a larger area of coarse sediment and an absence of any rocky substrate in this area. To the east of the southern sample stations, there are several video segments where "Moderate Energy Circalittoral Rock" (CR.MCR) was allocated as a secondary MNCR biotope to the primary sedimentary biotope, which again indicates the presence of rock habitat in a patchy distribution. At one station (Stn02), to the east of the centre of the sample array (where the 'Medium' reef was located from previous data), "Moderate Energy Circalittoral Rock" (CR.MCR) was allocated as a primary biotope, where cobbles were observed at approximately 30% composition with relatively low elevation, along with pebbles, gravel and sand.

The two sample stations taken in the central area (to the north of the southern sample stations) were allocated the biotopes of "Sublittoral coarse sediment" (SS.SCS) and "*Neopentadactyla mixta* in circalittoral shell gravel or coarse sand" (SS.SCS.CCS.Nmix).

4.5. 'Reefiness' Assessment

The current guidance from Golding *et al.*, (2020), as described in Section 3.4, was followed and the assessment for each video segment is summarised in Table 4. If the substrate composition for a video segment was assessed as <10% cobbles/boulders, this was then assessed as 'Not Reef' and the other criteria were not considered. If the substrate composition for a video segment was assessed as ≥10% cobbles/boulders, then the other criteria were also assessed, and these are shown in more detail in Sections 4.5.1 to Section 4.5.28.

Segment length was taken as a proxy for extent, assuming an average field of view in the video of 1m^2, and therefore 25m being the shortest length of video tow to justify splitting into segments for different habitats.

The majority of video segments (22) assessed for 'reefiness' had a substrate composition of <10% cobbles/boulders, showing an absence of Annex I stony reef. Four of the 35 video segments were assessed as showing a 'low' resemblance to Annex I stony reef, with a further eight video segments showing 'low' (patchy) resemblance to Annex I stony reef, where the presence of cobbles or boulders were patchy in distribution and the dominant substrate component was sedimentary in nature.

Only one segment was assessed as showing 'medium' resemblance to Annex I stony reef, and this was a short segment from Station 09, with segments on either side assessed as 'Not Reef'. The extent of this was calculated to be approximately 28m^2 (assuming an average field of view of 1m^2, and length 28m) and is therefore at the lower end of the 'extent' criteria, and could in itself be considered a large patch.

Table 4.
Summary of 'reefiness' assessment for each video segment, including criteria evaluated e.g. substrate composition, elevation, extent, segment length (proxy for extent) and biota.

Station	Seg-ment	Overall 'Reefiness' Assessment	Evaluation of 'Reefiness' Criteria				
			Composition	Elevation	Extent	Segment Length (m)	Biota
01	1	Not Reef	Not Reef	N/A	N/A	91	N/A
02	1	Low	Low	Low	Reef	126	Low-High
03	1	Not Reef	Not Reef	N/A	N/A	162	N/A
04	1	Not Reef	Not Reef	N/A	N/A	160	N/A
05	1	Low (Patchy)	Low in Patches	Low	Reef	140	Low-High
06	1	Not Reef	Not Reef	N/A	N/A	108	N/A
07	1	Low (Patchy)	Low in Patches	Low	Reef	25	Low-High
07	2	Not Reef	Not Reef	N/A	N/A	109	N/A
08	1	Not Reef	Not Reef	N/A	N/A	162	N/A
09	1	Not Reef	Not Reef	N/A	N/A	90	N/A
09	2	Medium	Medium	Medium	Reef	28	Low-High
09	3	Not Reef	Not Reef	N/A	N/A	38	N/A
10	1	Low (Patchy)	Low in Patches	Low	Reef	124	Low-High
11	1	Not Reef	Not Reef	N/A	N/A	200	N/A
12	1	Low	Low	Low	Reef	187	Low-High
13	1	Low (Patchy)	Low in Patches	Low	Reef	46	Low-High
13	2	Not Reef	Not Reef	N/A	N/A	61	N/A
13	3	Low	Low	Low	Reef	57	Low-High
14	1	Not Reef	Not Reef	N/A	N/A	189	N/A
15	1	Not Reef	Not Reef	N/A	N/A	142	N/A
16	1	Not Reef	Not Reef	N/A	N/A	153	N/A
17	1	Not Reef	Not Reef	N/A	N/A	204	N/A
18	1	Not Reef	Not Reef	N/A	N/A	203	N/A
19	1	Low (Patchy)	Low in Patches	Low	Reef	174	Low-High
20	1	Low (Patchy)	Low in Patches	Low	Reef	61	Low-High
20	2	Low	Low	Low	Reef	72	Low-High
21	1	Not Reef	Not Reef	N/A	N/A	119	N/A
22	1	Not Reef	Not Reef	N/A	N/A	55	N/A
22	2	Low (Patchy)	Low in Patches	Low	Reef	61	Low-High
23	1	Not Reef	Not Reef	N/A	N/A	193	N/A
24	1	Not Reef	Not Reef	N/A	N/A	129	N/A
25	1	Low (Patchy)	Low in Patches	Low	Reef	101	Low-High
26	1	Not Reef	Not Reef	N/A	N/A	81	N/A
27	1	Not Reef	Not Reef	N/A	N/A	161	N/A
28	1	Not Reef	Not Reef	N/A	N/A	180	N/A

4.5.1. Station 01

No Reef - silty pebbles, gravel, sand, with some cobbles and faunal turf, scallops common.

4.5.2. Station 02

Substrate composition supports 'reefiness' assessment:

Criterion	Score	Notes
Composition	Low	Cobbles and occasional boulder present at approximately 30% composition, with silty pebbles
Elevation:	Low	Average elevation <64mm.
Extent	Reef	Length: 126m
Biota:	Low - High	Established faunal turf present including species indicative of reef habitat
Overall Assessment		**Low Reef**

4.5.3. Station 03

No Reef - rippled coarse sand, sparse epifauna, hermit crab, fish, brittle star.

4.5.4. Station 04

No Reef - silty pebbles, gravel, sand, with some cobbles and faunal turf, scallops common, anemones, *Mustelus spp*.

4.5.5. Station 05

Substrate composition supports 'reefiness' assessment:

Criterion	Score	Notes
Composition	Low in Patches	Cobbles and boulders present at approximately 10% composition, soft sediment as dominant substrate
Elevation:	Low	Average elevation <64mm.
Extent	Reef	Length: 140m
Biota:	Low - High	Established faunal turf present including species indicative of reef habitat
Overall Assessment		**Low Reef (Patchy)**

4.5.6. Station 06

No Reef - rippled shelly sand, with occasional cobble or boulder with faunal turf.

4.5.7. Station 07

Station 07 – Segment 01

Substrate composition supports 'reefiness' assessment:

Criterion	Score	Notes
Composition	Low in Patches	Cobbles and boulders present at approximately 10-30% composition, soft sediment as dominant substrate
Elevation:	Low	Average elevation <64mm.
Extent	Reef	Length: 25m
Biota:	Low - High	Established faunal turf present including species indicative of reef habitat
Overall Assessment		**Low Reef (Patchy)**

Station 07 – Segment 02

No Reef - sand, with shell/gravel/pebbles, occasional cobble/boulder, sparse epifauna, scallops.

4.5.8. Station 08

No Reef - sand, with shell/gravel/pebbles, occasional cobble/boulder, sparse epifauna, scallops, small patch 'Low' reef (<25m).

4.5.9. Station 09

Station 09 – Segment 01

No Reef – sand, gravel, pebbles with occasional cobbles/boulders, sparse epifauna, Terebellidae, scallops.

Station 09 – Segment 02

Substrate composition supports 'reefiness' assessment:

Criterion	Score	Notes
Composition	Medium	Cobbles and boulders present at approximately 40% composition.
Elevation:	Medium	Medium (64mm – 5m). Elevation range 50-500mm.
Extent	Reef	Length: 28m
Biota:	Low - High	Established faunal turf present including species indicative of reef habitat
Overall Assessment		**Medium Reef**

Station 09 – Segment 03

No Reef - sand, gravel, pebbles with sparse epifauna, Terebellidae, scallops and cobbles/boulders (<10% composition) with epifauna.

4.5.10. Station 10

Substrate composition supports 'reefiness' assessment:

Criterion	Score	Notes
Composition	Low in Patches	Cobbles and boulders present at approximately 10-20% composition, soft sediment as dominant substrate
Elevation:	Low	Average elevation <64mm.
Extent	Reef	Length: 124m
Biota:	Low - High	Established faunal turf present including species indicative of reef habitat
Overall Assessment		**Low Reef (Patchy)**

4.5.11. Station 11

No Reef - rippled shelly sand/gravel, pebbles, scallops, Terebellidae, epifauna on occasional submerged shell or rock.

4.5.12. Station 12

Substrate composition supports 'reefiness' assessment:

Criterion	Score	Notes
Composition	Low	Cobbles and occasional boulder present at approximately 10-30% composition, with silty pebbles
Elevation:	Low	Average elevation <64mm.
Extent	Reef	Length: 187m
Biota:	Low - High	Established faunal turf present including species indicative of reef habitat
Overall Assessment		**Low Reef**

4.5.13. Station 13

Station 13 – Segment 01

Substrate composition supports 'reefiness' assessment:

Criterion	Score	Notes
Composition	Low in Patches	Cobbles and boulders present at approximately 10-20% composition, soft sediment as dominant substrate
Elevation:	Low	Average elevation <64mm.
Extent	Reef	Length: 46m
Biota:	Low - High	Established faunal turf present including species indicative of reef habitat
Overall Assessment		**Low Reef (Patchy)**

Station 13 – Segment 02

No Reef - coarse gravel / sand, no epifauna, more pebbles towards end.

Station 13 – Segment 03

Substrate composition supports 'reefiness' assessment:

Criterion	Score	Notes
Composition	Low	Cobbles and occasional boulder present at approximately 10-30% composition, with silty pebbles
Elevation:	Low	Average elevation <64mm.
Extent	Reef	Length: 57m
Biota:	Low - High	Faunal turf present, some species indicative of reef habitat
Overall Assessment		**Low Reef**

4.5.14. Station 14

No Reef - sand/gravel waves and scallops, then flat, with small patches of 'low' reef and more pebbles, cobbles, occasional boulder, with epifauna at end.

4.5.15. Station 15

No Reef – slightly silty sand/gravel, scallops, occasional cobble with epifauna, *Alcyonium digitatum*, and infauna.

4.5.16. Station 16

No Reef - shelly, gravelly sand ripples, scallops, occasional boulder with epifauna, pebbles at end.

4.5.17. Station 17

No Reef - rippled shelly sand/gravel, pebbles, scallops, Terebellidae, epifauna on occasional submerged shell or rock.

4.5.18. Station 18

No Reef - sand, gravel, pebbles and occasional cobbles/boulders with epifauna, sea cucumbers, Terebellidae, small patches of 'low' reef throughout.

4.5.19. Station 19

Substrate composition supports 'reefiness' assessment:

Criterion	Score	Notes
Composition	Low in Patches	Cobbles and occasional boulder present at approximately 10-20% composition, soft sediment as dominant substrate
Elevation:	Low	Average elevation <64mm.
Extent	Reef	Length: 174m
Biota:	Low - High	Established faunal turf present, species indicative of reef habitat
Overall Assessment		**Low Reef (Patchy)**

4.5.20. Station 20

Station 20 – Segment 1

Substrate composition supports 'reefiness' assessment:

Criterion	Score	Notes
Composition	Low in Patches	Cobbles and occasional boulder present at approximately 10-30% composition, soft sediment as dominant substrate
Elevation:	Low	Average elevation <64mm.
Extent	Reef	Length: 61m
Biota:	Low - High	Established faunal turf present, species indicative of reef habitat
Overall Assessment		**Low Reef (Patchy)**

Station 20 – Segment 2

Substrate composition supports 'reefiness' assessment:

Criterion	Score	Notes
Composition	Low	Cobbles and boulders present at approximately 20-30% composition, with small patches of 'medium' reef
Elevation:	Low	Average elevation <64mm.
Extent	Reef	Length: 72m
Biota:	Low - High	Established faunal turf present, species indicative of reef habitat
Overall Assessment		**Low Reef**

4.5.21. Station 21

No Reef - sand, gravel, pebbles, scallops, occasional boulder with epifauna, sea cucumbers, gets more cobbly, with small patches of 'Low' reef towards end.

4.5.22. Station 22

Station 22 – Segment 1

No Reef - rippled coarse sand, no epifauna, patches of cobble/boulder with epifauna.

Station 22 – Segment 2

Substrate composition supports 'reefiness' assessment:

Criterion	Score	Notes
Composition	Low in Patches	Cobbles and boulders present at approximately 10% composition, soft sediment as dominant substrate
Elevation:	Low	Average elevation <64mm.
Extent	Reef	Length: 61m
Biota:	Low - High	Established faunal turf present, species indicative of reef habitat
Overall Assessment		**Low Reef (Patchy)**

4.5.23. Station 23

No Reef - rippled shelly sand and gravel, large shells and occasional cobble with epifauna.

4.5.24. Station 24

No Reef - sand/gravel, pebbles, occasional cobble, scallops and Inachidae common.

4.5.25. Station 25

Substrate composition supports 'reefiness' assessment:

Criterion	Score	Notes
Composition	Low in Patches	Cobbles and boulders present at approximately 10-20% composition, soft sediment as dominant substrate
Elevation:	Low	Average elevation <64mm.
Extent	Reef	Length: 101m
Biota:	Low - High	Established faunal turf present including species indicative of reef habitat
Overall Assessment		**Low Reef (Patchy)**

4.5.26. Station 26

No Reef - shelly sand and gravel (rippled at start), large shells and occasional cobble with epifauna.

4.5.27. Station 27

No Reef - shelly sand/gravel (rippled at start), epifauna on submerged shell or rock, more pebbly towards end.

4.5.28. Station 28

No Reef - rippled shelly sand/gravel, sea cucumbers, Terebellidae and cobbles/big boulders with epifauna, small patches of 'Low'/'Medium' reef, pebbly towards end .

4.6. Annex I Features

The video and acoustic data have been reviewed and analysed in accordance with current UK guidelines (Turner *et a*l. 2016[12], Gubbay, 2007[13]; Irving, 2009[14]; Golding *et al.*, 2020[15]) and any potential Annex I features identified. Annex I reef was present in 13 of the video segments at 11 stations, as shown in Figure 11 and Figure 12.

[12] *Turner, J.A., Hitchin, R., Verling, E., van Rein, H. 2016. Epibiota remote monitoring from digital imagery: Interpretation guidelines.*

[13] *GUBBAY, S. 2007. Defining and managing Sabellaria spinulosa reefs. Report of an interagency workshop. JNCC Report No. 405.*

[14] *Irving, R. 2009. The identification of the main characteristics of stony reef habitats under the Habitats Directive. Summary report of an inter-agency workshop 26-27 March 2008. JNCC Report No. 432*

[15] *Golding. N., Albrecht. J., McBreen. F. 2020. Refining criteria for defining areas with a 'low resemblance' to Annex I stony reef; Workshop Report. JNCC Report No. 656, JNCC, Peterborough, ISSN 0963-8091.*

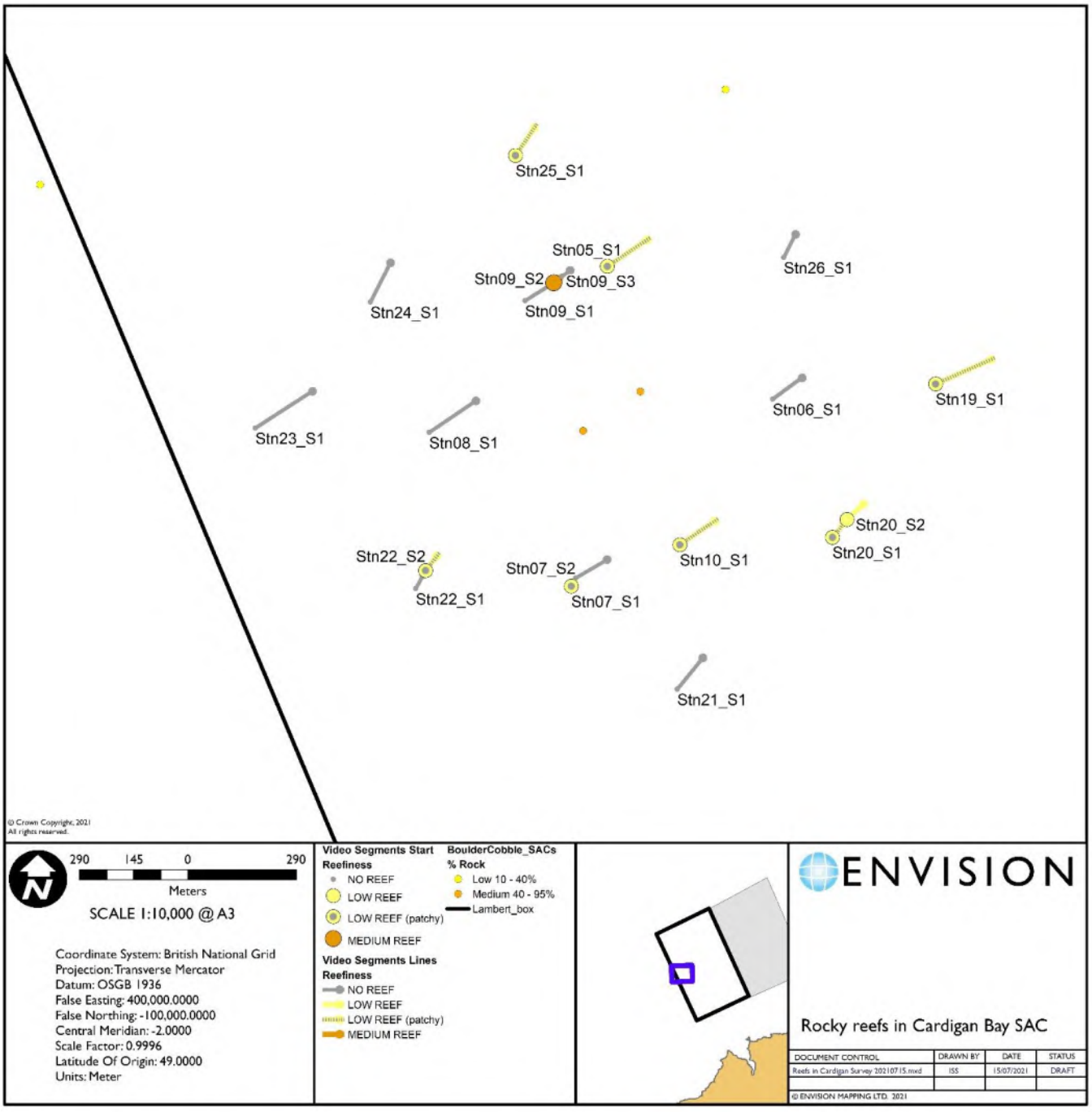


Figure 11.

Location of Annex 1 reef assessed from imagery collected at northern sample stations within Cardigan Bay, alongside existing sample data.

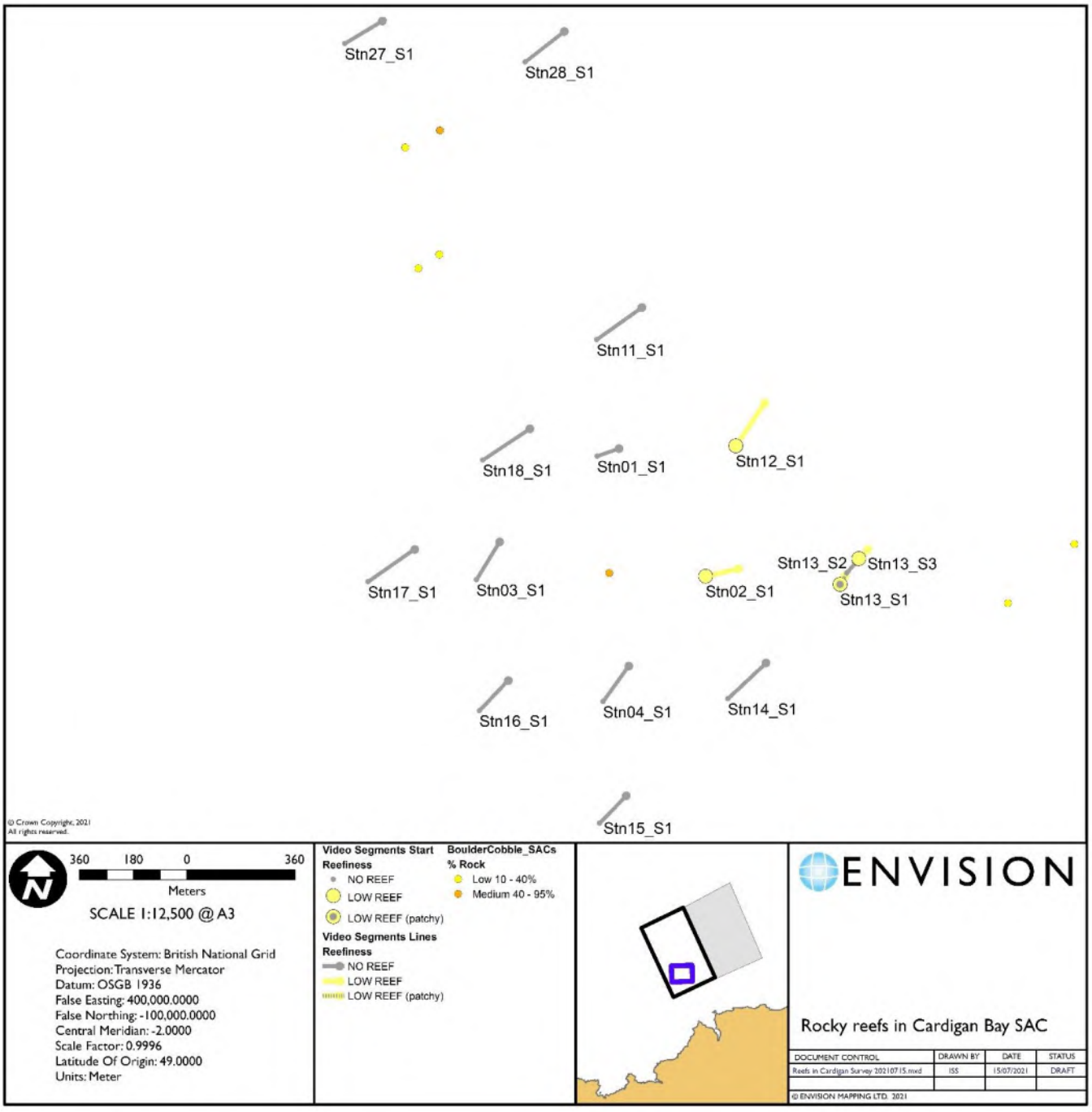


Figure 12.

Location of Annex 1 reef assessed from imagery collected at southern sample stations within Cardigan Bay, alongside existing sample data.

The distribution of 'reefiness' for each sample segment is shown in Figure 11 and Figure 12, and as with the habitat distribution, does not show any major spatial trends.

In the northern sample stations, seabed showing 'Low (Patchy)' resemblance to Annex 1 stony reefs are found throughout the area with no particular patterns being evident. One video segment has been assessed as showing 'Low' resemblance to Annex 1 stony

reefs to the east of the area, with the remaining footage at that stations showing 'Low (Patchy)' resemblance to Annex I stony reefs. One other video segment in the area has been assessed as showing 'Medium' resemblance to Annex I stony reefs, but the footage in the video segments at either end of this segment have been assessed as 'Not Reef' and the majority of nearby sample stations are all 'Not Reef', with a couple of sample stations showing a 'Low (Patchy)' resemblance.

In the southern sample stations, the 'reefiness' assessment mirrors the distribution of the rock habitats allocated at three sample stations to the east of the site, with three video segments assessed as showing 'Low' resemblance to Annex I stony reefs, one segment showing a 'Low (Patchy)' resemblance and one assessed as 'Not Reef'.

5. Discussion

In summary, the habitats observed in the imagery from the sample stations in Cardigan Bay were sedimentary with some infauna apparent, often interspersed with patchy cobbles and boulders with epifauna that could be indicative of reef environments, supporting the findings of previous studies in this area[16].

On many occasions, the rock appeared to have been covered in coarse sediments, which are understood to be ephemeral in this area, and it is possible a thick veneer of sediment occurs in some of these locations. However, from the appearance in the video, the majority of sediment was rippled or in waves, with no 'hard-substrate' epifauna observed growing through the sediment (this was mostly observed on the exposed rock substrate), and therefore the term was not used within the analysis.

The objectives of the project were to survey areas of seabed adjacent to locations with existing evidence of 'medium' quality (or 'reefiness') reef in the 'Lambert Box' within Cardigan Bay SAC, to establish the extent of boulder/cobble reef habitat at these locations.

5.1. Results Discussion

Whilst some of the imagery was assessed as showing 'Low' resemblance to Annex I stony reef, the majority were either assessed as 'Not Reef' or 'Low (Patchy') reef (**Table 5**). Only one video segment was assessed as showing 'Medium' resemblance to Annex I stony reef, and this was a short segment in the middle of the imagery from Station 09, with segments on either side assessed as 'Not Reef'. The extent of this segment was calculated to be approximately 28m^2, and is therefore at the lower end of the 'extent' criteria, and could in itself be considered patchy in nature.

Table 5. *Summary of 'reefiness' assessment for video segments.*

Overall 'Reefiness' Assessment	Number of Segments
Not Reef	22
Low Reef (Patchy)	8
Low Reef	4
Medium	1

The observations from the imagery recorded at sample stations in Cardigan Bay suggest that whilst there are areas showing resemblance to Annex I stony reef, these are very patchy in distribution. The presence of mobile coarse sediments (rippled or in waves) also suggest that these may be subject to seasonal movement, which would mean that any areas of reef could be ephemeral as they become exposed or covered at various times. This evidence would suggest that it is not possible to define extents of areas with 'medium' resemblance to Annex I stony reef within the areas surveyed.

[16] *Lambert, G. I., Murray, L.G., Benell J.D. & Kaiser, M.J. (2013). Habitat assessment of the area of the Cardigan Bay SAC proposed for a fishing intensity experiment. Fisheries & Conservation report No. xx, Bangor University. Pp.51*

6. Accompanying Data

To accompany this report a series of data sets are available:

6.1. Benthic Data

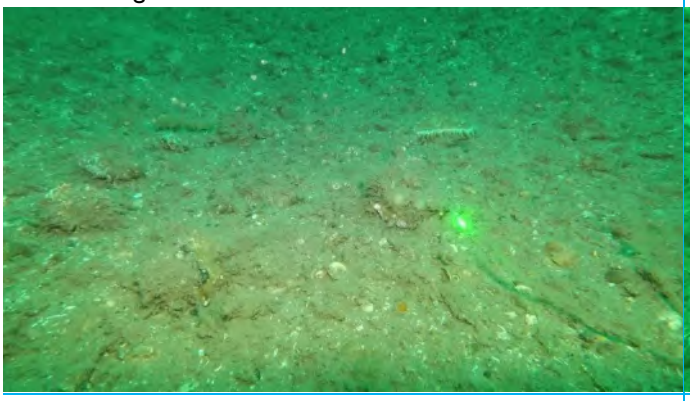
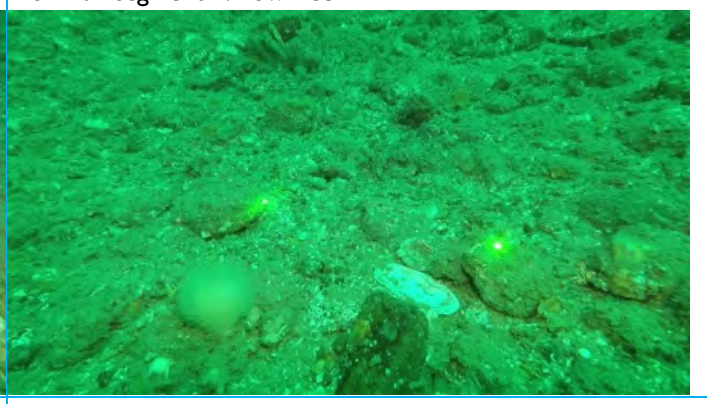
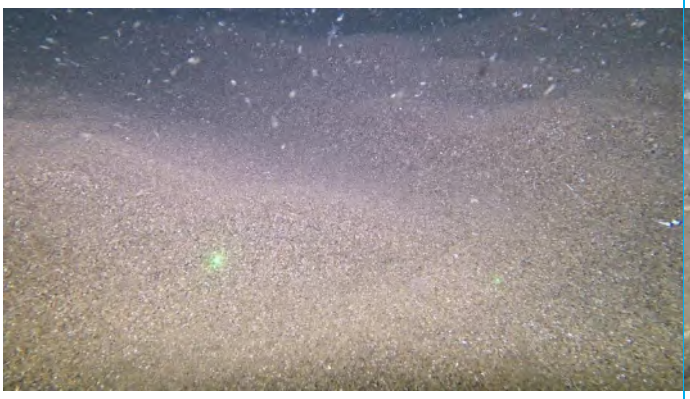
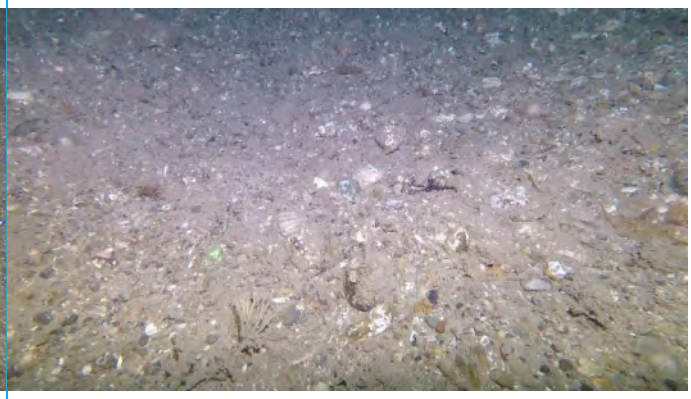
- HD video footage and still images are available digitally
- Spreadsheets of video and stills analysis outputs with a brief description of each video segment or still image, along with substrate, associated biotopes/habitats and quantitative information on epifauna

6.2. GIS and Map Data

An ArcGIS project & layer package for final interpretative maps is provided. Additionally, shape files for samples with biotopes, habitats and substrate are provided with associated ArcGIS layer files. All report maps are provided as image files at 300 dpi or higher.

7. Appendix A

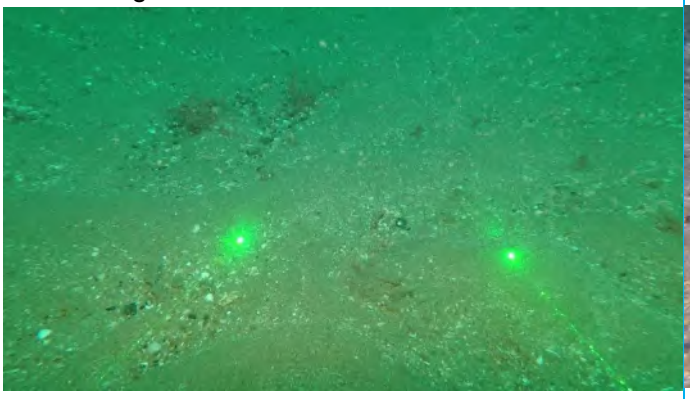
Table 6.
Still video images from the 35 video segments from the 28 DDV stations located in the Cardigan Bay survey area, along with 'reefiness' assessment for each segment.

STN01 segment 1: Not Reef	STN02 segment 1: Low Reef
	
STN03 segment 1: Not Reef	STN04 segment 1: Not Reef
	
STN05 segment 1: Low Reef (Patchy)	STN06 segment 1: Not Reef
	

STN07 segment 1: Low Reef (Patchy)

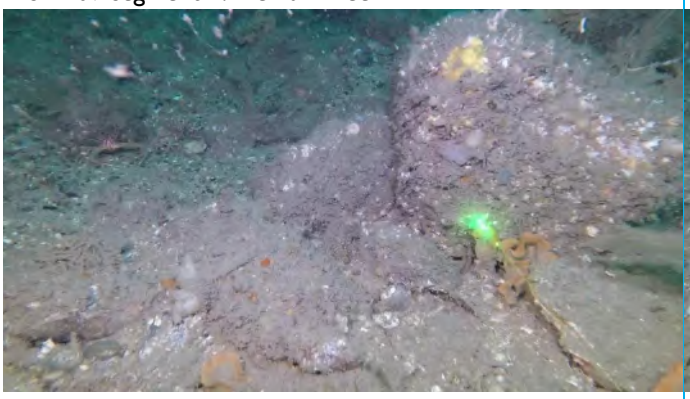
STN07 segment 2: Not Reef

STN08 segment 1: Not Reef



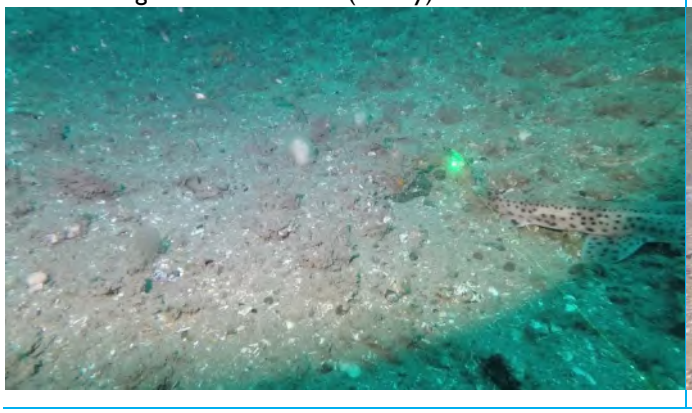
STN09 segment 1: Not Reef

STN09 segment 2: Medium Reef

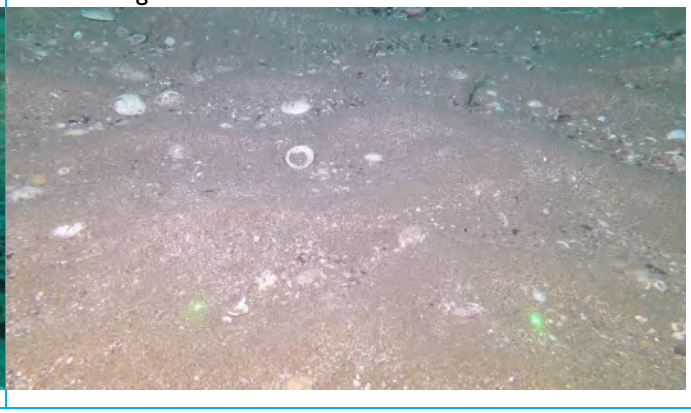


STN09 segment 3: Not Reef

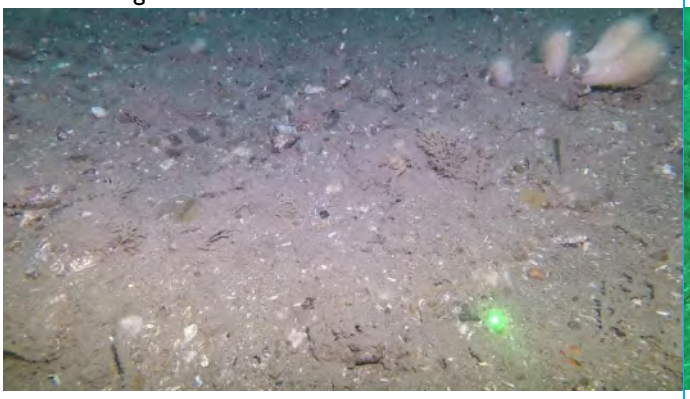
STN10 segment 1: Low Reef (Patchy)



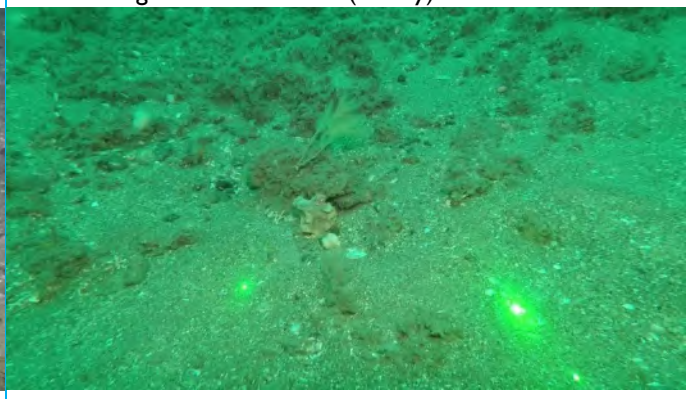
STN11 segment 1: Not Reef



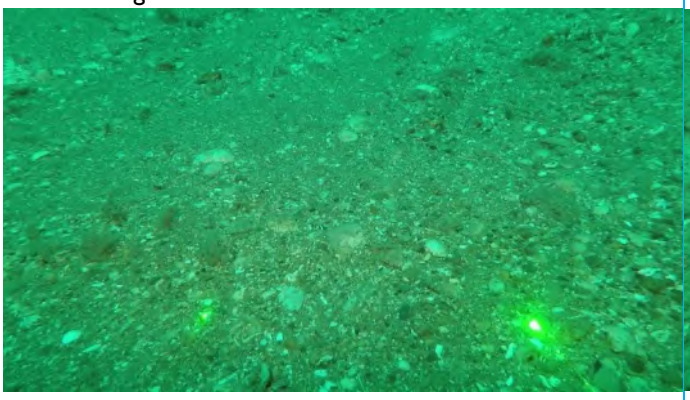
STN12 segment 1: Low Reef



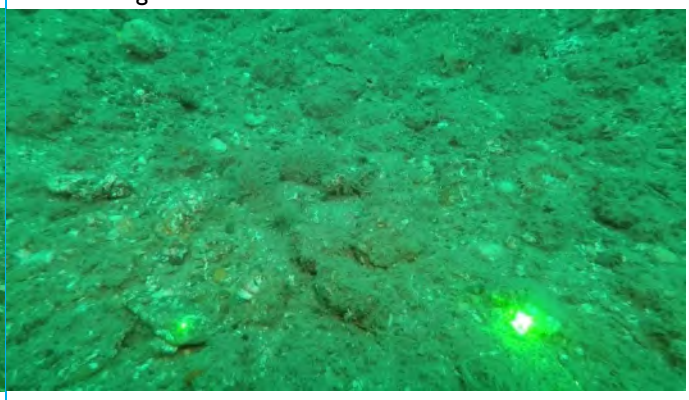
STN13 segment 1: Low Reef (Patchy)



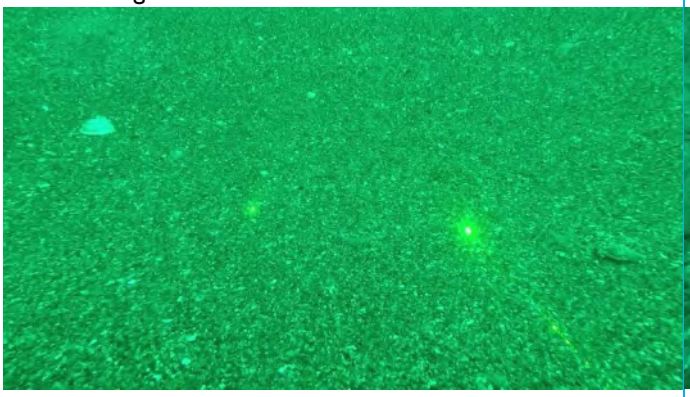
STN13 segment 2: Not Reef



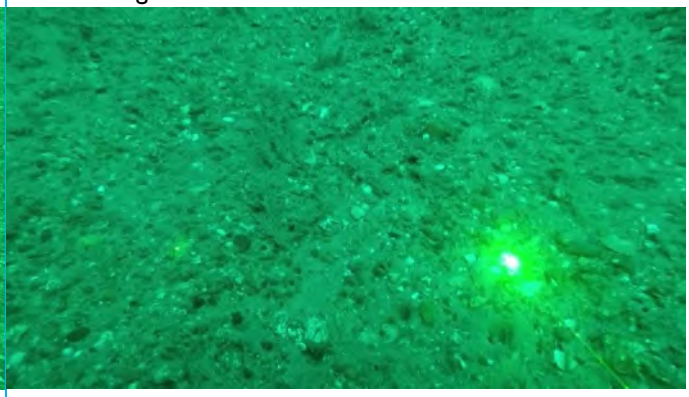
STN13 segment 3: Low Reef



STN14 segment 1: Not Reef



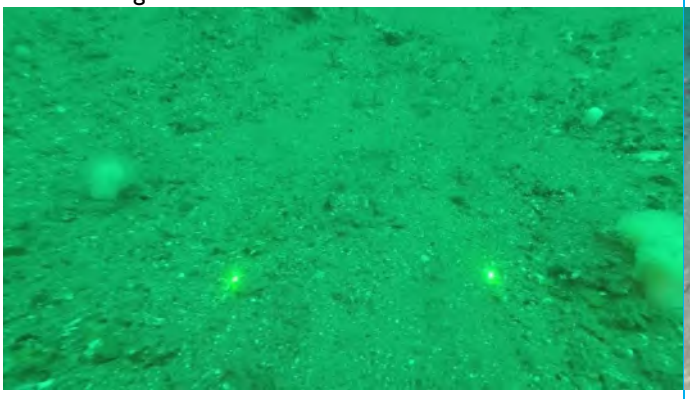
STN15 segment 1: Not Reef



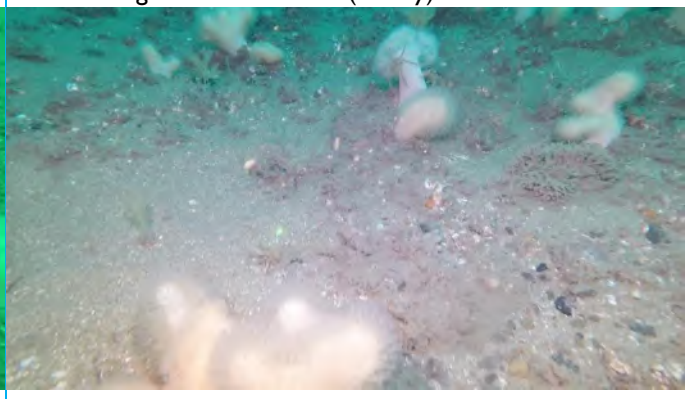
STN16 segment 1: Not Reef

STN17 segment 1: Not Reef

STN18 segment 1: Not Reef

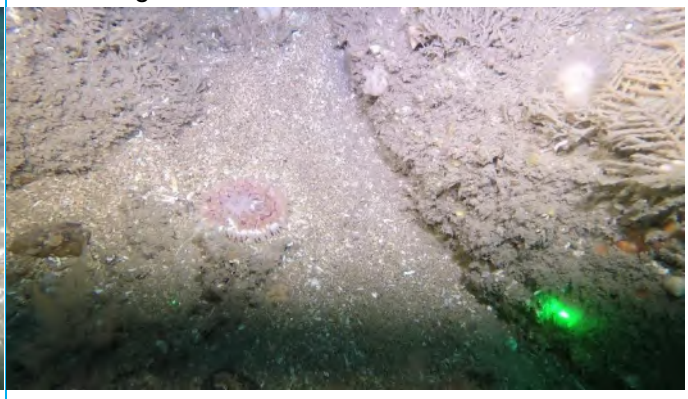


STN19 segment 1: Low Reef (Patchy)

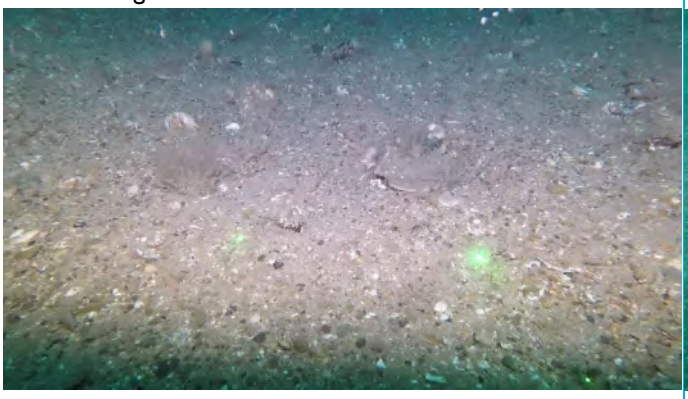


STN20 segment 1: Low Reef (Patchy)

STN20 segment 2: Low Reef



STN21 segment 1: Not Reef



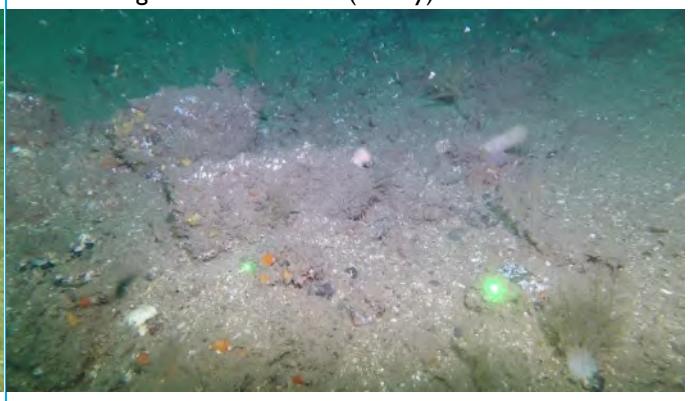
STN22 segment 1: Not Reef

STN22 segment 2: Low Reef (Patchy)

STN23 segment 1: Not Reef

STN24 segment 1: Not Reef

STN25 segment 1: Low Reef (Patchy)



STN26 segment 1: Not Reef

STN27 segment 1: Not Reef

STN28 segment 1: Not Reef

Table 7.
Video station information (Eastings and Northings provided in GCS OSGB 1936, Latitudes and Longitudes provided in WGS 1984).

STN	TAKE	SEG	LATITUDE START	LONGITUDE START	LATITUDE END	LONGITUDE END	DEPTH approx. (m)
01	07	1	52.1911490	-4.7708010	52.1914470	-4.7695580	40.0
02	08	1	52.1876640	-4.7652760	52.1879540	-4.7634880	37.0
03	09	1	52.1873000	-4.7764790	52.1885720	-4.7753140	37.0
04	10	1	52.1837830	-4.7700590	52.1849810	-4.7687590	40.0
05	01	1	52.2179850	-4.8233610	52.2187240	-4.8217080	44.0
06	06	1	52.2149520	-4.8166810	52.2155580	-4.8154410	43.0
07	04	1	52.2102630	-4.8242840	52.2104650	-4.8241290	44.0
07	04	2	52.2104650	-4.8241290	52.2109930	-4.8227830	44.0
08	03	1	52.2138270	-4.8300820	52.2146930	-4.8281750	45.0
09	02	1	52.2170830	-4.8265280	52.2175400	-4.8254370	46.0
09	02	2	52.2175400	-4.8254370	52.2177050	-4.8251290	46.0
09	02	3	52.2177050	-4.8251290	52.2179130	-4.8246800	46.0
10	05	1	52.2113600	-4.8200980	52.2120250	-4.8186450	44.0
11	26	1	52.1946500	-4.7710390	52.1957460	-4.7687270	40.0
12	11	1	52.1916170	-4.7640420	52.1930460	-4.7626040	38.0
13	12	1	52.1875750	-4.7586820	52.1879350	-4.7583620	40.0
13	12	2	52.1879350	-4.7583620	52.1883680	-4.7578090	40.0
13	12	3	52.1883680	-4.7578090	52.1887510	-4.7572500	40.0
14	13	1	52.1840110	-4.7639550	52.1852170	-4.7620130	38.0
15	14	1	52.1801240	-4.7699990	52.1810710	-4.7686140	43.0
16	15	1	52.1833700	-4.7760850	52.1844010	-4.7746080	39.3
17	24	1	52.1871140	-4.7817760	52.1882180	-4.7793950	40.0
18	25	1	52.1908970	-4.7763930	52.1919690	-4.7739840	40.0
19	22	1	52.2154660	-4.8103260	52.2161500	-4.8080450	43.0

STN	TAKE	SEG	LATITUDE START	LONGITUDE START	LATITUDE END	LONGITUDE END	DEPTH approx. (m)
20	16	1	52.2116830	-4.8141300	52.2121230	-4.8135870	44.0
20	16	2	52.2121230	-4.8135870	52.2125880	-4.8128640	44.0
21	17	1	52.2078930	-4.8199760	52.2087460	-4.8189260	44.0
22	18	1	52.2100620	-4.8303710	52.2105010	-4.8300150	45.0
22	18	2	52.2105010	-4.8300150	52.2109460	-4.8295040	45.0
23	23	1	52.2137710	-4.8368950	52.2147700	-4.8345870	46.0
24	19	1	52.2169080	-4.8325870	52.2179600	-4.8317960	45.0
25	20	1	52.2205640	-4.8271260	52.2213360	-4.8263450	46.0
26	21	1	52.2183670	-4.8164660	52.2190270	-4.8159760	43.0
27	27	1	52.2032540	-4.7839230	52.2040480	-4.7819540	41.0
28	28	1	52.2029110	-4.7750610	52.2039540	-4.7730460	40.0

Table 8.
Video station information, Folks classification, EUNIS classification, broadscale habitat, MNCR code and descriptor, Habitat FOCI and presence of Annex I habitats.

STN	TAKE	Seg	Depth approx. (m)	EUNIS Code	Primary Broadscale Habitat	MNCR / 2nd MNCR Biotope Code	MNCR Descriptor	Habitat FOCI	Annex I	Notes
01	07	1	40.0	A5.1	Subtidal Coarse Sediment	SS.SCS	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels		
02	08	1	37.0	A4.2	Moderate Energy Circalittoral Rock	CR.MCR	Moderate energy circalittoral rock		Reef	
03	09	1	37.0	A5.14	Subtidal Coarse Sediment	SS.SCS.CCS	Circalittoral coarse sediment	Subtidal Sands and Gravels		

04	10	1	40.0	A5.1	Subtidal Coarse Sediment	SS.SCS	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels		
05	01	1	44.0	A5.1 / A4.2	Subtidal Coarse Sediment	SS.SCS / CR.MCR	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels	Reef	
06	06	1	43.0	A5.14	Subtidal Coarse Sediment	SS.SCS.CCS	Circalittoral coarse sediment	Subtidal Sands and Gravels		
07	04	1	44.0	A5.14 / A4.2	Subtidal Coarse Sediment	SS.SCS.CCS / CR.MCR	Circalittoral coarse sediment	Subtidal Sands and Gravels	Reef	
07	04	2	44.0	A5.1	Subtidal Coarse Sediment	SS.SCS	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels		
08	03	1	45.0	A5.1	Subtidal Coarse Sediment	SS.SCS	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels		"Patch low cobbles/boulders @ 04:08 - 04:35 but small.
09	02	1	46.0	A5.1	Subtidal Coarse Sediment	SS.SCS	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels		Poor illumination"
09	02	2	46.0	A4.2	Moderate Energy Circalittoral Rock	CR.MCR	Moderate energy circalittoral rock		Reef	Patch of 'medium reef' at 05:25 - 06:15

09	02	3	46.0	A5.1 / A4.2	Subtidal Coarse Sediment	SS.SCS / CR.MCR	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels		Imagery quite high above substrate for parts
10	05	1	44.0	A5.1 / A4.2	Subtidal Coarse Sediment	SS.SCS / CR.MCR	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels	Reef	Imagery quite high above substrate for parts
11	26	1	40.0	A5.14	Subtidal Coarse Sediment	SS.SCS.CCS	Circalittoral coarse sediment	Subtidal Sands and Gravels		
12	11	1	38.0	A5.1 / A4.2	Subtidal Coarse Sediment	SS.SCS / CR.MCR	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels	Reef	
13	12	1	40.0	A5.1 / A4.2	Subtidal Coarse Sediment	SS.SCS / CR.MCR	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels	Reef	
13	12	2	40.0	A5.1	Subtidal Coarse Sediment	SS.SCS	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels		
13	12	3	40.0	A5.1 / A4.2	Subtidal Coarse Sediment	SS.SCS / CR.MCR	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels	Reef	
14	13	1	38.0	A5.1	Subtidal Coarse Sediment	SS.SCS	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels		

15	14	1	43.0	A5.1	Subtidal Coarse Sediment	SS.SCS	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels		
16	15	1	39.3	A5.14	Subtidal Coarse Sediment	SS.SCS.CCS	Circalittoral coarse sediment	Subtidal Sands and Gravels		
17	24	1	40.0	A5.14	Subtidal Coarse Sediment	SS.SCS.CCS	Circalittoral coarse sediment	Subtidal Sands and Gravels		
18	25	1	40.0	A5.1	Subtidal Coarse Sediment	SS.SCS	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels		
19	22	1	43.0	A5.1 / A4.2	Subtidal Coarse Sediment	SS.SCS / CR.MCR	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels	Reef	
20	16	1	44.0	A5.1 / A4.2	Subtidal Coarse Sediment	SS.SCS / CR.MCR	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels	Reef	
20	16	2	44.0	A4.2	Moderate Energy Circalittoral Rock	CR.MCR	Moderate energy circalittoral rock		Reef	
21	17	1	44.0	A5.1	Subtidal Coarse Sediment	SS.SCS	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels		
22	18	1	45.0	A5.14	Subtidal Coarse Sediment	SS.SCS.CCS	Circalittoral coarse sediment	Subtidal Sands and Gravels		

22	18	2	45.0	A5.1 / A4.2	Subtidal Coarse Sediment	SS.SCS / CR.MCR	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels	Reef	
23	23	1	46.0	A5.14	Subtidal Coarse Sediment	SS.SCS.CCS	Circalittoral coarse sediment	Subtidal Sands and Gravels		
24	19	1	45.0	A5.1	Subtidal Coarse Sediment	SS.SCS	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels		
25	20	1	46.0	A5.1 / A4.2	Subtidal Coarse Sediment	SS.SCS / CR.MCR	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels	Reef	
26	21	1	43.0	A5.1	Subtidal Coarse Sediment	SS.SCS	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels		
27	27	1	41.0	A5.1	Subtidal Coarse Sediment	SS.SCS	Sublittoral coarse sediment (unstable cobbles and pebbles, gravels and coarse sands)	Subtidal Sands and Gravels		
28	28	1	40.0	A5.144	Subtidal Coarse Sediment	SS.SCS.CCS.Nmix	*Neopentadactyla mixta* in circalittoral shell gravel or coarse sand	Subtidal Sands and Gravels		