Appendix 17.1: Marine Benthic Survey

Longue Hougue South Baseline Survey 2019

Technical report for marine ecological and environmental sampling undertaken at Longue Hougue South, Guernsey

Produced by Eco Marine Consultants Ltd for Royal HaskoningDHV

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Non-technical Summary

Eco Marine Consultants Limited (Eco Marine) was commissioned by Royal Haskoning DHV (RHDHV) on behalf of the States of Guernsey to conduct a benthic and epibenthic survey in support of an EIA for an inert waste facility development at Longue Hougue South (LHS), Guernsey. The data collected as part of this programme will be used to establish the benthic and epibenthic communities present as a baseline assessment.

The survey completed in May 2019 included benthic grab sampling using a mini Hamon grab as well as the deployment of a drop-down video (DDV) system to obtain seabed images of the benthic and epibenthic communities present at LHS. A full survey plan was prepared ahead of mobilisation, however the rocky and variable nature of the seabed, coupled with very strong tidal streams across the survey area, meant that several of the sites designated to be sampled in the field could not be accessed and new stations had to be placed on an *ad hoc* basis on site. Nonetheless, the rocky nature of the seabed prohibited the acquisition of several samples, even with relocated positions. DDV images were captured from 19 stations, macrofaunal samples from eight stations, sediment particle size analysis samples from seven stations and contaminant samples from six stations. Due to the very large tidal range at the study site, several stations were also sampled on foot at low water to provide ancillary habitat information.

The data collected has allowed identification of the existing habitats and features across the study area, which have been quantified and mapped where possible in line with the agreed methodology. The key findings of this report are as follows:

- Sediments at LHS were dominated by sand, though some stations contained variable fractions of mud and gravel. A total of seven Folk sediment categories were recorded: slightly gravelly Sand ((g)S), Sand (S), gravelly Sand (gS), sandy Gravel (sG), muddy sandy Gravel (msG), slightly gravelly muddy Sand ((g)mS) and gravelly Mud (gM).
- A total of 245 taxa and 3,653 individuals were identified in the eight grab samples collected during the 2019 characterisation survey of the Longue Hogue South area. The mean number of taxa recorded per sample was 52 and the mean number of organisms per sample was 457.
- Maerl beds were identified at numerous stations both during the DDV and grab surveys. Abundance and species diversity were high at stations where maerl was present which was in keeping with relevant literature.
- The three most abundant species recorded in the survey area were the Spionid polychaete *Spio symphyta,* the small amphipod *Leptocheirus tricristatus* and the dwarf brittle star *Amphipholis squamata*, which contributed approximately 28% of the total abundance. In total, the 10 most abundant taxa recorded within the samples made up 56.9% of the fauna.
- A total of six biotope complexes were recorded in the survey area. The biotope present at the largest amount of DDV stations was A5.51 'Maerl beds' closely followed by A3.1152 '*Laminaria hyperborea* park with dense foliose red seaweeds on exposed upper infralittoral rock' and A5.2 'Sublittoral sands and muddy sands'.
- The protected coralline algae known as maerl was identified at numerous locations across Longue Hougue South during the 2019 survey. Maerl is a species of great conservation importance and listed as protected under several designations.

Contents

1. Introduction

Eco Marine Consultants Limited (Eco Marine) was commissioned by Royal Haskoning DHV (RHDHV) on behalf of the States of Guernsey to conduct a benthic and epibenthic survey in support of an EIA for an inert waste facility development at Longue Hougue South (LHS), Guernsey.

As part of the development it is understood that there will be an element of land reclamation and subsequent habitat loss in the marine environment, in addition to secondary level or indirect impacts. As such the data collected as part of this programme will be used to establish the benthic and epibenthic communities present as a baseline assessment.

1.1. Project Aim and Objectives

The main aim of the LHS subtidal survey programme is to survey and acquire high quality biological data of suitable resolution from the LHS area of interest and to examine the present condition of the seabed.

The principal objectives of the survey programme are as follows:

- To collect information on and describe the benthic and epibenthic biological communities that occur within the survey area, along with the characterising taxa for each community type in order to provide a robust basis for subsequent impact assessments;
- To describe the distribution of sediment types within the survey area and their relation to biological community composition;
- To collect information on any contaminants in the sediments within the survey area; and
- To identify and document the occurrence of any species or communities of conservation importance.

In order to fulfil the aims and objectives for this project, a subtidal (and intertidal) survey was completed across the LHS study area using DDV techniques and a mini Hamon grab as well as limited data collected on foot across exposed intertidal areas at low water. This report outlines the findings and implications of these survey elements.

2. Project Design & Methodology

All subtidal sampling was conducted aboard the *'Aquadynamic'*, a 12m shallow-draft and custom-built survey vessel between the 10th and 12th May 2019. The vessel is able to travel at high speeds between stations and is equipped with a grab recovery system for ease of sampling. Additionally, the *Aquadynamic* is equipped with a DGPS Simrad MX512 system in the survey cabin that gives a navigational accuracy of approximately +/- 1m. The GPS system is routinely inspected and calibrated to ensure navigational accuracy.

A full survey plan was prepared by Eco Marine prior to mobilisation (Eco Marine, 2018). All methods for the work were agreed between RHDHV and Eco Marine in May 2019. Due to the rocky nature of the seabed, the complexity of bathymetry in the study area (some drying heights recorded at over 8m) and the presence of strong tidal currents, some adaption of the survey plan was required in the field; this was communicated to the RHDHV project team as fieldwork progressed.

2.1. DDV, Benthic Survey & Environmental Monitoring

The locations for each of the LHS grab, DDV and environmental data collection stations are shown in Figure 1 and full coordinates can be found in Appendix 1. A breakdown of the number of stations sampled and the type of sample recovered is shown in Table 1.

2.1.1. Drop Down Video Sampling

Prior to the collection of sediment samples, seabed (epibenthic) photographs and video footage were collected from across the survey area. A total of 33 DDV stations were initially proposed to be sampled in the survey plan for the works. However, upon arrival at the site and upon inspection of the numerous rock and tidal hazards present across the survey area it was determined that safe navigation to a large number of the target sites would prove difficult. As a result, only stations that could safely be accessed were surveyed; as many stations as possible that could not be safely reached were repositioned in the field to give as good coverage as possible across the survey area. A total of 19 stations were therefore sampled using DDV techniques as part of the LHS survey (Figure 1).

Images from the DDV were initially reviewed on board in real-time to enable surveyors to collect data while broadly determining the nature of the seafloor and any epibenthic communities present prior to collecting sediment for faunal and particle size analysis. At a large number of stations, it was determined that the seabed substrate comprised predominantly bedrock or large cobbles, which would be unsuitable for subsequent grab sampling.

A hydrostatic HD freshwater lens camera system (Weasel II) was deployed from *Aquadynamic* to the seabed at each station (Plate 1). To ensure suitable image quality, the underwater camera was high resolution (53 million pixels per m^2) with a multi-element lighting capability and an internal processor to enable the user to collect high quality images in low-light conditions. The camera was built on a robust sled structure which allowed a stable landing, even in strong tidal conditions (such as those often present in the Channel Islands). The video was activated once the vessel was held on station and the camera was lowered to a suitable depth. Upon reaching the seabed the position was fixed and a minimum of three photographs were taken along with continuous video where it was safe to do so. Due to strong currents at some statins, only two stills could be collected. Detailed field notes were made by survey staff which included details of any species or habitats of conservation importance. As a minimum, field notes included the station co-ordinates, time of sampling (in UTC), depth of water, quality of image, sediment type, weather conditions and any notes on the fauna present within the video stream and images.

A total of 53 images were collected during the DDV element of the LHS survey. Upon return to the Eco Marine lab, data from the video drops have been analysed to determine habitat types present at each station and notes have been made of any obvious macrobenthic and epifaunal species present. Where appropriate (and where image quality has allowed) biotopes have been assigned in accordance with the EUNIS classification scheme, taking faunal data from sediment samples into careful consideration.

Table 1. Summary of the samples collected using different techniques during the May 2019 LHS baseline survey. Note that multiple samples were acquired from the same station location in some cases. Differing numbers of benthic samples were recovered due to the nature of the seabed yielding only small grab samples in some cases, or else where dense maerl beds prohibited certain sample types from being acquired.

Sample Collection Zone	Data Collection Format	Number Obtained
Epibenthic	DDV stations	19
	DDV images	53
Benthic	Grab stations	9
	Faunal samples	8
	PSA samples	7
	Contaminants samples	6
Intertidal	Intertidal stations	7

2.1.2. Grab Sampling

Following initial review of the epibenthic DDV data, it was determined that a total of nine benthic stations could be safely accessed in locations likely to be characterised by sandy substrates rather than bedrock and boulders. These stations were subsequently sampled using a 0.1m^2 Hamon grab deployed from the *Aquadynamic* (Plate 1). Attempts were made to obtain samples at additional stations where rocky substrate with a thin covering of sediment was present, however this resulted in damage to the sampling equipment and no sample was returned.

Where sediment allowed, samples were obtained as close as possible to the grab target station co-ordinates, typically within 5m though new stations were sampled on a relatively *ad hoc* basis. Three attempts were made at each station to retrieve a sample of at least 5L in volume. When small samples of less than 5L in volume were recovered during the attempts, they were kept to one side and the largest of the small samples was processed if a 5L sample could not be obtained. If the sample was less than approximately 4L, the sample was kept for sediment particle size analysis (PSA)/contaminants purposes only.

Though the mini-Hamon grab used for the purposes of the survey was designed for targeting coarse and mixed sediments, faunal samples could not be obtained at a number of stations. This was due to a lack of sediment overlying bedrock at certain stations. A breakdown of sample type collected at each station is given in Table 2 below and illustrated in Figure 2. Note that PSA and contaminants sub-samples were not collected at Stations 1 and 2 because of the maerl contained in the samples. Though maerl was also recovered at other stations, fractions of sediment were also returned which was not the case at Stations 1 and 2.

Table 2. Breakdown of the sample types collected at each station during the benthic survey of Longue Hogue South, Guernsey in 2019.

Station No.	Sample Type
1	Fauna only
2	Fauna only
3	Fauna & PSA
4	Fauna, PSA & contaminants
5	Fauna, PSA & contaminants
6	Fauna, PSA & contaminants
7	Fauna, PSA & contaminants
8	Fauna, PSA & contaminants
9	PSA & Contaminants

At each station, detailed field notes were taken including (as a minimum) the grab co-ordinates, time of sampling (in UTC), depth of water, sample volume, sediment type, weather conditions and any notes on the fauna present within the grab. Subsamples of approximately 0.5L were taken for PSA and for contaminants analysis from each sample (apart from where sample type did not allow this, see below). Each sediment PSA subsample was placed in sealed tough polythene bags with appropriate internal and external labels. Contaminants samples were placed into amber-glass containers supplied by the analysing laboratory and subsequently labelled and frozen.

The remainder of the sample was then placed on a 1mm mesh net supported on a 4mm mesh stainless steel sieve (Plate 1) and gently washed with seawater to remove excess fine sediments. The residual sample was then transferred into a labelled plastic bucket, preserved and sealed with a tight-fitting lid. The sample was retained for subsequent analysis of the benthic infauna in the laboratory.

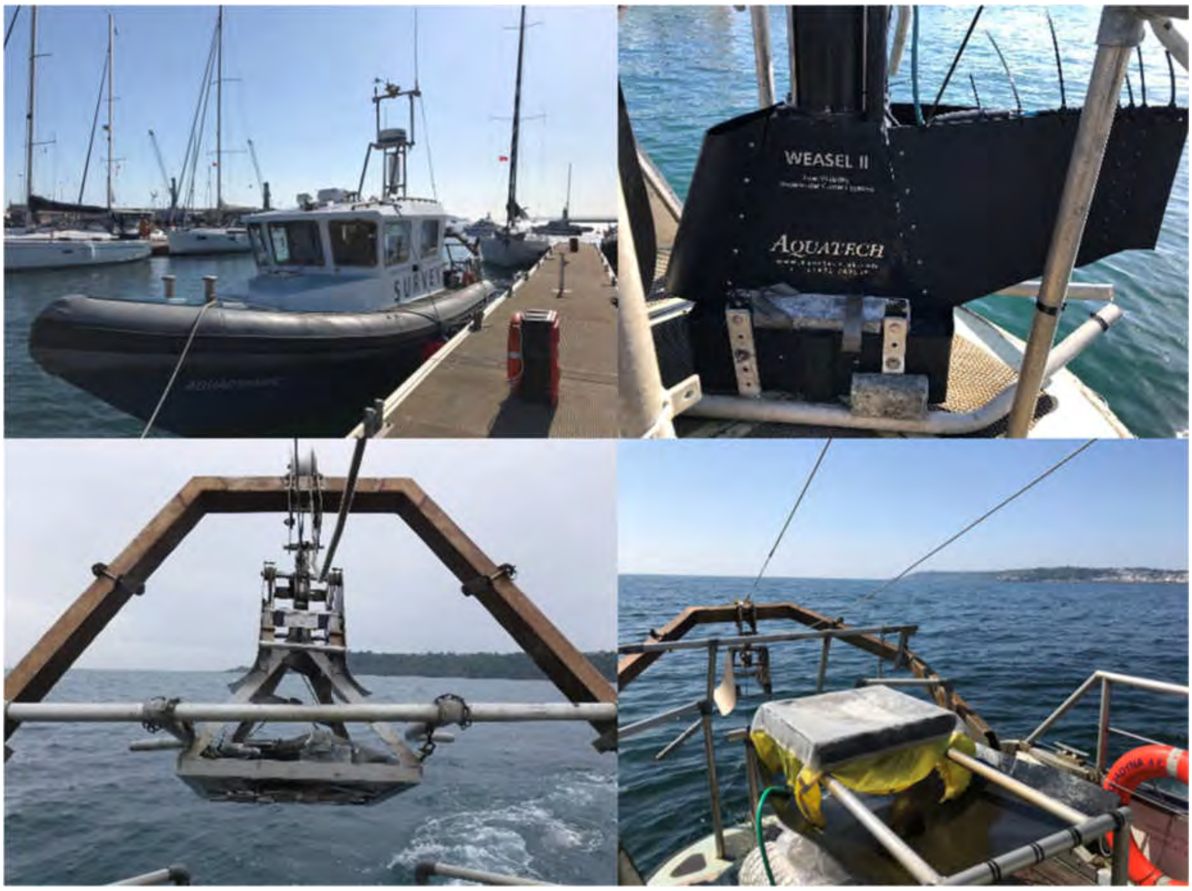

Plate 1. (from top to bottom, left to right): Aquadynamic in St Peter Port; 'Weasel II' DDV camera system; mini-Hamon grab used for collecting sediment samples; and sample processing set-up on *Aquadynamic* deck.

2.1.3. Intertidal Survey

Due to difficulties accessing some of the originally proposed stations because of exposed rock at high tide, a small intertidal survey was undertaken on foot. This allowed an assessment of the intertidal zone along the upper shore area which could not be accessed by boat but would be likely to be affected by the proposed development at LHS. The intertidal stations locations are shown in Figure 1.

A total of seven stations located along the LHS foreshore were accessed on-foot during low-tide periods over two days. Parts of the site remained submerged at all times and could not be accessed either on foot or by boat and as such, the positioning of the stations were chosen on a relativly *ad hoc* basis to represent the range of habitats in the safely accessible intertidal region. Biotopes were assigned during the intertidal survey using the EUNIS classification system to the highest possible level (minimum level 3). At each intertidal station, a series of photos were taken alongside a 'survey ruler', a fix was taken using a Garmin handheld GPS device (accurate to 10m), and a complement of field notes were taken. Typically, these included:

- Sample code, date & time
- Latitude & longitude
- Texture and presence of surface features (accretions, algae, fauna)
- Digital image of sediment in sediment surface (image ID code = transect point code and date), include 'survey ruler' in image.

Please note that following the completion of the LHS survey, station numbers were reassigned for all survey elements to ensure a continuous labelling system given the number of stations which could not be accessed as well as the number of new stations that were logistically placed during the field work operations. The updated numbering system (opposed to that given in the original Survey Plan) is used for the duration of this report and in the charts below.

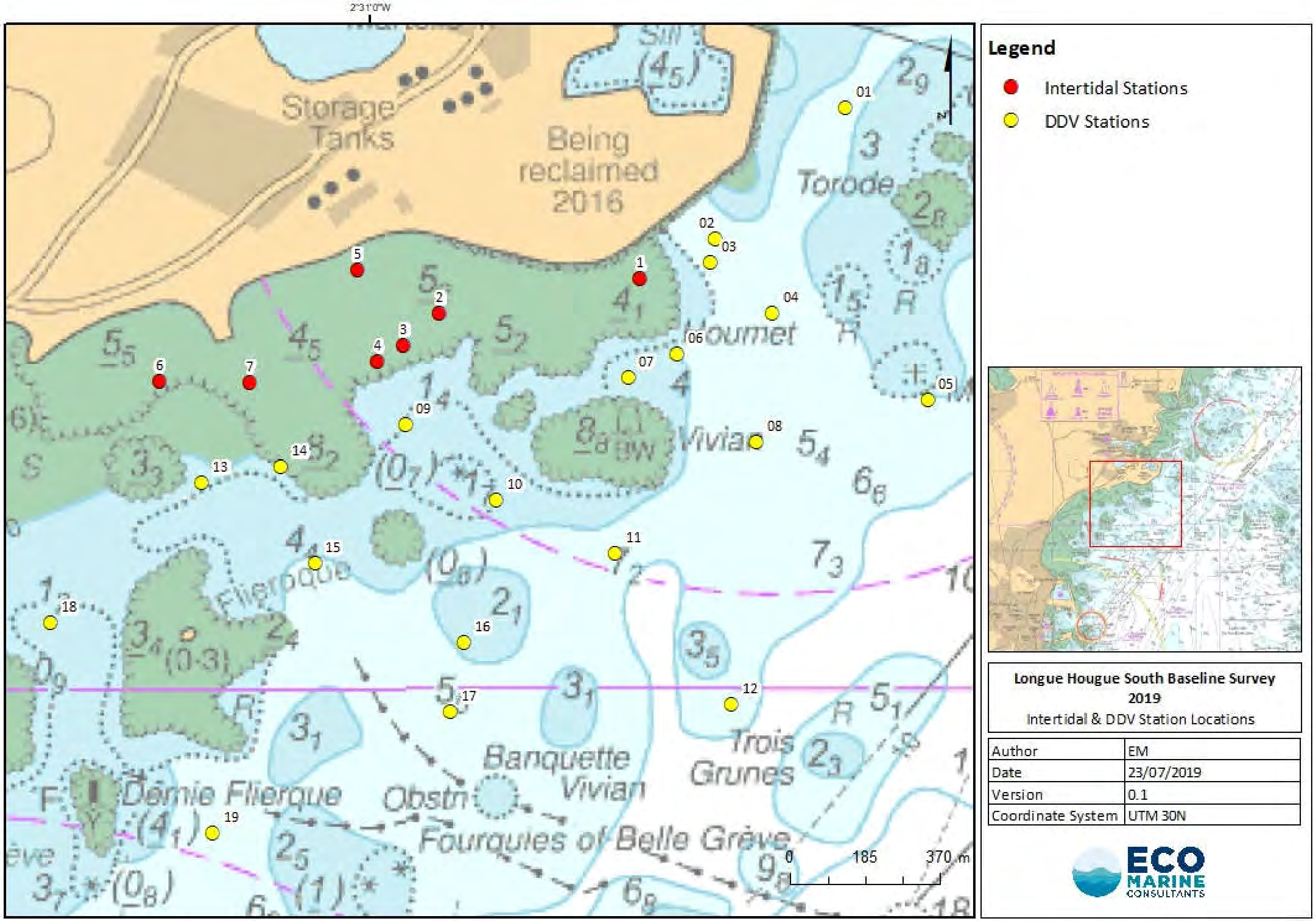

Figure 1. Location of the 19 DDV stations and seven intertidal stations sampled in the LHS study area in Guernsey, 2019.

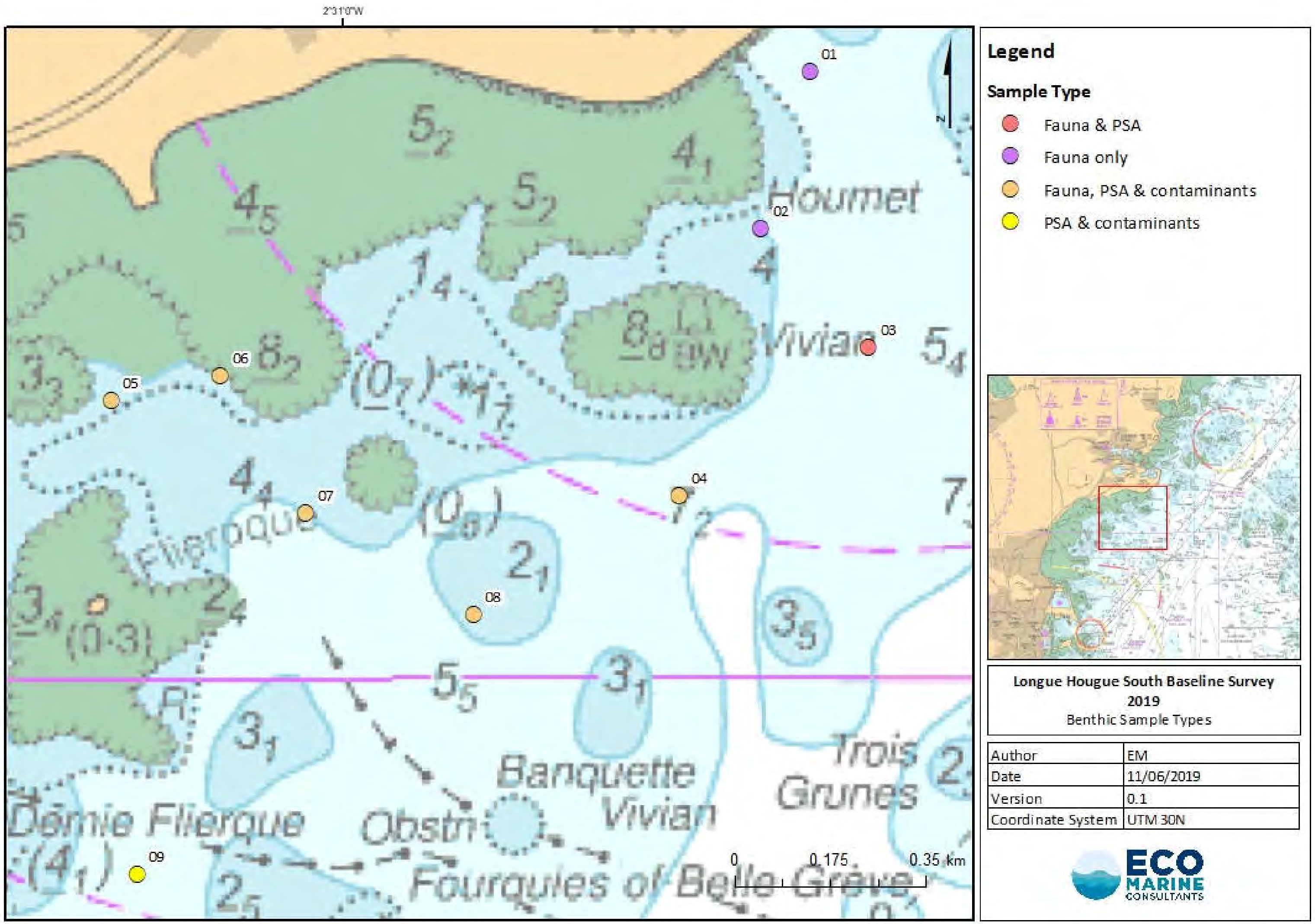

Figure 2. Location of the nine grab stations sampled in the LHS study area in Guernsey, 2019. Stations where PSA and physiochemical contaminant samples were collected are marked separately on the chart.

2.2. Sample & Data Processing

2.2.1. Infaunal Sample Analysis

On arrival at the Eco Marine analytical laboratory the samples were checked against the field notes in accordance with standard operating procedures and signed against the list of samples collected. The excess formalin was poured through a 1mm mesh sieve and collected for licensed disposal. Each sample was then gently eluted with tap water through a 1mm mesh sieve to extract the low-density components (Crustacea and Polychaeta) and combined with the floating material initially separated from the formalin in the sample. The larger macrofauna were removed from the eluted material and preserved for analysis. This stage in the initial sorting process was carried out in the open air to reduce the effects of residual formalin used to fix the sample in the field.

The sediments were next sorted under a stereomicroscope with the aim of extracting the remaining fauna. The entire sample of separated fauna was then preserved in industrial methylated spirit (IMS) for subsequent analysis. Each of the extracted samples was sorted into major faunal groups before being analysed to species level, where practicable, by experienced taxonomists who sign a log sheet on completion of the analysis of each individual sample. Species identification was recorded in a standard format using species codes from Howson & Picton (1997). Taxonomic identification was checked throughout the process by senior NMBAQC certified analysts.

2.2.2. Biomass Determination

The blotted wet weight of major groups recorded from the faunal samples was measured. These data were then used to estimate total biomass as Ash-Free Dry Weight (AFDW) in grams using conventional conversion factors for each of the faunal groups. The wet weight conversion factors are as follows in accordance with Eleftheriou & Basford (1989):

- Annelida = x 0.155
- Crustacea = x 0.225
- Mollusca = x 0.085
- Echinodermata = x 0.08
- Miscellaneous groups including the major groups shown below = x 0.155
    - Turbellaria
    - Nemertea
    - Nematoda

In terms of species diversity, miscellaneous groups were largely accounted for by Bryozoa. Please note that biomass was not measured for encrusting fauna found on substrate as separating encrusting and colonial specimens from their anchor point or substrate is highly damaging to the specimen and makes identification difficult. Additionally, many bryozoan forms are encrusting and as such, cannot be weighed accurately or with ease.

2.2.3. Particle Size Analysis

The sediment samples were subjected to PSA carried out by Kenneth Pye Associates Limited. PSA samples were obtained from seven sample stations; details of the results are presented in Appendices 2 and 3 along with supplementary information obtained during the survey.

The sediments were sieved at ½ phi[1] intervals over a particle size range of 64mm-0.063mm on the Wentworth Scale. The PSA values are summarised in Appendix 3 into higher groupings of % silt (<0.063mm), % sand (0.063-2mm) and % gravel (>2mm), for ease of broad-scale substrate assessment. These data were used for the description and classification of sediments.

2.2.4. Contaminants Analysis

Samples were collected for chemical contaminant analysis from all benthic stations where sufficient sediment could be collected using the Hamon grab. Analysis was undertaken by SOCOTEC analytical laboratory on behalf of Eco Marine. Contaminant samples were obtained from six sample stations; full details of the results are presented in Appendix 4.

The sediment samples were subject to MMO specification analyses (lower limits of detection and a wide spectrum of contaminant testing e.g. DBT/TBT and additional PAHs). This ensured that analyses of the sediments collected at LHS covered a broad range of contaminants to fully determine the environmental status of the surface sediments at the site. A breakdown of determinands tested within each sediment sample is outlined below in Table 3.

Table 3. Chemical contaminants and test methods for the sediment samples collected at LHS, Guernsey in 2019.

Determinand	Limits of Detection	Method	Quality Management System
Metals suite (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn)	0.015 - 2mg/kg	Aqua-regia extraction & ICP-MS	UKAS 17025 & MMO
Organotins (DBT, TBT)	0.001 mg/kg	Acid digest and solvent extraction GC-MS	MMO
PAHs (DTI 2-6 ring aromatics + EPA 16)	1µg/kg	Solvent extraction & GC-MS	UKAS 17025 & MMO
Total hydrocarbon content	1mg/kg	UV fluorescence spectroscopy	MMO

[1] Phi = $-\log_2 D/D_0$ (D is the diameter of the particle, D_0 is a reference diameter, equal to 1mm).

2.3. Seabed Imagery Analysis

All image analysis has been undertaken in-line with JNCC guidance given in the Marine Monitoring Handbook (JNCC, 2001) and the JNCC guidance on assigning benthic biotopes (Parry, 2015). Biotopes have been assigned to each DDV station sampled in the LHS study area by an experienced ecologist using a standardised recording format. This enables the identification of biotopes through record of substrate type, habitats and species present as well as the identification of energy regimes locally (through video footage and field notes).

The data resulting from faunal analysis has been used to ground truth the image data at a higher resolution. EUNIS categories for each of the assigned biotopes have been checked against descriptions and the JNCC hierarchy and confirmed by a second ecologist in every case.

3. Results

3.1. Composition of the Longue Hogue South Sediments

The pie diagrams of Figure 3 illustrate that the sediment composition across the site was dominated by sand (<2mm), although a number of stations also contained fractions of gravel (>2mm) and mud. It should be noted that grab samples could not be collected from numerous stations due to a lack of overlying sediment above the exposed seabed. Therefore, any assumptions regarding the sediment types across the LHS site should be made with caution as much of the site was composed of bedrock and boulders which are not represented within the PSA results.

In order to further describe the substrate types recorded across the study area, sediment samples have been classified according to the Folk classification system (Folk, 1954). These classifications are shown in Figure 3. Each station sampled at LHS was classified as a different Folk category, these were: slightly gravelly Sand ((g)S), gravelly muddy Sand ((g)mS), Sand (S), gravelly Mud (gM), gravelly Sand (gS), muddy sandy Gravel (msG) and sandy Gravel (sG). The variation in categories between stations demonstrates the variability of the characteristics of the seafloor in the channels running between the rocky outcrops. The red coralline algae maerl was observed at several of the stations where sediment was returned and this is likely to have further led to variation within the PSA samples. Maerl was particularly dominant at Stations 3 and 4 where higher proportions of gravel were recorded than in other locations – most probably as a result of the calcified algae nodules present within the sediment samples rather than being fully comprised of just gravel. The survey area is subject to very high tidal flow, which is exacerbated in some places by complex channel systems while in other areas pockets of calmer waters may be found. This has resulted in the aggregation of varying proportions of fine and coarse sediments across LHS with the sandiest sediments present closest to shore.

The average percentage gravel, sand and mud content of the site as a whole gave values of 17.2%, 68.9% and 13.9% respectively. These average values placed the site as a whole as gravelly muddy Sand (gmS) within the Folk classification system, highlighting the mixed nature of the sediment fractions across the site.

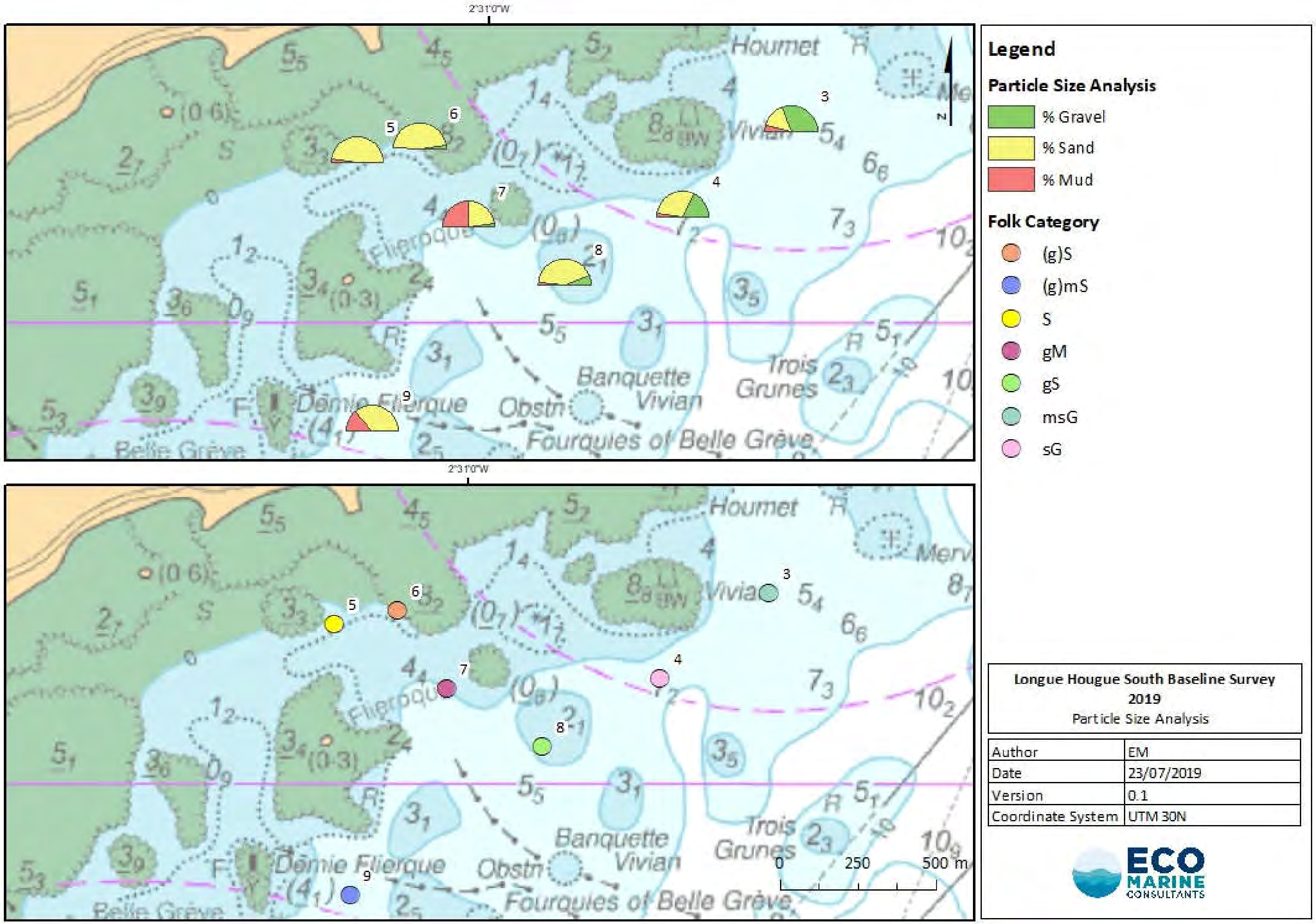

Figure 3. Top: The relative proportions of gravel, sand and mud as a percentage contribution to sediment in PSA samples collected at Longue Hougue South. Bottom: Sediment samples classified using the Folk classification system. It should be noted that pie diagrams represent approximate locations of sampling stations only.

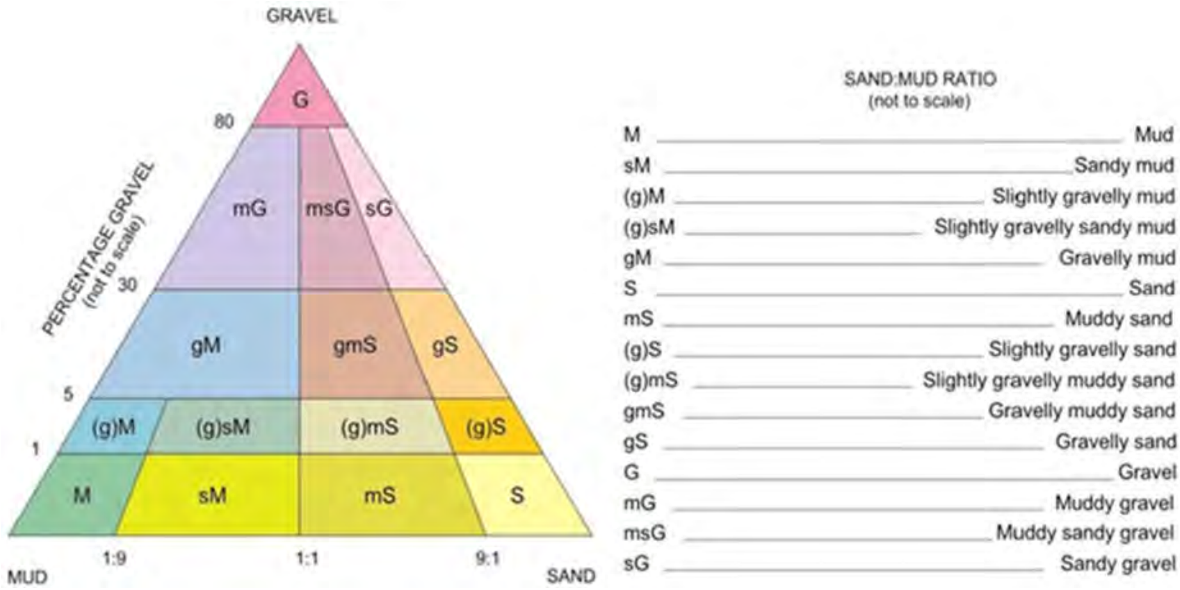

Figure 4. Folk triangle used to classify sediments collected at Longue Hougue South, Guernsey in 2019.

3.2. Sediment Contaminants

The concentrations of contaminants in the sediments collected at Longue House South are presented below. A full record of contaminants results is given in Appendix 4.

Table 4 shows the concentration of heavy metals and organotins recorded at the six stations where contaminants samples could be acquired. Also presented are Cefas Action Levels (MMO, 2018) for heavy metal concentrations. For the sake of comparison, Cefas Action Levels are used to determine the degree of contaminant loading of marine sediments in the UK and are typically taken into account when assessing marine licence applications. Crucially, none of the contaminants tested exceeded either Action Level with the exception of Chromium at Station 5, although the concentration recorded at Station 1 was also close to this limit. No values exceeded Action Level 2. With regards to seabed development and marine licensing, it is understood that contaminant levels in seabed sediments below Action Level 1 are of no concern and are unlikely to influence any marine licensing decision. However, seabed material with contaminant levels between Action Levels 1 and 2 may require further consideration and testing before a licensing decision can be made. Seabed sediments with contaminant levels above Action Level 2 are generally hazardous and disturbance may be restricted (PLA, 2018).

Table 4. The results of the heavy metal and organotin analysis from sediment samples obtained from the six sampling stations at LHS in 2019. Contaminants have been assessed against Cefas Action Levels 1 and 2. Figures shown as 'less than' represent values below the limits of detection. Values shown in red exceed Cefas Action Level 1.

Contaminant	Station						Cefas Action Level 1	Cefas Action Level 2
	4	5	6	7	8	9		
Arsenic (mg/Kg)	5.5	3.7	4.1	2.5	2.7	2.1	20	100
Cadmium (mg/Kg)	0.08	0.09	0.1	0.08	0.08	0.08	0.4	5
Chromium (mg/Kg)	33.7	43.5	39	24.1	13.1	9.8	40	400

Contaminant	Station						Cefas Action Level 1	Cefas Action Level 2
	4	5	6	7	8	9		
Copper (mg/Kg)	6.5	7.8	9.8	5.9	5.6	4.6	40	400
Lead (mg/Kg)	8.5	8.8	8.1	3.8	6.3	6.3	50	500
Mercury (mg/Kg)	<0.015	0.04	<0.015	<0.015	0.03	<0.015	0.3	3
Nickel (mg/Kg)	11	10.9	10.7	8.3	6.3	4.7	20	200
Zinc (mg/Kg)	27.6	27.5	29.8	14.6	18.9	17.2	130	800
Dibutyltin (mg/Kg)	<0.001	0.0015	<0.001	<0.001	<0.001	<0.001	0.1	1
Tributyltin (mg/Kg)	<0.001	0.0163	<0.001	<0.001	<0.001	<0.001	0.1	1

The concentration of polycyclic aromatic hydrocarbons (PAHs) recorded at LHS is shown in Table 5. Cefas Action Levels are not available for PAHs, however it is common practice in the UK to use alternative environmental quality standards. In particular, the Canadian Sediment Quality Guidelines (CSQG) for the Protection of Aquatic Life have been developed as guidelines to identify potentially hazardous levels of contaminants in marine sediments that may pose an impact to ecology (CCME, 2001; PLA, 2018). The guidelines identify threshold effect levels (TELs) and probable effect levels (PELs); concentrations below the TEL are unlikely to cause any adverse effects on ecology, concentrations between the TEL and the PEL may cause effects on ecology and concentrations above the PEL frequently cause adverse effects on ecology.

Additionally, the European Commission lists contaminants which are priority substances against which environmental quality should be measured as part of the Water Framework Directive (EC, 2008). These contaminants identified as priority hazardous substances are also indicated in Table 5.

Table 5. The results of the polycyclic aromatic hydrocarbon (PAH) and total hydrocarbon content analysis from sediment samples obtained from the six sampling stations at LHS in 2019. Figures shown as 'less than' represent values below the limits of detection.

Contaminant	Station						EC Commission Priority Hazardous Substance	CSQG Threshold Effect Level (TEL)	CSQG Probable Effect Level (TEL)
	4	5	6	7	8	9			
Naphthalene (µg/Kg)	<1	4.35	1.02	<1	1.69	7.36		34.6	391
Acenaphthylene (µg/Kg)	<1	3.93	<1	<1	<1	2.89		5.87	128
Acenaphthene (µg/Kg)	<1	1.74	<1	<1	<1	2.05		6.71	88.9
Fluorene (µg/Kg)	<1	3.41	<1	<1	<1	3.96		21.2	144
Phenanthrene (µg/Kg)	1.44	24.7	2.47	2.08	3.41	31.7		86.7	544
Anthracene (µg/Kg)	<1	16.9	<1	1.35	1.17	18.4	X	46.9	245
Fluoranthene (µg/Kg)	3.32	111	9.42	9.7	9.79	85.1		113	1494
Pyrene (µg/Kg)	2.94	94.3	8.2	8.71	8.08	70.2		153	1398
Benzo[a]anthracene (µg/Kg)	1.96	53.7	4.24	4.47	5.99	31.6		31.7	385
Chrysene (µg/Kg)	1.9	45.7	4.42	4.51	4.42	27.4		108	846
Benzo[b]fluoranthene (µg/Kg)	2.23	34.9	4.1	4.52	5.19	24.2	X	-	-
Benzo[k]fluoranthene (µg/Kg)	1.38	22.2	2.61	2.21	2.26	13.9	X	-	-

Contaminant	Station						EC Commission Priority Hazardous Substance	CSQG Threshold Effect Level (TEL)	CSQG Probable Effect Level (TEL)
	4	5	6	7	8	9			
Benzo[a]pyrene (µg/Kg)	2.45	43.8	4.53	5.26	4.59	33.5	X	88.8	763
Indeno[1,2,3-cd]pyrene (µg/Kg)	2.13	26.2	2.99	3.67	3.36	20.4	X	-	-
Diben[ah]anthracene (µg/Kg)	<1	4.75	<1	<1	<1	4.5		6.22	135
Benzo[ghi]perylene (µg/Kg)	2.13	23.4	3.44	3.4	3.16	19.8	X	-	-
Benzo[e]pyrene (µg/Kg)	1.65	25.3	3.24	3.24	3.69	19.7		-	-
C1-naphthalenes (µg/Kg)	1.25	9.13	3.12	<1	5.41	11.4		-	-
C1-phenanthrene (µg/Kg)	1.42	28.5	2.84	2.34	3.43	23.8		-	-
C2-naphthalenes (µg/Kg)	1.21	9.77	3.4	1.56	5.46	11.1		-	-
C3-naphthalenes (µg/Kg)	<1	10.4	2.32	<1	3.64	10.4		-	-
Perylene (µg/Kg)	<1	11.6	1.05	1.43	1.23	8.75		-	-
Total Hydrocarbon Content (mg/Kg)	<1	17.6	23.7	<1	69.3	15		-	-

All of the PAH contaminants tested in the vicinity of LHS were below the CSQG effect levels and as such the concentrations of contaminants present are unlikely to have any impact on ecology in the vicinity. The concentration of Fluoranthene at Station 5 was however noted to be near the limit TEL limit (value observed = 111 µg/kg; TEL threshold = 113 µg/kg).

A comparison of the total concentration of heavy metals and PAHs by station is shown in Figure 5.

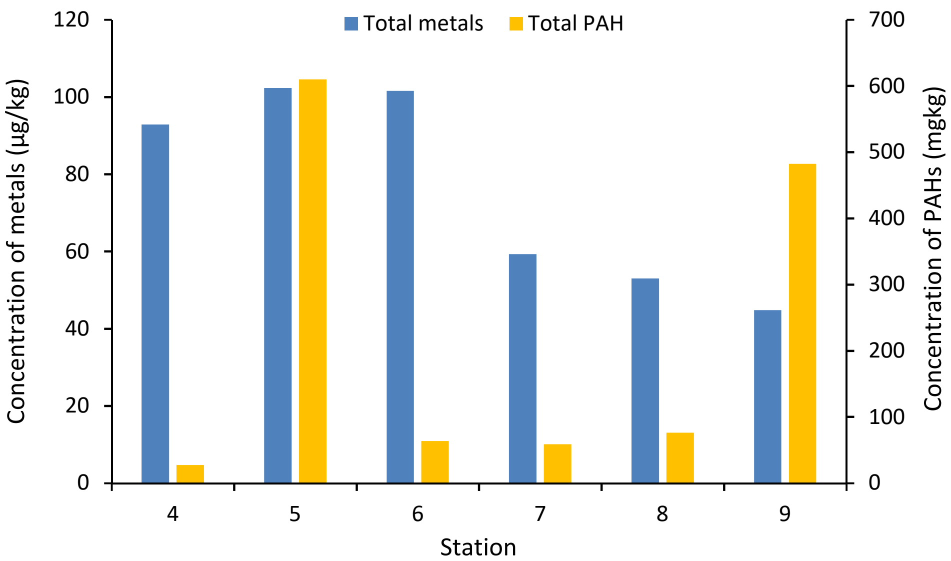

Figure 5. Concentration of contaminants recorded in sediments in the LHS survey area in May 2019. Note that this figure excludes organotins and 'total hydrocarbon content'.

Heavy metal concentrations showed some variability between stations, with those stations showing greatest values recording over double the lowest (Figure 5). Station 9 recorded the lowest concentration of total metals and Station 5 the greatest.

PAH concentration indicated higher spatial variability with Stations 5 and 9 recording considerable elevated levels of hydrocarbons compared to the remainder. This may be a factor of sediment type at these locations, as sandy/muddy sediments were observed at both stations in contrast to the other locations (see Section 3.1). Total PAH was greatest at Station 5, similar to total metals, and least at Station 4 (Figure 6).

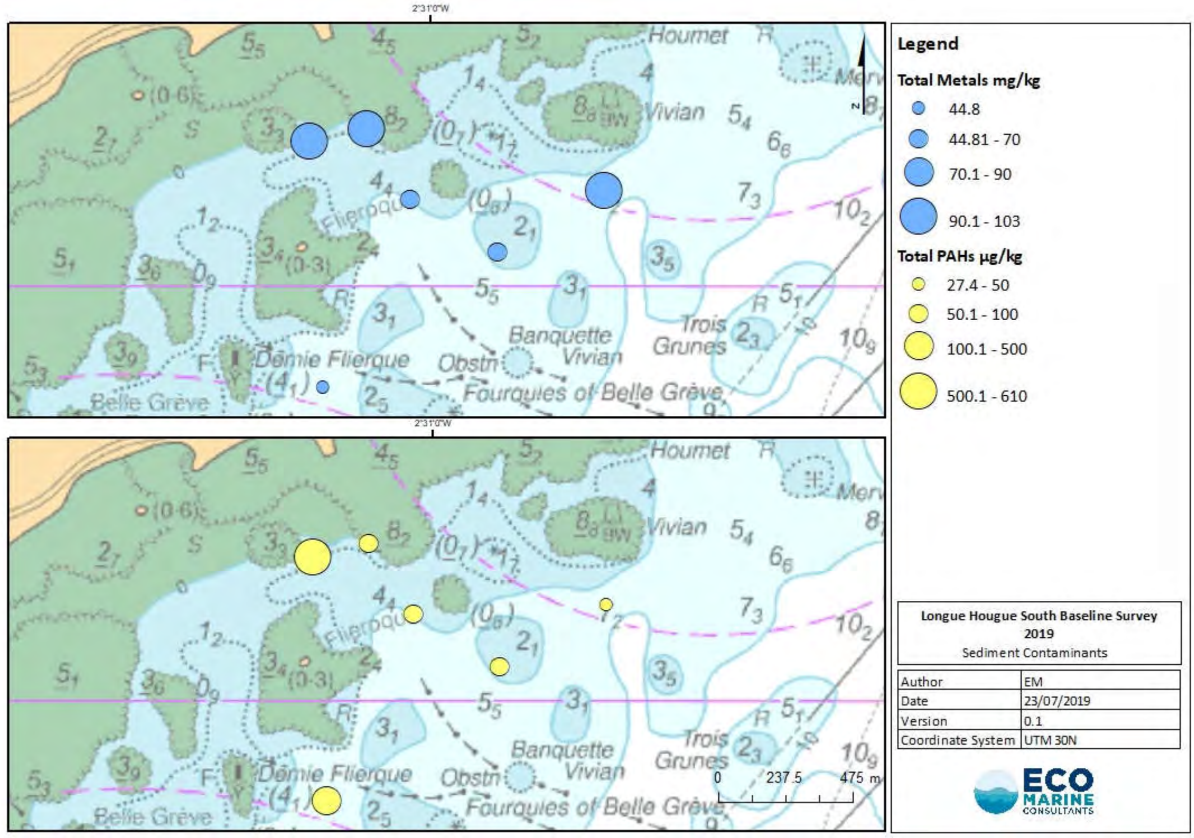

Figure 6. Total metal and total PAH contaminant levels identified in sediment samples collected at Longue Hougue South in 2019.

3.3. The Nature of Infauna at Longue Hougue South

A total of 245 taxa and 3,653 individuals were identified in the eight grab samples collected during the Longue Hougue South survey. The full taxonomic list, including the numerical abundance of each taxon by station, is provided in Appendix 5 and a contact sheet showing each sample collected is presented in Appendix Plate 1.

The mean number of taxa (± standard deviation) recorded per sample was 52 (± 41) while the mean number of organisms per sample was 457 (±590). Variation in faunal communities between samples collected from across the site was apparent, with the abundance ranging between 141 and 1,885 individuals per sample. Both the faunal abundance and biomass at LHS are considered to be elevated for the habitat conditions at the site which can often result in scoured conditions. Elevated numbers of benthic fauna were especially notable at the stations where maerl was present.

The total biomass recorded was 4.75 grams ash free dry weight (g AFDW) (44.89g wet weight) with values ranging from 0.12 to 2.19 gAFDW per sample. A summary of biomass by major group per station is given in Appendix 6. Please note that colonial taxa including Bryozoa, Hydrozoa and Porifera were not subject to biomass. The relative contributions made to the macrofaunal assemblages by the major groups Annelida, Crustacea, Mollusca, Echinodermata and miscellaneous phyla are shown below in Figure 7.

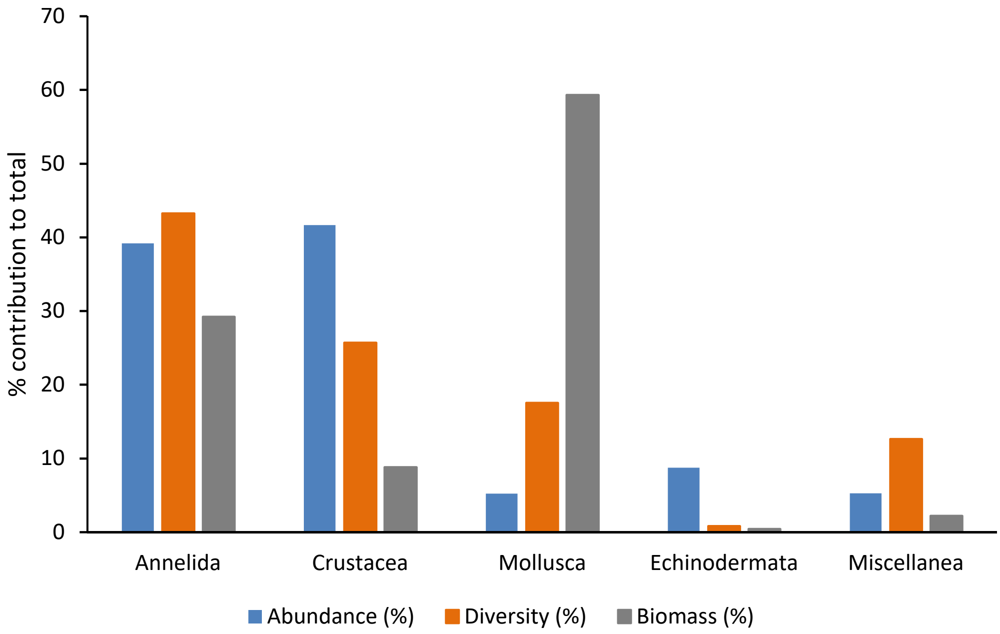

Figure 7. Percentage contribution of the major faunal groups to total abundance, species diversity and biomass at LHS in 2019.

Taxa belonging to Crustacea marginally dominated the abundance of the benthic faunal communities at LHS, contributing 42% to the total abundance. This can be ascribed to the high proportion of amphipods including *Leptocheirus tricristatus*, *Leptocheirus pectinatus*, *Animoceradocus semiserratus* and *Socarnes erythrophthalmus* at Stations 1, 2 and 3 as well as the presence of the tanaid *Apseudopsis latreillii* at Stations 7 and 8. Taxa belonging to the group Annelida were the second most abundant faunal group (comprising 39% of the total abundance recorded) which was largely attributable to the presence of the Spionid worm *Spio symphyta* which was highly abundant at Stations 5, 6 and 7. Following Crustacea and Annelida, abundance was accounted for by Echinodermata (9%), miscellaneous fauna (5%) and Mollusca (5%).

The faunal communities present within the eight samples collected for analysis were highly diverse and variable over a small survey area. Annelida was the most diverse faunal group with a wide range of families & genera present (comprising 43% of the total diversity) followed by Crustacea (26%), Mollusca (18%), miscellaneous fauna (13%) and finally Echinodermata (1%). Faunal communities at Stations 1, 2 and 3 where maerl was present were especially diverse with 139 taxa alone identified at Station 3.

Though not the most abundant group, Mollusca contributed the most to total biomass recorded across all faunal groups (59.3%) followed by Annelida which also made large contributions (29.2%). Molluscs are comparatively heavier than other phyla because of their weighty exterior shells as well as their characteristically larger size; they therefore typically represent a considerable proportion of biomass for the site. The relatively high biomass contributions by Annelida are a result of the presence of several large-bodied worms such as *Lumbrineris cingulata* and *Sphaerodorum gracilis* as well as abundant smaller bodied species. After Mollusca and Annelida, Crustacea represented the third highest contribution to biomass (8.8%) followed by miscellaneous taxa (2.2%) and Echinodermata (0.4%).

The contribution of the top ten taxa to overall abundance at LHS is illustrated in Figure 8. The three most abundant taxa accounted for 28% of the total abundance recorded while the 10 most abundant species accounted for 57%, highlighting the diversity within the faunal communities present in the study area.

The single most abundant species was the spionid *Spio symphyta* which represented 10% of the total abundance. This was followed by the amphipod *Leptocheirus tricristatus* (9%) and the dwarf brittle star *Amphipholis squamata* (8%), highlighting the contributions from different faunal groups in communities across the LHS area. Other small amphipods were highly abundant within faunal samples including *L. pectinatus, A. semiserratus, A. latreillii, Socarnes erythrophthalmus* and *Apherusa bispinosa* while the abundance of the small tanaid *A. latreillii* further illustrates the dominance of small crustaceans in benthic communities (Figure 8). No Mollusca or miscellaneous fauna were recorded within the top 10 most abundant species.

The 43% of species unaccounted for by the top ten most abundant shown in Figure 8 were largely made up of a diverse mixture of fauna from all major groups.

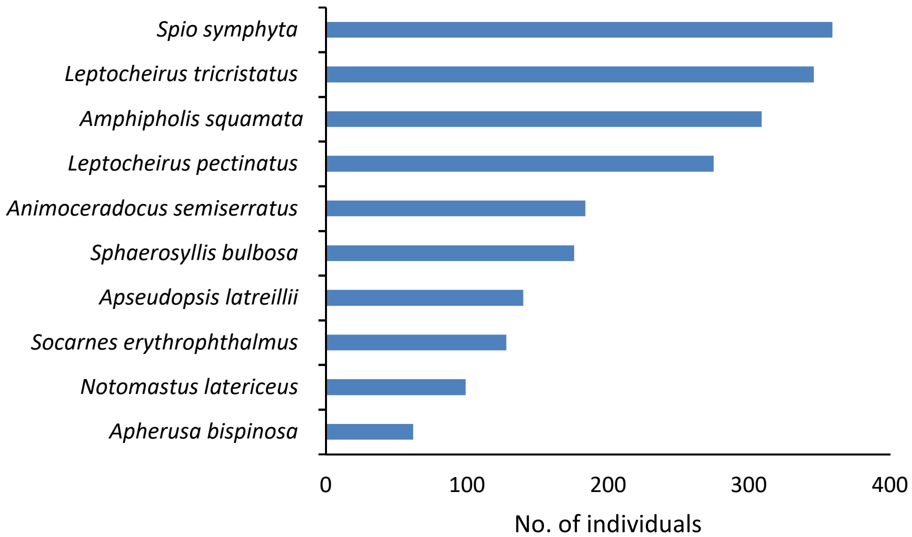

Figure 8. The ten most abundant taxa in samples collected at LHS in 2019.

Figure 9 illustrates the taxa that occurred in the highest number of samples collected at LHS in 2019. The most frequently occurring taxa were all Annelida: the Capitellidae *Notomastus* latericeus (present in 8 of 8 samples), the Spionidae *S. symphyta* (7 of 6 samples) and the Maldanidae *Praxillella affinis* (6 of 8 samples) and *Euclymene oerstedii* (6 of 7 samples). The ribbon worm Nemertea spp. was recorded at 6 of 8 stations while *A. squamata, Polycirrus* spp., *Leichone* sp., *S. bulbosa* and Nematoda spp. were all present at five stations each. It is apparent that Annelida were widespread across the LHS site with several species being present at the majority, if not all of the stations targeted during the survey.

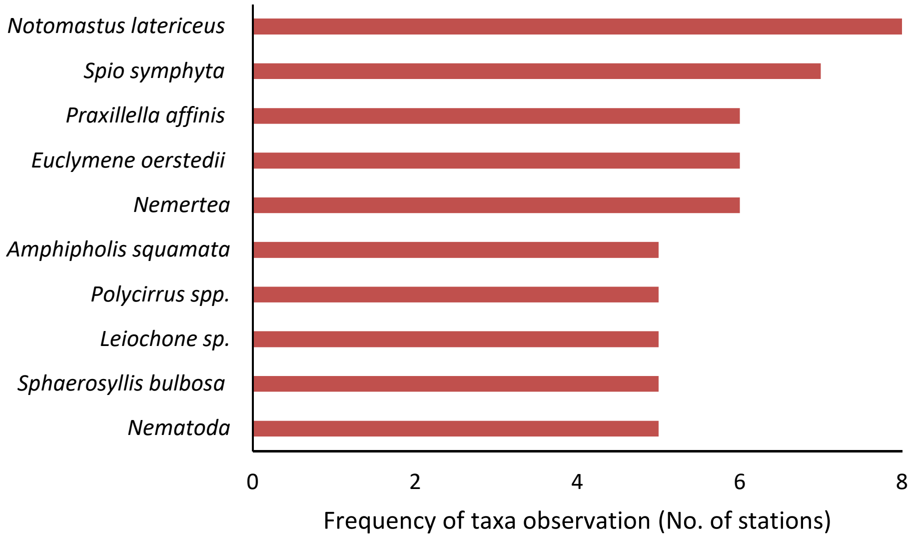

Figure 9. The ten most frequently occurring taxa sampled at LHS in 2019.

Numerous benthic taxa were observed in the images collected during the DDV survey of LHS and these have not been included within the faunal analyses. In some cases, these species were not recorded in the samples collected for faunal analyses. Typically, these were gastropods and crabs belonging to the family Inachidae, as well as colonial bryozoans and epibenthos that could not be sampled using grabbing techniques. A breakdown of both faunal and algal species identified in the DDV images can be found in Appendix 8 and though the fauna observed in the photographs were not included in the benthic faunal analyses, they were a central component in determining the biotopes present at LHS (Section 3.9).

3.4. The Spatial Distribution of Benthic Faunal Communities

Figures 10, 11 and 12 illustrate the distribution of fauna in terms of abundance, species diversity and biomass respectively within the samples collected at LHS in 2019.

Faunal abundance was variable across the site with peak records occurring at Station 3 (1,885 individuals), Station 2 (536 individuals) and Station 5 (253 individuals). Generally, the highest abundances were seen in the eastern part of the LHS site in a channel subject to high tidal flow where the most extensive maerl beds were identified during the DDV and grab surveys. Maerl is an unattached, coralline red algae capable of forming extensive beds in tide-swept channels that often support high benthic biodiversity and productivity through increased habitat complexity (Hall-Spencer, 1998; Grall *et al*., 2006). As such, it is probable that the presence of maerl is highly influential on the spatial distribution of abundance (as well as other indices such as diversity) across the LHS site.

The abundance of individual fauna was lowest at the stations located in the outer and slightly more exposed reaches of the LHS site (Stations 4, 7 and 8) with the minimum abundance of 141 individuals observed at Station 4. The seabed in the LHS area was highly variable and prone to patchiness which is typical of many coastal benthic habitats. Large rocky outcrops that prevented site navigation in some areas also dictates complex physical conditions which are reflected in the variability in abundance.

There was little correlation between Folk sediment classification and abundance at LHS though the lowest abundance was recorded at Station 7 where the proportion of mud to other fractions was highest.

As with abundance, the distribution of species diversity at LHS was also variable (Figure 11). A maximum of 139 taxa was recorded at Station 3 at the eastern portion of the site where abundance was also the highest of all stations while the lowest diversity of just 15 taxa was recorded at Station 6, one of the most inshore stations. High faunal diversity at Stations 1, 2, 3 and 4 is indicative of the presence of complex benthic communities at LHS though the split between the east and west is apparent. Substantial amounts of maerl were recovered at each of these four stations, and it appeared to be particularly healthy (high ratio of living to dead structures and well-developed nodules) at Station 3 where abundance and diversity were particularly elevated. Note that complex encrusting communities often colonise cobbles and bedrock which can be hard to obtain for benthic faunal analysis. As such, it should be considered that both abundance and diversity may, to a degree, be underrepresented in some areas of LHS – especially those at which samples could not be obtained due to a lack of overlying sediment.

Faunal biomass recorded in the samples collected across the site demonstrated little correlation with abundance and few trends between the two metrics were apparent (Figure 12). The highest biomass per sample was recorded at Station 8 (2.19 gAFDW) where abundance was relatively low but the presence of a large bivalve (*Venus casina*) contributed fairly substantially in terms of weight. The lowest biomass per sample was recorded at Station 7 (0.12 gAFDW) at the edge of a rocky outcrop in the southwest portion of the LHS site; the lowest abundance as also recorded at this station. Biomass was typically low across the site despite the high abundance due to the amount of very small-bodied specimens that dominated the faunal communities. Larger fauna were visible across LHS during the DDV survey though it was not possible to sample these with the Hamon grab due to unsuitable substrate. Fauna and algae identified during the DDV survey are discussed further in section 3.9.

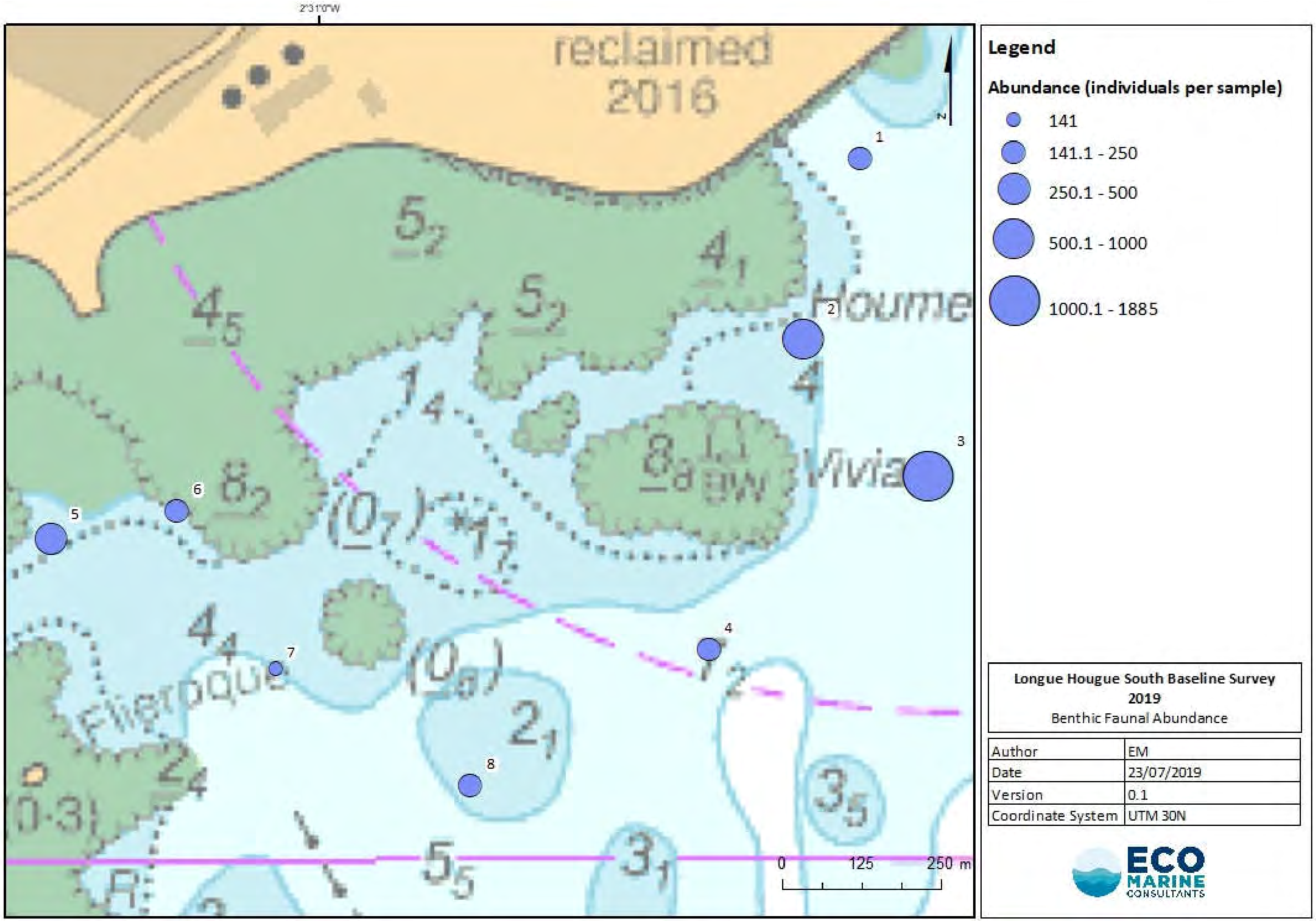

Figure 10. The distribution of abundance recorded in samples collected at Longue Hogue South in 2019.

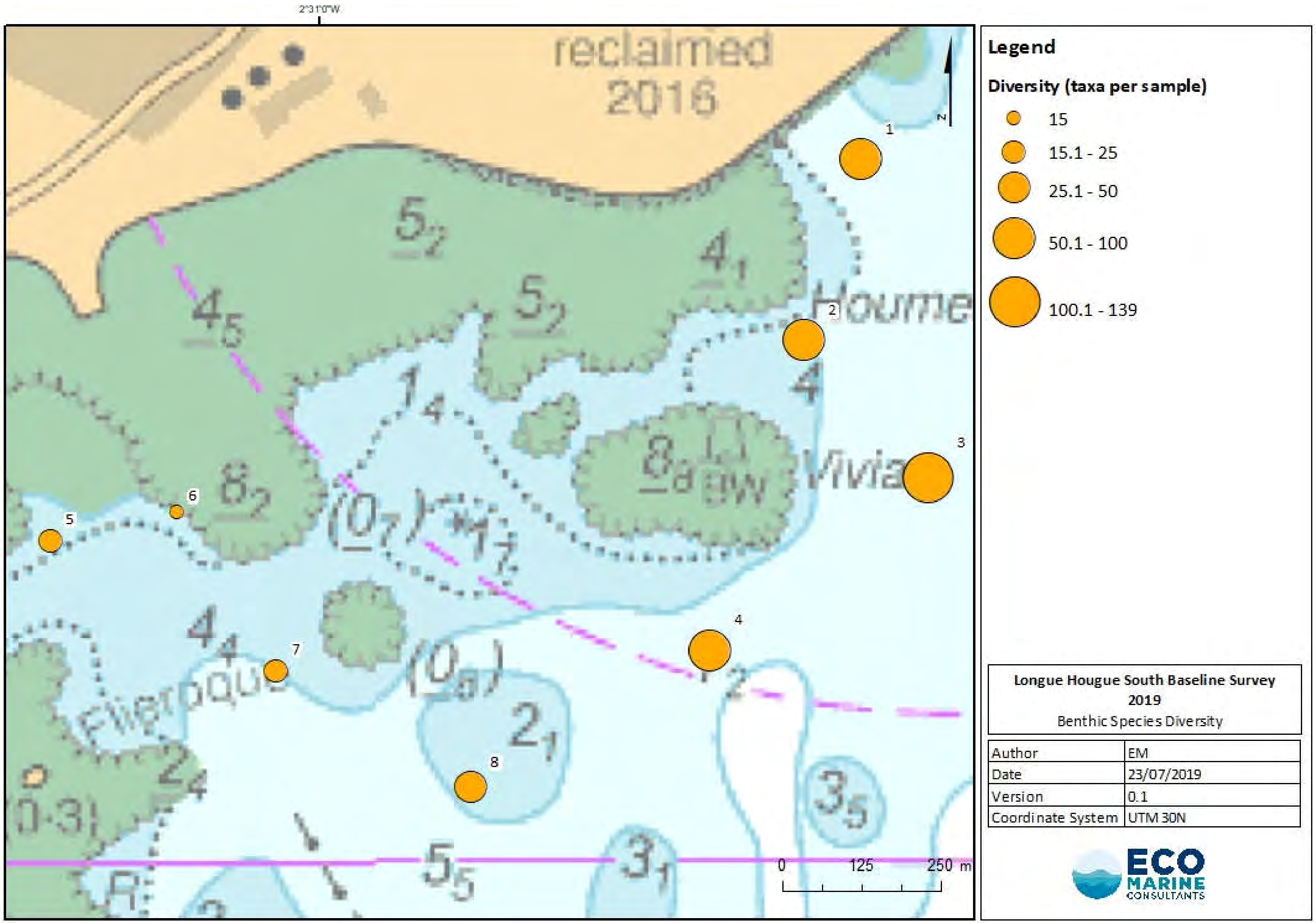

Figure 11. The distribution of species diversity recorded in samples collected at Longue Hogue South in 2019.

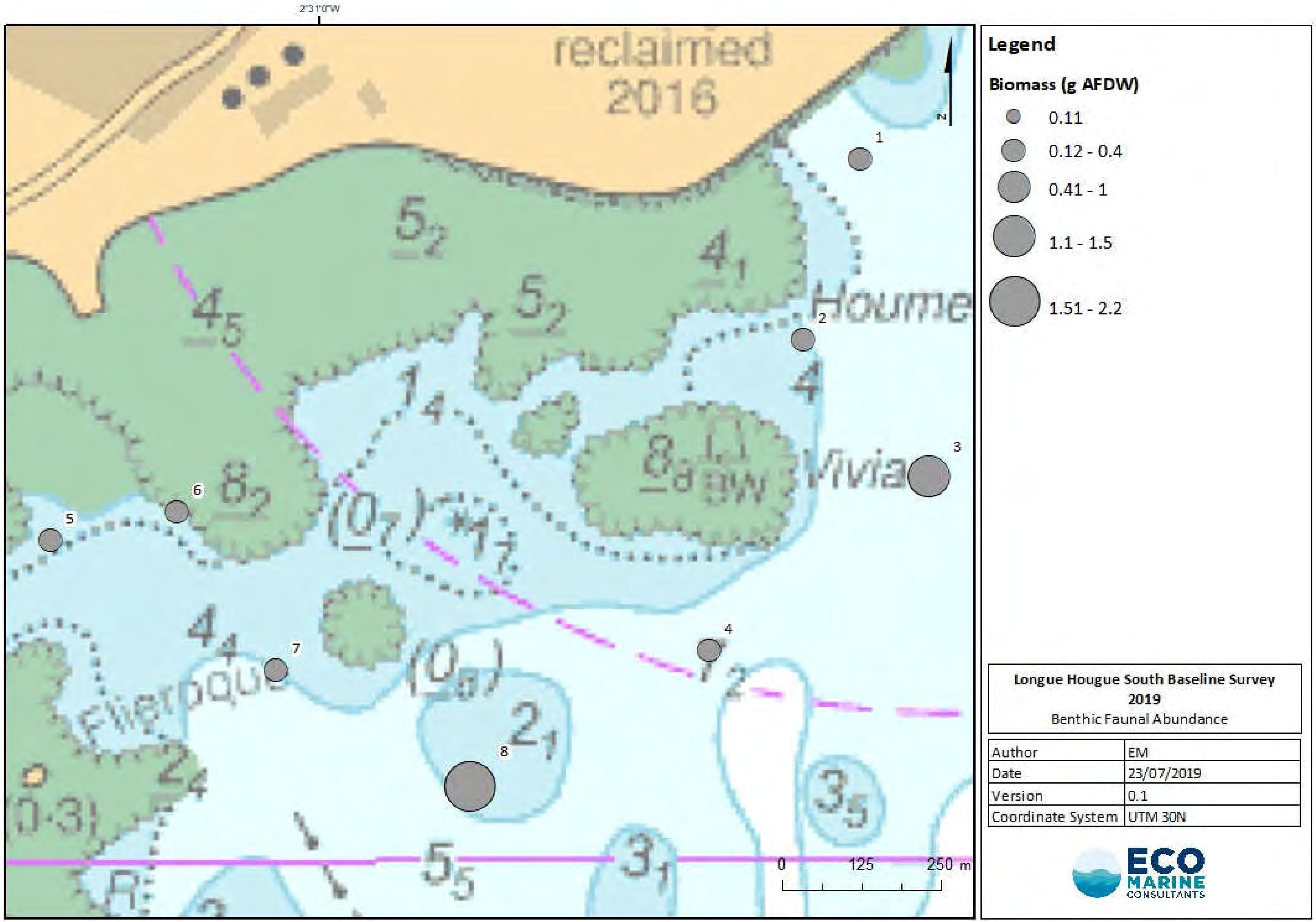

Figure 12. The distribution of faunal biomass recorded in samples collected at Longue Hogue South in 2019.

3.5. Multivariate Analysis

In addition to the univariate analyses presented above, multivariate analyses have also been employed to interrogate the data on a community level.

Cluster analysis was initially undertaken to explore the data and to identify those stations which contain a similar faunal community. Figure 13 shows a group average sorting dendrogram (based on Bray-Curtis similarity of square root transformed abundance data), with the accompanying non-metric multidimensional plot shown in Figure 14.

The SIMPROF routine has been utilised to identify statistically similar groupings at the 5% significance level (p = <0.05). Faunal groups have been assigned to the stations identified as clustering together and thus having a similar faunal community. The cluster analysis and MDS plot show two statistically significant faunal groups (essentially separated as those where maerl was documented and those where maerl was not observed), in addition to one station which did not group with any others and has been labelled as an 'Outlier'. A spatial illustration of the identified faunal groups is shown in Figure 15.

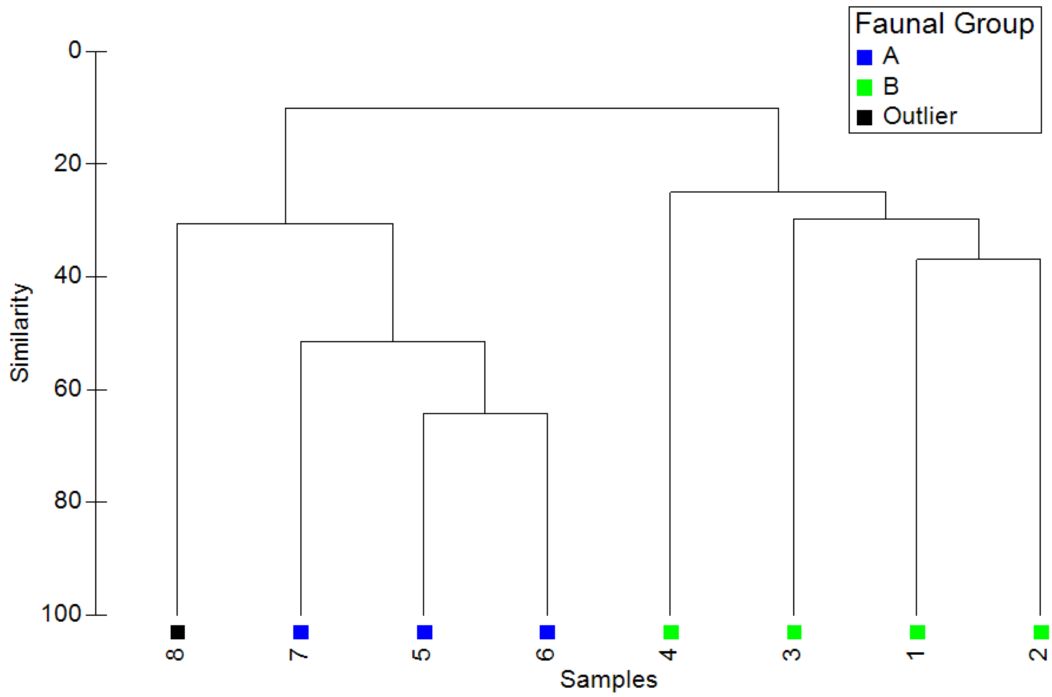

Figure 13. Group average sorting cluster dendrogram based on the square root transformed benthic abundance data (Bray-Curtis similarity) from the 2019 LHS survey, showing faunal groups.

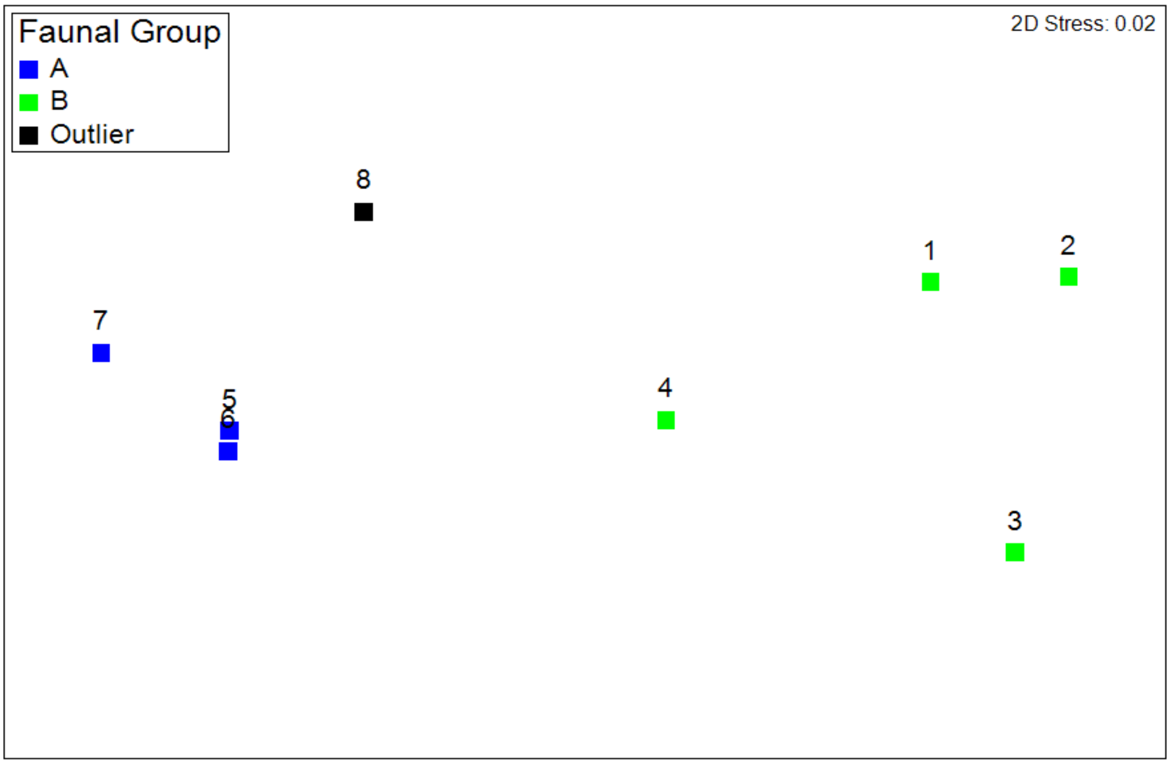

Figure 14. Non-metric multidimensional scaling (MDS) plot, presented in 2D format, based on the square root transformed benthic abundance data (Bray-Curtis similarity) from the 2019 LHS baseline survey, showing faunal groups.

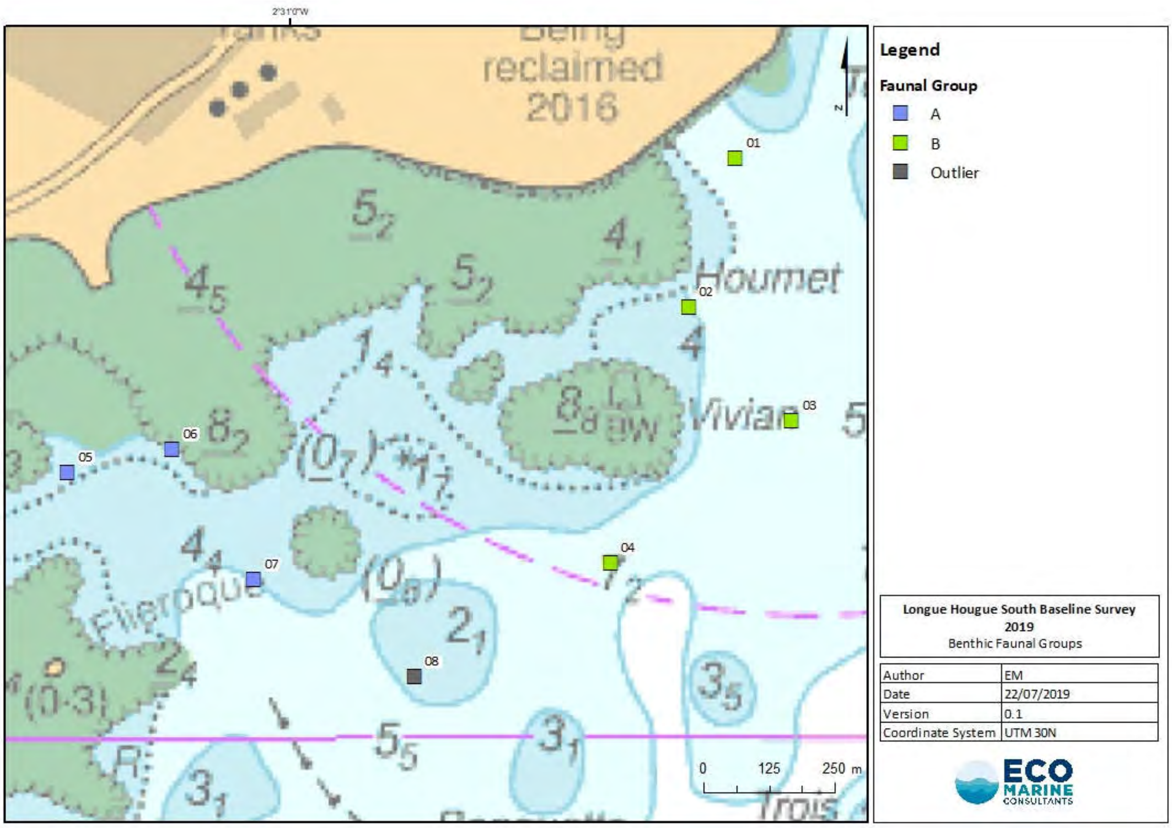

Figure 15. Plot of faunal groups identified from the cluster analysis of data collected at Longue Hogue South in 2019.

The average abundance, species diversity and biomass per faunal group is shown in Table 6. A description of each of the faunal groups identified is provided below.

Table 6. Average abundance, species diversity (number of taxa) and biomass per sample of each of the multivariate faunal groups identified across from samples collected during the 2019 LHS benthic survey. Note that outliers are not classed as a faunal group.

Faunal Group	Mean Abundance (±SD)	Mean Number of Taxa (±SD)	Mean Biomass (gAFDW) (±SD)
A	204.7 (±57.6)	18.7 (±3.5)	0.2 (±0.1)
B	706.3 (±801.9)	80.8 (±39.6)	0.5 (±0.5)

Faunal Group A

Faunal Group A (average group similarity of 55.70%) was recorded at three stations in the nearshore mid-section of the survey array (Stations 5, 6 and 7). Sediment records for the stations identified as Faunal Group B showed combinations of Sand, slightly gravelly Sand and gravelly Mud. The group displayed comparatively lower mean faunal abundance, species diversity and biomass compared to Group B. SIMPER analysis indicated that the main species occurring in this group were the polychaetes *Spio symphyta*, *Euclymene oerstedii* and *Notomastus latericeus*, which together accounted for over 60% of the total group similarity.

Faunal Group B

Faunal Group B (average group similarity of 28.56%) was the most frequent group identified, occurring at four stations predominantly located to the north east of the survey array in the deeper, higher energy channels. Sediments recorded at these stations were classified as sandy Gravel and muddy sandy Gravel. Group B was the most abundant and most diverse of the groups identified and contained the greatest level of biomass recorded with each index being considerably greater than those observed for Group A. SIMPER analysis indicated that the main species occurring in this group were the polychaetes *Sphaerosyllis bulbosa* and *Syllis mauretanica*, the brittlestar *Amphipholis squamata* and the oligochaete *Grania* spp. Notably, maerl was present at all four of the stations categorised as Group B. Maerl is known to promote localised biodiversity and increase complexity of benthic communities and as such, was likely to have been highly influential in the formation of the localised ecology.

In addition to those groups identified above there was also one station (Station 8) that did not group with any others during the cluster analysis and was hence labelled as an Outlier and not assigned a faunal group. This station was located in the mid of the survey array to the seaward edge of the sampling stations.

Faunal abundance and species diversity were low to moderate at Station 8, although species composition was considerably different to that observed at other stations, possibly due to the sandier nature of the sediments at this location. The tanaid *Apseudopsis latreilliid* was especially abundant at this station, coupled with lower abundances of the polychaetes *Spio symphyta* and *Sphaerosyllis bulbosa* that were present in comparatively larger numbers in the faunal groups. Station 8 also recorded numerous taxa not observed at the other stations in high numbers, including the amphipod *Urothoe elegans*, the polychaete *Galathowenia oculate* and the bivalve *Timoclea ovata*. The lack of any of the other common species in high numbers at this station likely indicates why this station did not form any groups along with other stations during the cluster analysis.

3.6. Diversity Indices

In addition to the identification of faunal groups, an assessment of community diversity and evenness was undertaken using diversity indices. The results of this are shown in Table 7.

Table 7. Evenness and diversity indices for benthic abundance data gathered during the 2019 LHS survey.

Station	Evenness	Shannon-Weiner	Simpson's Dominance
1	0.96	3.83	0.99
2	0.93	3.97	0.98
3	0.93	4.60	0.99
4	0.97	3.97	0.99
5	0.89	2.76	0.92
6	0.90	2.44	0.91
7	0.89	2.61	0.92
8	0.92	3.21	0.96

The evenness value is a consideration of equality of representation of species within a given community (the nearer to 1, the more balanced the community). Evenness for sites sampled in the LHS survey was moderate–high overall across the survey area. Stations 5 and 7 (both identified as Faunal Group A in the multivariate analysis and noted to contain Sand and gravelly Mud sediments) displayed the lowest overall evenness, likely as a result of the dominance of a single species (*Spio symphyta*) and low diversity of others. Stations 1-4 located within maerl beds to the north east of the site demonstrated the highest evenness.

For Shannon-Weiner diversity indices, the index increases as a factor of increase in evenness and species richness. Values above 4 indicate relatively high diversity; typical values are between 1.5-3.5. The results shown in Table 7 indicates that the diversity of the site, according to this index, is relatively high, with values ranging between 2.44 and 4.60. Station 3, where dense maerl bed was noted, displayed a Shannon-Weiner value of greater than 4, with several more samples collected from the north east of the site approaching this figure.

Values for Simpson’s Dominance index (the chance of encountering a different species with the next random sample, values up to 1) were likewise relatively uniform across the survey area and were reflective of the overall diversity of the region, whilst accounting for the fact that numerous species were found at multiple stations.

3.7. Driving Factors of Community Composition

The data relating to sediment and faunal groupings, presented above, suggest a degree of between the benthic communities and the composition of the substrate which at Longue Hogue South included maerl.

It was noted that Stations 5 and 6 which had increased proportions of fine sediments contained a different faunal community to those found across the rest of the site and likewise, communities at Stations 1-4 located within maerl beds were distinctly different to those elsewhere at LHS.

It is well documented that sediment composition is an important factor for determining the distribution of infaunal communities (e.g. Cooper *et al.,* 2011). For example, the presence of coarse sediments provides attachment sites for a diverse assemblage of species including bryozoans and hydroids, which may not otherwise have suitable attachment surfaces in more muddy substrates. The heterogeneous matrix provided by complex maerl beds has a similar positive impact for benthic communities that colonise the interstitial spaces between thalli (Perry & Tyler-Walters, 2018).

Other factors, such as water depth, bed shear stress, tidal streams, the presence of organic enrichment or contaminants and natural or anthropogenic disturbance may also be considerable controlling factors in the patterns of faunal community composition observed.

3.8. Macroalgae of Longue Hogue South

The seaweed (macroscopic marine algae) communities at Longue Hougue South were well developed and established wherever suitable substrate allowed. A wide range of forms and species were observed across the site, offering multiple functions to the local ecosystem including habitat provision, food supply, shelter and protection. Though identification from DDV stills was challenging as many algal species require very close inspection, some prominent species were identified.

The forest kelp *Laminaria hyperborea* was frequently observed at stations where bedrock and large boulders provided surfaces for holdfasts to anchor to, whilst sugar kelp *Saccharina latissima* was recorded less frequently. These large, brown macroalgae provide food directly to fauna that feed on them and also by releasing dissolved organic matter (e.g. Bunker *et al*.,2017). Please see Appendix 7 for a full breakdown of algal species identified from stills collected during the DDV survey.

In the band below the kelp forest along the edges of rocky outcrops were well developed seaweed turfs. These were made up of tufts of foliose red, green and brown seaweeds important for grazing gastropods and other herbivores. Encrusting Corallina species were common here in the lower infralittoral zone alongside *Dictyota dichotoma*, *Ulva* spp., and *Dasysiphonia japonica*.

Between the rocky outcrops and boulder covered areas of Longue Hogue South some scarce seaweeds formed on the mixed sandy and gravelly substrates. These were often filamentous forms and *Chorda filum* and *D. japonica* were often recorded.

3.9. Biotope Designation at Longue Hogue South

On completion of the DDV, intertidal and benthic sampling survey, the gathered information was transferred to an internal database, whilst photographs and footage were processed for assessment. Maps of the extent and distribution of the broad-scale habitats of interest Longue Hougue South have been produced by analysing field notes and positional data alongside the faunal and PSA data collected during the survey. Note that station numbers referred to in this section are not aligned with the faunal and PSA stations and are subject to their own DDV numbering system. Images captured at each station during the DDV survey are provided in Appendix Plate 2. A full rationale for each biotope designation is provided in Appendix 7.

A total of eight biotope complexes were identified from the 2019 survey data – three intertidal and five subtidal. The locations of the biotopes have been identified from DDV stills analysis, direct site access on foot, and ground-truthed with sediment and faunal data where sample locations intersected. These biotopes have been digitised to allow the visualisation of biotope distribution and are representative of EUNIS levels 3-6 (Figure 16). An example photograph of each biotope designation is given below in Plate 2. Variation in biotopes across the site is apparent with infaunal communities transitioning between stations as environmental conditions transform. Table 8 shows the coverage per station for each of the assigned biotopes identified at Longue Hougue South.

Table 8. Biotope coverage at Longue Hogue South in 2019.

EUNIS Biotope Complex	Habitat Description	No. of records	Percentage coverage
A1.11 (Level 4)	Mussel and/or barnacle communities	3 stations	12%
A1.1132 (Level 6)	*Semibalanus balanoides, Fucus vesiculosus* and red seaweeds on exposed to moderately exposed eulittoral rock	2 stations	8%
A2.4 (Level 3)	Littoral mixed sediment	8 station	8%
A3.1152 (Level 6)	*Laminaria hyperborea* park with dense foliose red seaweeds on exposed upper infralittoral rock.	6 stations	23%
A3.116 (Level 5)	Foliose red seaweeds on exposed infralittoral rock	1 station	4%
A5.14 (Level 4)	Circalittoral coarse sediment	1 station	4%
A5.2 (Level 3)	Sublittoral sands and muddy sands	5 stations	19%
A5.51 (Level 4)	Maerl beds	6 stations	23%

The biotopes designated to the communities at Longue Hougue South were all typified by high energy regimes and ranged from the littoral intertidal, to shallow sublittoral zones. Strong tidal flow and complex flow dynamics were defining environmental conditions at all stations which is likely to have had a substantial bearing on the benthic communities present across the site. As discussed in Section 3.1, mixed gravelly muddy Sands were marginally dominant across the Longue Hougue South site and at locations where PSA and faunal samples could not be collected, photo and video analysis revealed that large boulders and cobbles were present. The variable proportions of gravel, sand and mud, formed the defining feature for different biotopes at several stations – particularly those where 'Circalittoral coarse sediment' and 'Sublittoral sands and muddy sands' were ascribed. At other stations, bedrock, boulders and cobble were identified as the dominant substrate type which narrowed the field of potential biotopes accordingly. The intertidal area accessed on foot was predominantly bedrock though a mixed sediment 'beach' was present at low water at intertidal Stations 1 and 5 which was largely composed of boulders, cobbles and coarse sand.

One of the most frequently recorded biotopes was 'Maerl beds' (A5.51) which was identified at a total of six stations, demonstrating the dominance of maerl in the north eastern portion of the site. This biotope was found to be representative of 23% of the DDV stations surveyed at Longue Hougue South and was present in the channel running parallel to the coastline. This particular habitat was characterised by the presence of maerl on clean gravel and sand in a tide-swept channel. As is typical of maerl habitats, abundance and diversity were elevated in the faunal samples used to ground truth the DDV images. Distinguishing between maerl forming species requires the study of cells once the outer calcareous structure has been dissolved in acid and for this reason, a species identification has not been possible to advance the habitat classification past level 3. However, it is thought that in fully marine conditions the dominant maerl is typically *Phymatolithon calcareum* (JNCC, 2015).

The biotope '*Laminaria hyperborea* park with dense foliose red seaweeds on exposed upper infralittoral rock' (A3.1152) was also identified a total of six times representing 23% of the DDV sites at Longue Hogue South. This habitat was found in exposed waters 10-15m deep across the site both very close to shore and several hundred meters offshore and often fringed the maerl beds. This biotope was characterised by the presence of the kelp species *L. hyperborea*, bedrocks and large boulders with a dense turf of foliose red algae and encrusting coralline algae as well as some brown algae species. Typically, this habitat is associated with high faunal and algal biodiversity though it was not possible to identify many of the algal species in particular from DDV imagery alone.

The habitat 'Sublittoral sands and muddy sands' (A5.2) was identified five times (19% of stations). It was recorded at Stations 13-15, 18 and 19 in the south west portion of the Longue Hougue South site among a series of rocky outcrops. Faunal communities observed in samples collected from the area where this biotope was identified demonstrated some distinction from the other stations as discussed in Section 3.5. This biotope was characterised by the muddier nature of the sands present in the western section of Longue Hougue South site as well as the lack of overlying epibiota and fauna though a range of benthic annelids, amphipods and bivalves were identified in the samples collected from this area. Some faunal tubes (possibly *Spio symphyta*) and very sparse patches of green algae were identifiable at the stations assigned to this biotope.

The intertidal biotope 'Mussel and/or barnacle communities' (A1.11) was observed at three of the seven nearshore intertidal stations accessed on foot (12% of stations). Intertidal Stations 2-4 which were designated as A1.11 were located on uneven bedrock frequently occupied by communities of the barnacle *Semibalanus balanoides*, the limpet *Patella* spp., and the winkle *Littorina* spp.. There were numerous cracks, crevices and boulders strewn across the mid-section of the foreshore which provided shelter for small intertidal fauna. Algae present included *Corallina officinalis,* occasional *Ulva* spp., the invasive *Sargassum muticum* in small pools along the foreshore, *Mastocarpus stellatus* and occasional green films.

The intertidal biotope '*Semibalanus balanoides, Fucus vesiculosus* and red seaweeds on exposed to moderately exposed eulittoral rock' (A1.1132) was observed at intertidal Stations 6 and 7 along the mid-section of the rocky foreshore of Longue Hougue South. This biotope represented 8% of stations in total and was characterised by the exposed bedrock, the presence of *S. balanoides, Patella* spp., and occasional pockets of *Fucus vesiculosus.* Other algal species including *C. officinalis*, *Osmundea pinnatifida*, *M. stellatus* and *Enteromorpha* sp. were also present.

'Littoral mixed sediment' (A2.4) was recorded at intertidal Stations 1 and 5 along the edge of the emerging bedrock, bordering the coastal defences at Longue Hougue South. These stations were characterised by a combination of boulders, cobbles with gravel and sand components with little visible fauna. Patches of *Fucus serratus* were present on cobbles and boulders alongside *Enteromorpha* spp.. This biotope represented 8% of the station coverage.

The habitats less frequently observed were 'Circalittoral coarse sediment' (A5.14) and 'Foliose red seaweeds on exposed infralittoral rock' (A3.116) which were each identified at a single station each.

'Circalittoral coarse sediment' was ascribed to Station 16 in the mid-channel in shallow waters of approximately 10 m. It was characterised by tide-swept coarse sand with large shell fragments shell. The red algae *Dasysiphonia japonica* and the brown algae *Chorda filum* were common and the dahlia anemone *Urticina felina* was also recorded here.

'Foliose red seaweeds on exposed infralittoral rock' was identified at Station 3 in the north eastern portion of the site, bordering the maerl beds. Bedrock and large boulders with a dense turf of foliose and coralline red algae were a dominant feature of this habitat and though it was found neighbouring the maerl, no overlying maerl was observed on the substrate at Station 3. As it is characteristic of this biotope, the brown algae *Dictyota dichotoma* was abundant.

3.10. Notes on Biotope Designations

It should be noted that limited detail regarding the presence of faunal species identified during the grab sampling element of the survey were included in the biotope descriptions. Many of the most abundant taxa including *S. symphyta, L. tricristatus* and *A. squamata* were not mentioned in the most frequently occurring biotope descriptions though they were clearly important components of the community structure across the site. Additionally, many of the macrofauna mentioned in the JNCC habitat descriptions such as *Cerianthus lloydii* or *Pagurus bernhardus* were not visible either during the DDV survey or in photographs collected during the survey. This may be a result of the niche environmental conditions present at Longue Hougue South, particularly the strong tidal streams and exposed nature of the substrate. There was also a high degree of overlap between biotopes A1.11 and A1.1132 in the intertidal stations and borders between the two designations would be challenging to define.

Though the biotopes used to describe the benthic communities at Longue Hougue South are a helpful descriptive tool, it is considered that the complexity of the benthos within this small site is not fully captured by these particular biotopes. As such, the full species matrix in Appendix 5 and the biotope designation notes in Appendix 7 should be consulted for further ecological detail.

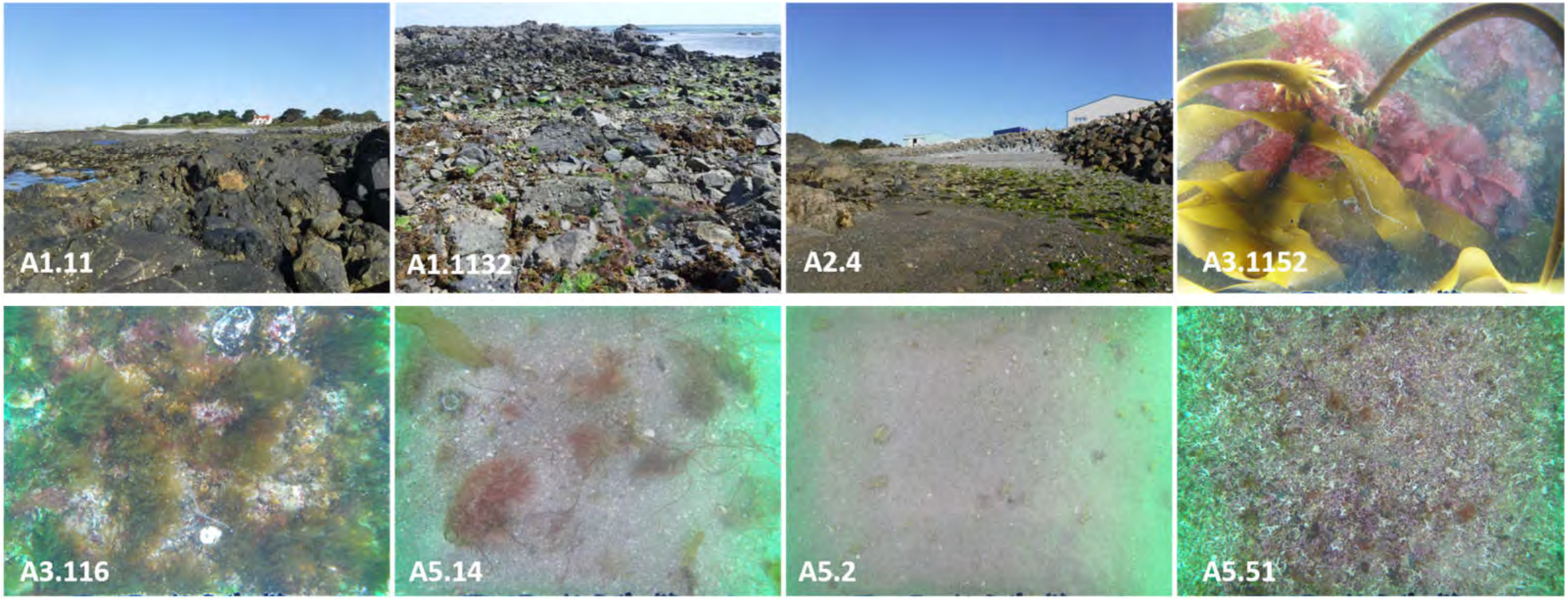

Plate 3. Photographs of the five biotopes identified during the DDV survey of Longue Hogue South in 2019. Top to bottom, left to right: '*Laminaria hyperborea* park with dense foliose red seaweeds on exposed upper infralittoral rock' (A3.1152); 'Foliose red seaweeds on exposed infralittoral rock' (A3.116); 'Circalittoral coarse sediment' (A5.14); 'Sublittoral sands and muddy sands' (A5.2) and 'Maerl beds' (A5.51).

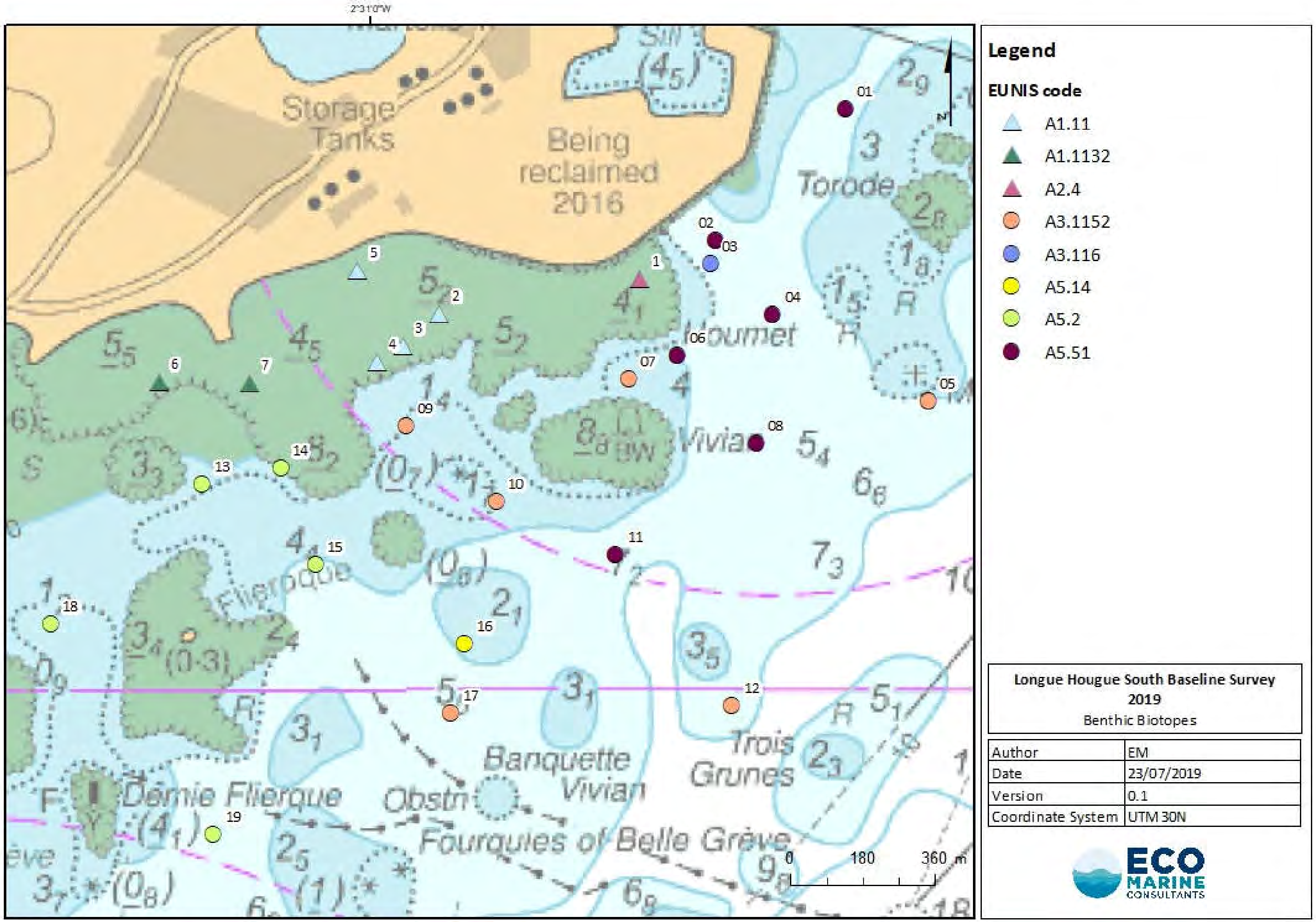

Figure 17. The distribution of biotopes assigned at Longue Hogue South in 2019. Triangles represent intertidal stations accessed on foot while circles represent subtidal stations assessed using DDV.

3.11. Species of Conservation Interest

3.11.1. Maerl Beds

Coralline red algae (Corallinaceae) species forming extensive gravel-like beds of unattached nodules are referred to collectively as maerl. The beds that these hard, three-dimensional structured algae make are made up of both living and dead thalli and can be extensive. However, due to numerous anthropogenic pressures including trawling, dredging, coastal development and pollution, maerl beds are considered to be fairly rare, with species generally being restricted to the Channel Islands and the southwestern coasts of Britain and Ireland as well as the Scottish Isles in the north east Atlantic (Hall-Spencer *et al*., 2010). Typically, maerl forms in coarse, clean sand and gravel sediments in tide-swept currents on the open coast or in more sheltered marine inlets with a weak current. As maerl beds are formed by algal species, bed depths are shallow (no deeper than 40m) to allow sufficient light supply for photosynthesis (Hall-Spencer *et al*., 2010). As such, conditions at Longue Hogue South meet all pre-requisite conditions for the establishment of maerl as is evident from its extensive presence in the eastern portion of the site (Plate 3).

Maerl beds build very slowly (over millennia in some cases) to create carbonate rich environments that are associated with long-term increases in biodiversity and benthic ecological productivity and act as nursery grounds for both fish and shellfish (Hall-Spencer, 1998; Grall *et al*., 2006). Due to very slow growth rates, maerl deposits are highly sensitive to damage from any source. Maerl is also very slow to recruit and as such should be considered a non-renewable natural resource (Perry & Tyler-Walters, 2018; Barbera *et al*., 2003). Current evidence states that the recovery potential of maerl following removal or damage is next to none and the impact on local benthic communities (especially for large, long-lived species (such as *Dosinia exoleta* which was present at three stations) will last for up to 50 years (Perry & Tyler-Walters, 2018).

As a result of habitat value coupled with international loss and sensitivity to damage, maerl beds are considered a conservation priority. Though Guernsey is not considered to be within the UK and acts as a semi-autonomous state within the EU, British and European legislation protections are considered best practice and should be adopted accordingly in Guernsey where practicable. Therefore, primary European policy is discussed in reference to maerl in this section. Maerl is a Habitat of Principle Importance/Priority Habitat under the 1994 UK BAP Action Plan (as implemented by the UK Post-2010 Biodiversity Framework) and is also named in the OSPAR List of Threatened and/or Declining Species and Habitats as well as being listed in Annex 1 of the Habitats Directive. Additionally, some maerl species are also UKBAP Priority Species, and species of conservation importance for the purpose of conservation of biodiversity under the Natural Environment and Rural Communities Act 2006. As a semi-autonomous state however, EC Directives including the Habitats Directive have limited applicability in Guernsey. Nonetheless, the Habitats Directive is part of an international effort to conserve vulnerable species and habitats of value and as such, the protected status of maerl should be carefully considered.

Faunal samples collected from the maerl beds at Longue Hogue South were characterised by high abundance and species diversity as typically reported in relevant literature. Multivariate testing revealed distinct benthic communities between samples with maerl substrate and those without, further demonstrating its positive influence on complex benthic community formation. The maerl beds at Longue Hogue South were made up of both living and dead maerl and though relatively widespread, were not highly extensive. It is considered that physical pressures such as removal, habitat structure change, disturbance of the seabed and smothering would all result in a loss of habitat with no ability to recover (Perry & Tyler-Walters, 2018). Additionally, it is understood that maerl would be highly sensitive to local regime changes such as tidal current flow (Perry & Tyler-Walters, 2018) meaning that indirect impacts such as removal may not be necessary to permanently damage beds.

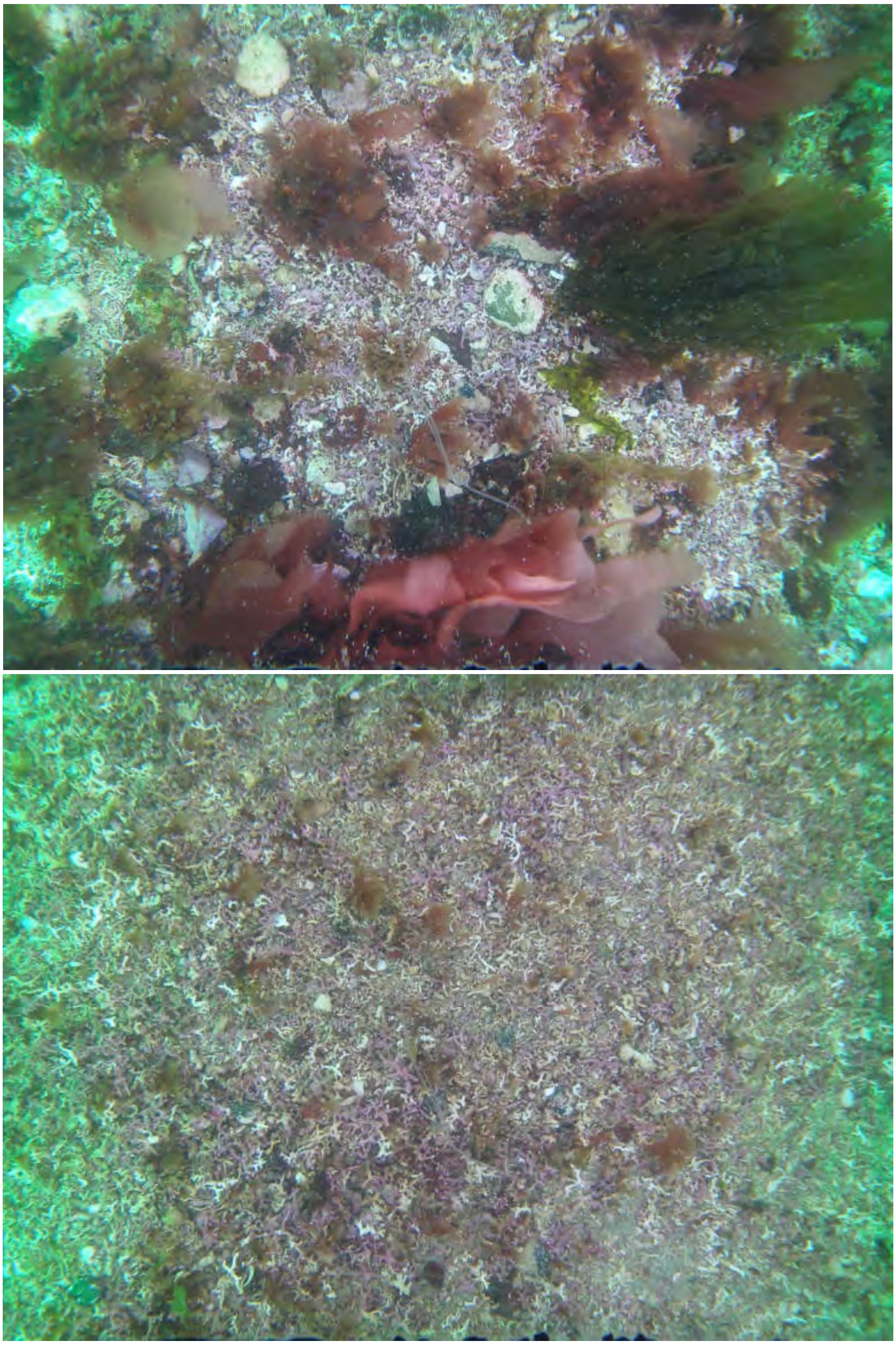

Plate 3. Coralline algae forming a maerl bed at DDV Station 1 (top) and Station 8 (bottom) at Longue Hougue South in 2019.

3.11.2. Rare & Invasive Species

The large 'sand gaper' bivalve *Mya arenaria* was recorded once at Station 3. It is considered alien in the UK and the wider north Atlantic and is believed to have colonized European coasts between the 13th and 17th centuries from the Pacific and west Atlantic coasts (Eno *et al*., 1997). As a long-established species, *M. arenaria* has become an abundant food source for many coastal species and is commonplace in intertidal and subtidal areas. The presence of *M. arenaria* has become 'naturalised' due to its long history in Europe which makes impacts relating to its presence difficult to assess, though it may still show some invasive properties when introduced to new areas. These might include out-competing local populations of habitat and food as well as altering the physical habitat that it colonises through burrowing activity (Jensen, 2010).

There were no records of other rare or any invasive non-native fauna in the 2019 benthic dataset. However, the invasive Japanese wireweed algae, *Sargassum muticum,* was identified in several locations in rockpools along the mid foreshore during the intertidal survey. This may be of significance for native pool-dwelling algae that find themselves competing with *S. muticum* for habitat space and sunlight.

4. Conclusions

This report has been prepared to characterise the benthic ecology and environmental conditions at the proposed development site of Longue Hogue South, Guernsey.

Overall it can be said that faunal communities observed at Longue Hogue South in 2019 were complex and diverse and reflected the environmental conditions including substrate type, depth and energy regime. The nature of the substrate across the proposed development site was variable over a small area though this was characteristic of a complex tidal regime and complex coastline with numerous rocky outcrops. The presence of maerl beds across the north eastern section of the site added structural complexity that can be associated with a diverse ecosystem at Longue Hogue South.

The following conclusions can be drawn from the monitoring investigation outlined in this report:

Nature of the Longue Hogue South Sediments

- Sediment composition at Longue Hogue South (LHS) was dominated by sand, although a number of stations also contained fractions of gravel and mud. The proportion of gravel was highest at stations where maerl was present in the north east of Longue Hogue South.

- Each station sampled at LHS was classified as a different Folk category, these were: slightly gravelly Sand ((g)S), gravelly muddy Sand ((g)mS), Sand (S), gravelly Mud (gM), gravelly Sand (gS), muddy sandy Gravel (msG) and sandy Gravel (sG). The variation in categories between stations demonstrated the variability of the seafloor.

- Stations where sediment samples could not be collected from the seafloor were dominated by bedrock, boulders and cobbles as seen in images collected during the drop-down video (DDV) survey.

- Concentrations of all heavy metals tested in sediment samples collected from six stations were found to be below the Cefas Action Level 1 thresholds at all sites with the exception of Chromium at Station 5 which marginally exceeded the Level 1 threshold.

- Concentrations of polycyclic aromatic hydrocarbons (PAHs) were found to be below CSQC Threshold Effect Levels for all substances though the concentration of Fluoranthene approached the limit.

- Greatest metal and PAH concentrations were recorded at Station 5. It is possible that sediment type influenced occurrences of higher PAH concentrations at some locations.

Nature of Longue Hogue South Fauna and Flora

- A wide range of benthic invertebrates were recorded at Longue Hogue South. A total of 245 taxa and 3,653 individuals were identified in the eight grab samples representing a large and diverse dataset with apparent differences in benthic communities and habitats between stations.

- The mean number of taxa recorded per sample was 52 while the mean number of organisms per sample was 457. Variation in faunal communities between stations was apparent, with the abundance ranging between 141 and 1,885 individuals per sample. The total biomass recorded was 4.75 gAFDW with values ranging from 0.12 to 2.19 gAFDW per sample.

- Some larger-formed epibenthos including bryozoa and Actiniaria were observed in stills collected during the DDV survey though these were not represented in the benthic dataset used for uni- and multivariate analysis due to their preference for rocky substrate which could not be sampled using a grab.

- Fauna and sediment data from the benthic samples as well as DDV images were used to designate biotopes to each of the 19 stations surveyed at Longue Hogue South. A total of five biotopes were characterised with the most common being 'Maerl Beds' and *'Laminaria hyperborea* park with dense foliose red seaweeds on exposed upper infralittoral rock.'

- Two distinct faunal communities were identified at the LHS study site through multivariate analysis. Considerable variation was found to exist between faunal groups, particularly at stations where seabed sediments were different and the presence of maerl was noted.

- The presence of gravel/coarse sand (maerl) and very fine sediments was found to be a significant controlling factor on the faunal communities observed, amongst other likely controlling factors such as water depth and bed stress/tidal currents.

- Overall diversity was high but other diversity indices varied, reinforcing the theory that faunal communities in the vicinity of the LHS proposed development site were either indicative of complex habitats or those dominated by a small number of species found at multiple stations.

- A diverse range of red, green and brown seaweeds and kelps were present across much of the Longue Hogue South site. Algae was present in numerous forms as turf, foliose and branching, suggesting a mature and complex ecosystem was present where suitable substrate allowed establishment.

Maerl

- Maerl beds were identified at numerous stations both during the DDV and grab surveys undertaken at Longue Hogue South. Abundance and diversity were high at stations where maerl was present which was in keeping with relevant literature.

- Maerl beds are a highly important marine habitat, listed in Annex I of the Habitats Directive, as a Habitat of Principle Importance/Priority Habitat under the 1994 UK BAP Action Plan (as implemented by the UK Post-2010 Biodiversity Framework) and is also named in the OSPAR List of Threatened and/or Declining Species and Habitats.

- Though Guernsey is a semi-autonomous state which limits the applicability of the Habitats Directive and UKBAP, it is considered that the protections afforded to maerl by these legislative processes should also be adhered to in Guernsey as a course of best practice.

- Cluster analysis revealed differences in the faunal communities between areas were maerl was present and areas where it was absent or rare.

- The maerl beds in the north eastern portion of the Longue Hogue South site would be highly sensitive to both direct and indirect physical pressures associated with coastal construction and would have very little chance of recovery.

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6. Appendices

Appendix 1 – Summary of field notes and positions for the Longue Hogue South DDV, grab and intertidal stations in 2019.

Appendix 2 – Table summarising the sediment particle size analysis (PSA) undertaken for samples collected at Longue Hogue South in 2019.

Appendix 3 – Table summarising the percentage of major sediment fractions of PSA samples collected at Longue Hogue South in 2019.

Appendix 4 – Table summarising the tested contaminants levels within sediments collected at Longue Hogue South in 2019.

Appendix 5 – Table summarising the abundance and species diversity of each benthic faunal sample collected at Longue Hogue South in 2019.

Appendix 6 – Table summarising the major group biomass of each benthic faunal sample collected at Longue Hogue South in 2019.

Appendix 7– Biotope designation rationale using DDV images collected at Longue Hogue South in 2019.

Appendix Plate 1 – Photographs of faunal samples collected at Longue Hogue South in 2019.

Appendix Plate 2 – DDV images collected at Longue Hogue South in 2019.

Appendix 1a. Field notes from the DDV survey conducted at Longue Hougue South in 2019.

Date	Station	Fix	Time	Depth (m)	Lat	Long	Water Clarity (m)	Sediment Description	Notes
11/05/2019	12	139	11:40	15.3	49.470304	-2.508595	5-10	Bedrock	Abundant *Laminaria,* red & green algae over bedrock, with a very thin layer of sand. Fast tidal flow. *Station name taken from nearest grab location.*
	12								
	12								
11/05/2019	1	140	11:58	13.2	49.478989	-2.506064	5-10	edrock & mae	Red & green algae, encrusting corraline algae present. Living maerl present. *Station name taken from nearest grab location* .
	1	141	11:59	13.1	49.478985	-2.506039			
	1	142	12:00	13.3	49.478963	-2.506055			
	1	143	12:01	13.3	49.478951	-2.506062			
11/05/2019	2	144	12:12	13.6	49.477078	-2.508947	5-10	Bedrock	Green , brown and red algae present. Abundant maerl and encrustring corraline algae. *Station name taken from nearest grab location.*
	2	145	12:13	13.9	49.477065	-2.508975			
	3	146	12:16	15.3	49.476749	-2.509075			
11/05/219	4	147	12:23	13.4	49.476000	-2.507674	5-10	Bedrock & maerl	Numerous photos taken between LHS_18 and LHS_19. Extensive maerl present in all images. A mixure of live maerl in 0012-0014, dead maerl bed in 0015. *Laminaria digitata* and *Sargassum muticum* present. Variable habitats between images. *Station name taken from nearest grab location.*
	4	148	12:24	13.2	49.476002	-2.507685			
	4	149	12:26	13.2	49.475995	-2.507694			
	4	150	12:30	12	49.475409	-2.509811			
	7	151	12:35	10.5	49.475068	-2.510905			
	7	152	12:36	11.3	49.475139	-2.510910			
11/05/2019	8	153	12:42	14.6	49.474122	-2.508054	5-10	Maerl	Extensive maerl beds, mixture of growing and dead maerl. Some small red algae colonisation. Numerous gastropoda present. Image 0020 = poor image. *Station name taken from nearest grab location.*
	8	154	12:43	14.5	49.474218	-2.508014			
	8	155	12:45	14.6	49.474177	-2.508021			
	8	156	12:45	14.6	49.474161	-2.508028			
11/05/2019	11	157	12:54	16.5	49.472518	-2.511192	5-10	G & maerl	A mixture of gravel,maerl and coarse, shelly sand on the seafloor, some red & brown algae. *Pentapora folicea* (0023) formations and some *Laminaria* also present. Fast tidal flow. *Station name taken from nearest grab location.*
	11	158	12:55	15.8	49.472407	-2.511108			
	11	159	12:56	15.8	49.472385	-2.511101			
11/05/2019	10	160	13:03	10.2	49.473292	-2.513855	5-10	Bedrock	*Laminaria* and some red algae present. *Station name taken from nearest grab location.*
	10	161	13:05	11.2	49.473213	-2.513875			
11/05/2019	9	162	13:11	10.3	49.474383	-2.515880	5-10	Bedrock	Green algae, encrusting corraline algae & *Laminaria* . *Station name taken from nearest grab location.*
	9	163	13:12	9.6	49.474334	-2.515952			
	9	164	13:13	9.8	49.474324	-2.515957			
	9	165	13:14	9.7	49.474290	-2.515993			

Date	Station	Fix	Time	Depth (m)	Lat	Long	Water Clarity (m)	Sediment Description	Notes
11/05/2019	14	166	13:32	8	49.473774	-2.518662	~5	Bedrock & S	Station located just west of LHS_01 - safer location away from rocky projection. Fairly barren sandy seafloor. *Lanice* tube and annelid burrows. *Station name taken from nearest grab location.*
	14	167	13:34	8.1	49.473715	-2.518787			
	14	168	13:34	8.3	49.473595	-2.518851			
11/05/2019	13	169	13:42	8.1	49.473532	-2.520424	~5	Bedrock & S	Fairly barren sandy seafloor. *Lanice* tubes and annelid burrows, green algae. *Station name taken from nearest grab location.*
	13	170	13:43	7.8	49.473588	-2.520419			
	13	171	13:44	7.5	49.473569	-2.520431			
11/05/2019	16	172	13:54	12.8	49.471216	-2.514556	~5	gS, G	Thin layer of sand and gravel above bedrock. Large actiniaria in 0038. Red algae, shelly fragments. *Station name taken from nearest grab location.*
	16	173	13:55	12.3	49.471247	-2.514445			
	16	174	13:56	11.5	49.471352	-2.514397			
11/05/2019	18	175	14:11	7.6	49.471506	-2.523800	~5	gS	Patchy brown and red algae, coarse sand and gravel present. *Station name taken from nearest grab location.*
	18	176	14:11	7.6	49.471490	-2.523824			
	18	177	14:14	7.5	49.471470	-2.523838			
11/05/2019	19	178	14:26	12.6	49.468437	-2.520170	5-10	Bedrock & S	Abundanct red algae, some green. Large marcopodia present in 0045. Hydroids present. *Station name taken from nearest grab location.*
	19	179	14:27	12.6	49.468409	-2.520217			
	19	180	14:28	12.5	49.468429	-2.520093			
11/05/2019	15	181	14:37	11.1	49.472362	-2.517891	5-10	Sa	Fairly barren sand, some *Lanice* /Annelida tubes present.*Station name taken from nearest grab location.*
	15	182	14:39	11.1	49.472347	-2.517906			
	15	183	14:40	11.1	49.472318	-2.517880			
11/05/2019	17	184	14:49	11.3	49.470207	-2.514861	5-10	Bedrock, G, S	Abundant red and encrusting coralline algae, some green algae. Gravel and coarse sand between outcrops of bedrock. *L. digitata* . *Station name taken from nearest grab location.*
	17	185	14:51	11.3	49.470223	-2.514846			
	17	186	14:52	11.2	49.470220	-2.514824			
11/05/2019	5	187	15:05	11.1	49.474751	-2.504217	5-10	Bedrock	Abundant red and encrusting coralline algae. Gravel and coarse sand between outcrops of bedrock. *L. digitata & L. saccharina* . *Station name taken from nearest grab location.*
	5	188	15:07	11.1	49.474713	-2.504225			
	5	189	15:08	10.5	49.474742	-2.504201			

Appendix 1b. Field notes from the grab survey conducted at Longue Hougue South in May 2019

Date	Time	Field Station No.	Newly Assigned No.	Depth (m)	Latitude	Longitude	Sample Volume	PSA Volume	No. of Attempts	Sediment Description	Notes
12/05/2019	09:25	22	9	13.3	49.46843506	-2.520065228	-	0.5	3	mS	Sample <5 L - only PSA sample collected, no faunal sample.
12/05/2019	09:32	7	8	13	49.47123364	-2.51452371	5	0.5	1	gS & S	
12/05/2019	09:41	13	4	16.3	49.47250564	-2.511132151	6	0.5	3	S & maerl	Maerl (living & dead) in sample.
12/05/2019	09:44	19	3	14.6	49.47410429	-2.508010452	8	-	1	S & maerl	Maerl - no contaminant or PSA sample collected
12/05/2019	09:53	18	2	12.1	49.47537922	-2.509786662	8	-	1	Maerl	Maerl - no contaminant or PSA sample collected
12/05/2019	09:56	17	1	12.7	49.47705425	-2.508980335	5	-	1	Maerl	Maerl - no contaminant or PSA sample collected
12/05/2019	10:04	23	7	12.8	49.47232011	-2.517288756	5	0.5	1	S	
12/05/2019	10:20	1	6	9	49.47378674	-2.518693334	5	0.5	3	S	
12/05/2019	10:29	5	5	8.9	49.47352079	-2.520498655	4	0.5	3	S	Slightly undersized for a faunal sample but kept nonetheless.

Appendix 1c. Field notes from the intertidal survey undertaken at Longue Hougue South, May 2019

Date	Time	Station	Latitude	Longitude	Sediment Description	Notes
13/05/2019	07:10	1	49.476517	-2.510635	C, gS, S	Cobbles & coarse sand along the low water mark through to the upper shore. *Patella* sp. , Cirripedia spp., *Gibbula* sp., *Steromphala* sp.
13/05/2019	07:21	2	49.475998	-2.515108	C/bedrock	Bedrock & rockpools. *Patella* sp., *Cirripedia* spp., *Gibbula* sp., *Steromphala* sp. Very uneven surfave, coralline algae abundant.
13/05/2019	07:28	3	49.475528	-2.515934	C/bedrock	Cobbles & bedrock. Brown and green algae present, *Fucus* abundant. *Patella* sp., *Cirripedia* spp., *Gibbula* sp. present.
13/05/2019	07:33	4	49.4753	-2.51651	Bedrock	Very uneven and elevated bedrock. *Cirripedia* sp. highly abundant on rock surface. *Patella* , Porifera, green & brown algae also present alongside *S. muticum* , *Fucus* and coralline algae. Rockpools present.
13/05/2019	07:44	5	49.476626	-2.516943	C, G & S	*Fucus* abundant, coarse sand present in pockets along the upper shoreline. Occasional large cobbles present with *Patella* sp.
04/05/2019	14:15	6	49.475012	-2.521379	Bedrock	Bedrock, *Patella* sp., *Cirripedia* , *Littorina* sp., *Ulva* ., sp. *Corallina* sp., *Porifera* sp etc.
04/05/2019	14:35	7	49.474987	-2.519356	Bedrock	Bedrock, *Patella* sp., *Cirripedia* , *Littorina* sp., *Ulva* ., sp. *Corallina* sp., *Porifera* sp. *Steromphala* present.

Appendix 2. Table summarising the sediment particle size for samples collected at Longue Hogue South in 2019. Data are expressed as percentage of material retained on each sieve.

Sieve size(µm)	3	4	5	6	7	8	9
>63000	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45000 to 63000	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31500 to 45000	0.00	0.00	0.00	0.00	4.80	0.00	0.00
22400 to 31500	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16000 to 22400	2.07	0.00	0.00	0.00	0.00	0.00	0.00
11200 to 16000	0.73	5.14	0.00	0.07	0.36	0.43	0.00
8000 to 11200	4.14	5.71	0.00	0.08	0.01	0.68	0.06
5600 to 8000	9.92	4.92	0.00	0.40	0.00	1.09	0.26
4000 to 5600	17.85	8.00	0.00	0.84	0.01	1.94	0.37
2800 to 4000	15.58	6.51	0.00	1.03	0.04	3.70	0.24
2000 to 2800	11.35	6.38	0.05	1.37	0.10	4.08	0.37
1400 to 2000	10.11	7.22	0.06	2.15	0.28	4.47	0.49
1000 to 1400	5.62	6.40	0.07	2.03	0.78	4.24	1.10
710 to 1000	3.14	6.76	0.11	2.11	1.70	3.89	1.10
500 to 710	2.34	7.00	0.19	1.55	3.29	4.15	1.15
355 to 500	1.19	7.02	0.32	0.85	3.88	4.20	0.96
250 to 355	0.63	8.63	1.15	0.66	6.96	3.80	0.97
180 to 250	0.82	5.58	12.30	5.30	13.97	9.32	4.16
125 to 180	2.44	5.78	46.55	47.00	10.96	34.42	40.10
90 to 125	2.66	3.07	26.23	25.85	2.59	13.60	27.27
63 to 90	1.89	1.41	8.44	7.12	0.53	2.77	8.25
<63	7.52	4.46	4.54	1.59	49.73	3.22	13.16
%Gravel (>2mm):	61.65	36.66	0.05	3.79	5.33	11.92	1.10
%Sand (63µm - 2mm):	30.83	58.88	95.41	94.63	44.94	84.87	72.90
%Mud (<63µm):	7.52	4.46	4.54	1.59	49.73	3.22	26.00

Appendix 3. Table summarising the Folk categories for the sediment samples collected at Longue Hougue South in May 2019.

Station Station	% Gravel (>2mm):	% Sand (63µm-2mm):	% Mud (<63µm):	Folk	EUNIS
3	61.65	30.83	7.52	msG	Mixed
4	36.66	58.88	4.46	sG	Mixed
5	0.05	95.41	4.54	S	Sand
6	3.79	94.63	1.59	(g)S	Sand
7	5.33	44.94	49.73	gM	Mixed
8	11.92	84.87	3.22	gS	Sand
9	1.10	72.90	26.00	(g)mS	Mud
Average	17.21	68.92	13.86	gmS	Mixed

Appendix 4. Table summarising the tested contaminants levels within sediments collected at Longue Hogue South in May 2019.

Contaminant	Station					
	4	5	6	7	8	9
Metals						
Arsenic (mg/Kg)	5.5	3.7	4.1	2.5	2.7	2.1
Cadmium (mg/Kg)	0.08	0.09	0.1	0.08	0.08	0.08
Chromium (mg/Kg)	33.7	43.5	39	24.1	13.1	9.8
Copper (mg/Kg)	6.5	7.8	9.8	5.9	5.6	4.6
Lead (mg/Kg)	8.5	8.8	8.1	3.8	6.3	6.3
Mercury (mg/Kg)	<0.015	0.04	<0.015	<0.015	0.03	<0.015
Nickel (mg/Kg)	11	10.9	10.7	8.3	6.3	4.7
Zinc (mg/Kg)	27.6	27.5	29.8	14.6	18.9	17.2
Dibutyltin (mg/Kg)	<0.001	0.0015	<0.001	<0.001	<0.001	<0.001
Tributyltin (mg/Kg)	<0.001	0.0163	<0.001	<0.001	<0.001	<0.001
Polycyclic aroatic hydrocarbons (PAHs)						
Naphthalene (µg/Kg)	<1	4.35	1.02	<1	1.69	7.36
Acenaphthylene (µg/Kg)	<1	3.93	<1	<1	<1	2.89
Acenaphthene (µg/Kg)	<1	1.74	<1	<1	<1	2.05
Fluorene (µg/Kg)	<1	3.41	<1	<1	<1	3.96
Phenanthrene (µg/Kg)	1.44	24.7	2.47	2.08	3.41	31.7
Anthracene (µg/Kg)	<1	16.9	<1	1.35	1.17	18.4
Fluoranthene (µg/Kg)	3.32	111	9.42	9.7	9.79	85.1
Pyrene (µg/Kg)	2.94	94.3	8.2	8.71	8.08	70.2
Benzo[a]anthracene (µg/Kg)	1.96	53.7	4.24	4.47	5.99	31.6
Chrysene (µg/Kg)	1.9	45.7	4.42	4.51	4.42	27.4
Benzo[b]fluoranthene (µg/Kg)	2.23	34.9	4.1	4.52	5.19	24.2
Benzo[k]fluoranthene (µg/Kg)	1.38	22.2	2.61	2.21	2.26	13.9
Benzo[a]pyrene (µg/Kg)	2.45	43.8	4.53	5.26	4.59	33.5
Indeno[1,2,3-cd]pyrene (µg/Kg)	2.13	26.2	2.99	3.67	3.36	20.4
Diben[ah]anthracene (µg/Kg)	<1	4.75	<1	<1	<1	4.5
Benzo[ghi]perylene (µg/Kg)	2.13	23.4	3.44	3.4	3.16	19.8
Benzo[e]pyrene (µg/Kg)	1.65	25.3	3.24	3.24	3.69	19.7
C1-naphthalenes (µg/Kg)	1.25	9.13	3.12	<1	5.41	11.4
C1-phenanthrene (µg/Kg)	1.42	28.5	2.84	2.34	3.43	23.8
C2-naphthalenes (µg/Kg)	1.21	9.77	3.4	1.56	5.46	11.1
C3-naphthalenes (µg/Kg)	<1	10.4	2.32	<1	3.64	10.4
Perylene (µg/Kg)	<1	11.6	1.05	1.43	1.23	8.75
Total Hydrocarbon Content (mg/Kg)	<1	17.6	23.7	<1	69.3	15

Appendix 5. Table showing the faunal abundance matrix from samples collected at Longue Hogue South in May 2019 using a 0.1m^2 Hamon grab.

Taxa	1	2	3	4	5	6	7	8
PORIFERA spp. indet.	0	1	0	0	0	0	0	0
Sycon sp.	1	7	2	0	0	0	0	0
Cliona spp. indet.	0	1	0	0	0	0	0	0
Sertularia spp.	0	0	1	0	0	0	0	0
Edwardsiidae spp. indet.	1	1	3	1	0	0	0	0
PLATYHELMINTHES "TURBELLARIA" spp. indet.	0	0	2	0	0	0	0	0
NEMERTEA spp. indet.	3	0	22	5	4	6	0	2
NEMATODA spp. indet.	3	4	36	5	0	0	0	1
CHAETOGNATHA spp. indet.	1	4	0	0	0	0	0	0
Golfingia vulgaris juv.	0	0	13	6	0	0	0	0
Golfingia margaritacea	0	1	0	0	0	0	0	0
Nephasoma minutum	0	0	21	5	0	0	0	0
Polynoidae spp. indet.	0	0	0	0	0	0	1	0
Adyte hyalina	0	0	3	0	0	0	0	0
Harmothoe spp. indet.	0	0	3	0	0	0	0	0
Malmgrenia darbouxi	0	0	0	1	0	0	0	0
Malmgrenia ljungmani	2	1	0	0	0	0	0	0
Malmgrenia marphysae	0	0	2	0	0	0	0	0
Pholoe inornata	0	0	4	0	0	0	0	1
Pisione remota	0	13	0	0	0	0	0	0
Phyllodocidae spp. indet.	0	0	1	0	0	0	0	0
Mystides caeca	0	0	1	0	0	0	0	0
Pseudomystides limbata	0	0	8	1	0	0	0	0
Eulalia mustela	3	0	4	7	0	0	0	0
Eumida spp. juv.	1	0	1	0	0	0	0	0
Pterocirrus macroceros	0	0	2	0	0	0	0	0
Glycera spp. juv.	0	1	0	0	0	0	0	0
Glycera lapidum agg.	4	4	6	2	0	0	0	0
Sphaerodorum gracilis	0	0	21	0	0	0	0	0
Gyptis spp. indet.	0	2	2	0	0	0	0	0
Hesiospina aurantiaca	1	0	2	0	0	0	0	0
Psamathe fusca	1	0	0	0	0	0	0	0
Eurysyllis tuberculata	0	0	16	0	0	0	0	0
Syllis mauretanica	14	4	9	14	0	0	0	0
Syllis armillaris agg.	0	0	5	0	0	0	0	0
Syllis licheri	2	2	0	0	0	0	0	0
Trypanosyllis coeliaca	7	0	6	1	0	0	0	0
Amblyosyllis formosa	0	0	3	0	0	0	0	0
Odontosyllis gibba	0	0	1	0	0	0	0	0
Streptosyllis campoyi	0	0	0	1	0	0	0	0
Exogone sp.	0	0	19	0	0	0	0	0
Exogone naidina	0	0	0	1	0	0	0	0
Sphaerosyllis bulbosa	9	112	39	15	0	0	0	1
Erinaceusyllis erinaceus	0	0	1	0	0	0	0	0
Sphaerosyllis hystrix	0	4	26	3	0	0	0	0
Nereididae spp. juv.	0	0	4	0	0	0	0	0
Eunereis longissima	0	1	0	0	0	0	0	0
Nephtyidae spp. juv.	0	0	0	1	0	0	0	0
Nephtys cirrosa	0	0	0	0	0	0	0	1
Pareurythoe borealis	2	0	1	0	0	0	0	0
Eunicidae spp. juv.	0	1	4	0	0	0	0	0
Eunice vittata	3	0	3	0	0	0	0	0
Lysidice ninetta	0	0	2	0	0	0	0	0
Paucibranchia bellii	0	0	0	0	15	11	0	0
Marphysa sanguinea	0	1	0	0	0	0	0	0
Lysidice unicornis	2	0	0	0	1	3	0	1
Lumbrineris nr cingulata	6	0	21	1	0	0	0	0
Lumbrineris latreilli	0	0	1	1	0	0	0	3
Scoletoma impatiens	1	0	1	0	0	0	0	0
Arabella iricolor	0	0	2	0	0	0	0	0
Protodorvillea kefersteini	12	0	2	0	0	0	0	1

Taxa	1	2	3	4	5	6	7	8
Schistomeringos neglecta	3	0	1	0	0	0	0	0
Scoloplos armiger agg.	0	0	0	0	6	14	1	0
Aricidea catherinae	0	0	0	0	2	0	1	1
Aricidea cerrutii	0	0	1	2	1	0	0	0
Cirrophorus furcatus	0	0	0	0	0	0	0	1
Paradoneis lyra	1	0	1	1	0	0	0	0
Poecilochaetus serpens	0	0	0	0	0	0	1	0
Spionidae spp. indet.	0	0	0	2	0	0	0	0
Aonides oxycephala	18	2	15	0	0	0	0	0
Aonides paucibranchiata	0	1	0	6	0	0	0	0
Laonice bahusiensis	3	0	29	0	0	0	0	0
Malacoceros tetracerus	0	0	0	0	1	0	1	0
Microspio atlantica	0	0	0	0	2	0	1	0
Dipolydora coeca	1	0	0	4	0	0	0	0
Aurospio banyulensis	0	0	0	3	0	0	0	0
Spio symphyta	0	3	3	1	159	104	78	11
Spiophanes bombyx	0	0	0	0	0	1	1	0
Aphelochaeta spp. indet.	0	0	1	1	0	0	0	0
Caulleriella alata	0	0	0	2	0	0	0	0
Caulleriella bioculata	1	0	0	0	0	0	0	0
Chaetozone zetlandica agg.	0	0	0	1	0	0	0	0
Diplocirrus stopbowitzi	1	0	0	0	0	0	0	0
Pherusa spp. indet.	0	0	1	0	0	0	0	0
Macrochaeta spp. indet.	0	1	0	0	0	0	0	0
Mediomastus fragilis	1	0	11	2	0	0	0	1
Notomastus latericeus	4	5	6	19	16	36	3	10
Maldanidae spp. regen.	0	0	0	0	4	0	0	0
Microclymene tricirrata	1	0	3	0	17	0	0	9
Leiochone sp. indet.	0	0	3	6	3	7	4	0
Euclymene lombricoides	0	0	1	0	0	0	0	0
Euclymene oerstedii	0	0	1	1	8	19	17	8
Heteroclymene robusta	0	0	0	0	0	0	1	0
Praxillella affinis	0	0	2	1	4	1	3	3
Nicomache/Petaloproctus sp. indet.	1	0	3	0	0	0	0	0
Asclerocheilus intermedius	1	0	0	4	0	0	0	0
Scalibregma celticum	0	0	0	1	0	0	0	0
Sclerocheilus minutus	2	0	1	0	0	0	0	0
Polygordius lacteus	12	5	18	0	0	0	0	0
Galathowenia fragilis	0	0	1	0	0	0	0	0
Galathowenia oculata	0	0	0	0	0	0	0	7
Ampharete lindstroemi agg.	0	0	3	0	0	0	0	0
Terebellides sp.	0	0	2	0	0	0	0	0
Trichobranchus roseus	0	0	22	0	0	0	0	0
Terebellidae spp. juv.	1	0	2	2	0	0	0	0
Lanice conchilega	0	0	1	0	0	0	0	0
Phisidia aurea	0	0	3	0	0	0	0	0
Pista sp.	0	0	2	1	0	0	0	0
Pista cristata	0	0	0	2	0	0	0	0
Amaeana trilobata	0	0	0	2	0	0	0	0
Polycirrus spp. indet.	1	0	1	3	2	12	0	0
Chone spp	0	0	0	1	0	0	0	0
Jasmineira spp. indet.	0	0	1	0	0	0	0	0
Amphicorina spp.	0	0	9	0	0	0	0	0
Serpulidae spp.	0	1	0	0	0	0	0	0
Spirorbinae spp. indet.	0	0	1	0	0	0	0	0
Tubificinae spp.	0	0	2	1	0	0	0	0
Grania spp.	7	5	10	7	0	0	0	0
MYODOCOPIDA spp. indet.	0	0	9	0	0	0	0	3
PODOCOPIDA spp. indet.	0	4	0	0	0	0	0	0
Sarsinebalia urgorrii	0	0	0	0	0	0	0	1
Heteromysis formosa	0	5	0	0	0	0	0	0
Apherusa bispinosa	0	0	62	0	0	0	0	0
Apherusa cirrus	0	0	1	0	0	0	0	0
Apherusa jurinei	0	0	2	0	0	0	0	0

Taxa	1	2	3	4	5	6	7	8
Synchelidium maculatum	0	0	0	0	1	0	0	0
Stenothoe monoculoides	0	6	0	0	0	0	0	0
Urothoe elegans	0	0	0	0	2	0	0	16
Harpinia sp. indet.	0	0	1	0	0	0	0	0
Harpinia crenulata	0	0	2	0	0	0	0	0
Harpinia pectinata	0	0	4	0	0	0	0	0
Metaphoxus fultoni	0	6	22	0	0	0	0	0
Normanion quadrimanus	0	2	3	0	0	0	0	0
Orchomene cf. humilis	25	16	4	0	0	0	0	0
Socarnes erythrophthalmus	8	82	38	0	0	0	0	0
Liljeborgia kinahani	1	6	1	0	0	0	0	0
Idunella picta	0	0	2	0	0	0	0	0
Nototropis guttatus	0	0	0	1	0	0	0	0
Nototropis vedlomensis	0	0	0	0	0	0	0	1
Guernea coalita	0	7	1	0	0	0	0	0
Ampelisca tenuicornis	0	0	0	0	1	0	0	1
Ampelisca typica	0	0	0	0	0	0	0	2
Bathyporeia tenuipes	0	0	0	0	0	0	2	0
Abludomelita gladiosa	0	0	54	0	0	0	0	0
Animoceradocus semiserratus	23	37	124	0	0	0	0	0
Microprotopus maculatus	0	0	1	0	0	0	0	0
Jassa falcata	0	0	0	1	0	0	0	0
Aoridae spp. female	0	0	15	0	0	0	0	0
Aora gracilis	0	0	0	1	0	0	0	0
Leptocheirus spp. indet.	0	0	19	0	0	0	0	0
Leptocheirus hirsutimanus	2	1	0	0	0	0	0	0
Leptocheirus pectinatus	4	45	224	0	0	0	0	2
Leptocheirus tricristatus	3	1	342	0	0	0	0	0
Microdeutopus versiculatus	0	0	3	0	0	0	0	0
Uncinotarsus pellucidus	0	3	0	0	0	0	0	0
Centraloecetes kroyeranus	0	0	0	0	1	0	0	0
Caprella acanthifera	0	0	1	1	0	0	0	0
Phtisica marina	0	0	0	0	0	0	0	1
Cyathura carinata	0	0	6	0	0	0	0	0
Paranthura costana	0	0	2	0	0	0	0	0
Natatolana borealis	0	0	0	0	0	0	0	1
Sphaeromatidae spp. juv.	0	0	1	0	0	0	0	0
Dynamene bidentata	2	1	0	0	0	0	0	0
Janira maculosa	5	0	19	0	0	0	0	0
Microcharon harrisi	0	2	0	0	0	0	0	0
Paramunna bilobata	0	1	0	0	0	0	0	0
Zeuxo holdichi	0	0	0	0	0	2	0	0
Pseudoparatanais batei	0	0	2	0	0	0	0	0
Tanaopsis graciloides	0	0	3	1	0	0	0	0
Paratyphlotanais microcheles	0	1	16	0	0	0	0	0
Pseudotanais jonesi	0	0	1	0	0	0	0	0
Apseudopsis latreillii	1	0	0	2	0	0	22	115
Vaunthompsonia cristata	0	1	43	0	0	0	0	0
Nannastacus unguiculatus	0	1	0	0	0	0	0	0
Galathea intermedia megalopa	0	0	4	0	0	0	0	0
BRACHYURA spp. megalopa	0	0	0	0	0	0	1	0
BRACHYURA spp. zoea	0	0	0	0	0	0	1	0
Ebalia tuberosa	0	0	1	0	0	0	0	0
Majidae spp. juv.	0	0	1	0	0	0	0	0
Atelecyclus rotundatus juv.	0	0	0	0	0	0	0	1
Liocarcinus pusillus	1	0	0	0	0	0	0	0
Leptochiton cancellatus	0	0	6	1	0	0	0	0
Emarginula rosea	0	0	1	0	0	0	0	0
Tricolia pullus	0	0	21	0	0	0	0	0
Gibbula spp. juv.	0	0	2	0	0	0	0	0
Gibbula tumida	0	0	1	0	0	0	0	0
Steromphala cineraria	0	0	1	0	0	0	0	0
Clelandella miliaris juv.	0	0	17	0	0	0	0	0
Jujubinus montagui	0	0	8	0	0	0	0	0

Taxa	1	2	3	4	5	6	7	8
Patella pellucida	0	0	6	0	0	0	0	0
Rissoa parva	0	0	7	0	0	0	0	1
Alvania beanii	0	0	1	0	0	0	0	0
Alvania cimicoides	0	0	1	0	0	0	0	0
Alvania punctura	0	0	1	0	0	0	0	0
Onoba semicostata	0	0	10	0	0	0	0	0
Caecum glabrum	0	13	0	0	0	0	0	0
Lamellaria latens	0	0	2	0	0	0	0	0
Eulimidae sp. juv.	0	1	0	0	0	0	0	0
Tritia reticulata	0	0	0	0	0	2	0	0
Chrysallida sp.	1	0	0	0	0	0	0	0
Eulimella ventricosa	0	0	0	1	0	0	0	0
Retusa spp. juv.	0	1	0	0	0	0	0	0
Nucula nucleus	0	0	2	0	0	0	0	0
Glycymeris glycymeris juv.	0	1	0	0	0	0	0	0
Mytilidae spp. juv.	0	0	3	0	0	0	0	0
Modiolula phaseolina juv.	0	0	3	0	0	0	0	0
Musculus subpictus	0	0	1	0	0	0	0	0
Pectinidae spp. juv.	0	0	1	0	0	0	0	0
Mimachlamys varia juv.	0	0	0	1	0	0	0	0
Anomiidae spp. juv.	0	1	0	0	0	0	0	0
Lucinoma borealis juv.	0	0	0	0	2	0	0	0
Spisula elliptica	0	0	0	3	0	0	0	0
Moerella donacina	0	0	0	0	0	1	1	0
Gari depressa	1	0	0	0	0	0	0	0
Abra nitida	0	0	0	0	0	0	0	1
Veneridae spp. Juv.	0	0	0	1	0	0	0	0
Venus casina	0	0	0	0	0	0	0	1
Timoclea ovata	0	1	27	4	0	0	0	4
Polititapes rhomboides	0	0	15	0	0	0	0	0
Dosinia lupinus	0	0	3	0	0	0	0	0
Dosinia exoleta	0	0	0	0	1	1	1	0
Mya arenaria	0	0	1	0	0	0	0	0
Thracia phaseolina	0	0	0	1	0	0	0	0
Lyonsia norwegica	0	0	1	0	0	0	0	0
Gwynia capsula	0	1	0	0	0	0	0	0
Tubulipora spp. indet.	0	1	0	0	0	0	0	0
Oncousoecia dilatans	0	1	0	0	0	0	0	0
Callopora discreta	0	1	0	0	0	0	0	0
Scrupocellaria scrupea	0	1	0	0	0	0	0	0
Puellina spp.	0	1	0	0	0	0	0	0
Hippothoa flagellum	0	1	0	0	0	0	0	0
Chorizopora brongniartii	0	1	0	0	0	0	0	0
Escharoides coccinea	0	1	0	0	0	0	0	0
Escharella immersa	0	1	0	0	0	0	0	0
Schizomavella discoidea	0	1	0	0	0	0	0	0
Microporella ciliata	0	1	0	0	0	0	0	0
Schizotheca fissa	0	1	0	0	0	0	0	0
Rhynchozoon bispinosum	0	1	0	0	0	0	0	0
Phoronis spp. indet.	3	0	1	0	0	0	0	0
Amphipholis squamata	15	81	211	1	0	0	0	1
Echinocyamus pusillus	0	1	8	1	0	0	0	0
Rhabdopleura compacta	0	1	0	0	0	0	0	0
ASCIDIACEA spp. indet.	0	4	1	3	0	0	0	0
Polycarpa spp. juv.	0	0	1	0	0	0	0	0
Ammodytes sp.	0	1	0	0	0	0	0	0

Appendix 6. Major group biomass of each benthic faunal sample collected at Longue Hogue South in May 2019.

Biomass (g AFDW)	1	2	3	4	5	6	7	8	Total
Annelida	0.2709	0.1140	0.4784	0.1141	0.1465	0.1204	0.0920	0.0512	1.3875
Crustacea	0.0574	0.0195	0.2514	0.0023	0.0018	0.0002	0.0114	0.0747	0.4187
Mollusca	0.0212	0.0004	0.4272	0.0738	0.0152	0.2029	0.0138	2.0616	2.8161
Echinodermata	0.0007	0.0020	0.0164	0.0022	-	-	-	0.0000	0.0214
Miscellanea	0.0058	0.0407	0.0335	0.0038	0.0008	0.0146	-	0.0062	0.1054
Total	0.3559	0.1767	1.2069	0.1962	0.1643	0.3381	0.1173	2.1938	4.75

Appendix 7a. Biotope designation rationale using DDV images collected at Longue Hogue South in May 2019.

DDV Station	Depth (m)	Substrate	Visible Fauna	Algae Present (attached only)	Energy	Designated Biotope	EUNIS code
1	13.2	Bedrock & maerl	Cirripedia, *Steromphala* sp.	Corallinaceae crusts, *Corallina* spp. *Lithothamnium coralloides* or *Phymatolithon calcareum* , various foliose reds, *Ulva* sp., dark encrusting reds, *Dictyota dichotoma*	High	Maerl beds	A5.51
1	13.1	Bedrock & maerl	Cirripedia	Corallinaceae crusts, Corallina spp. *Lithothamnium coralloides* or *Phymatolithon calcareum, Drachiella spectabilis,* various foliose reds, dark encrusting reds, encrusting brown, *Ulva* sp.	High	Maerl beds	A5.51
1	13.3	Bedrock & maerl	-	Corallinaceae crusts, Corallina spp. *Lithothamnium coralloides* or *Phymatolithon calcareum* , various foliose reds, dark encrusting reds, *Ulva* spp., *Drachiella spectabilis, Dictyota dichotoma*	High	Maerl beds	A5.51
1	13.3	Bedrock & maerl	*Steromphala* sp.?	Corallinaceae crusts, *Corallina* spp. *Lithothamnium coralloides* or *Phymatolithon calcareum* , various foliose reds, dark encrusting reds, *Dictyota dichotoma, Chondrus crispus* , possibly *Kallymenia* or *Nitophyllum* ,unidentified green.	High	Maerl beds	A5.51
2	13.6	Bedrock & maerl	Gastropoda - possibly *Euspira* sp. or a whelk.	*Laminaria hyperborea* , Corallinaceae crusts, *Corallina* spp. *Lithothamnium coralloides* or *Phymatolithon calcareum* , various foliose reds, dark encrusting reds, *Dasysiphonia japonica, Dictyota dichotoma,* unidentified green.	High	Maerl beds	A5.51
2	13.9	Bedrock & maerl	-	Corallinaceae crusts, *Corallina* spp. *Lithothamnium coralloides* or *Phymatolithon calcareum* , various foliose reds, dark encrusting reds, *Dictyota dichotoma, Ulva spp.*	High	Maerl beds	A5.51
3	15.3	Bedrock & boulders	-	*Dictyota dichotoma, Corallinaceae crusts, Corallina spp. various foliose reds, dark encrusting reds, Ulva spp.*	High	Foliose red seaweeds on exposed infralittoral rock	A3.116
4	13.4	Bedrock & maerl	Indet. bivalves	*Dictyota dichotoma, Corallina spp. Lithothamnium coralloides or Phymatolithon calcareum, various foliose reds, Ulva spp., Dasysiphonia japonica, Chondrus crispus*	High	Maerl beds	A5.51

DDV Station	Depth (m)	Substrate	Visible Fauna	Algae Present (attached only)	Energy	Designated Biotope	EUNIS code
4	13.2	Bedrock & maerl	-	*Dictyota dichotoma*, *Corallina* spp. *Lithothamnium coralloides* or *Phymatolithon calcareum* , various foliose reds, dark encrusting reds, *Ulva* spp., *Dasysiphonia japonica, Chondrus crispus*	High	Maerl beds	A5.51
4	13.2	Bedrock & maerl	-	*Dictyota dichotoma*, *Corallina* spp. *Lithothamnium coralloides* or *Phymatolithon calcareum* , various foliose reds, dark encrusting reds, *Ulva* spp., *Dasysiphonia japonica.*	High	Maerl beds / Mixed kelp and red seaweeds on infralittoral boulders, cobbles and gravel in tidal rapids	A3.223
5	11.1	Bedrock	-	*L. hyperborea,* various foliose reds, *Ulva* sp., *Corallina* sp.	High	*Laminaria hyperborea* park with dense foliose red seaweeds on exposed upper infralittoral rock.	A3.1152
5	11.1	Bedrock	-	*S. latissima, L. hyperborea,* various foliose reds, Corallinacea	High	*Laminaria hyperborea* park with dense foliose red seaweeds on exposed upper infralittoral rock.	A3.1152
5	10.5	Bedrock	-	*L. hyperborea,* various foliose reds, Corallinaceae crusts, *Co*	High	*Laminaria hyperborea* park with dense foliose red seaweeds on exposed upper infralittoral rock.	A3.1152
6	12	Bedrock, maerl & G	Indet. gastropoda	*Sargassum muticum*, *Corallina* spp. *Lithothamnium coralloides* or *Phymatolithon calcareum* , Corallinaceae crusts, indet. red algae	High	Maerl beds	A5.51
7	10.5	Bedrock, maerl & G	*Gibbula cineraria*	*Dictyota dichotoma, Corallina* spp. *Lithothamnium coralloides* or *Phymatolithon calcareum, L. hyperborea*	High	*Laminaria hyperborea* park with dense foliose red seaweeds on exposed upper infralittoral rock.	A3.1152
7	11.3	Bedrock, maerl & G	-	*L. hyperborea* , dark encrusting red, Corallina spp. Lithothamnium coralloides *or Phymatolithon calcareum, S. muticum* , *D. dichotoma*	High	*Laminaria hyperborea* park with dense foliose red seaweeds on exposed upper infralittoral rock.	A3.1152
8	14.6	Maerl	-	Corallina spp. *Lithothamnium coralloides* or *Phymatolithon calcareum, C. crispus* , indet. red.	High	Maerl beds	A5.51
8	14.5	Maerl	-	Corallina spp. *Lithothamnium coralloides* or *Phymatolithon calcareum, C. crispus, D. japonica*	High	Maerl beds	A5.51
8	14.6	Maerl	-	Failed image	-	-	-
8	14.6	Maerl	Possible *T. phillipinarum*	Corallina spp. *Lithothamnium coralloides* or *Phymatolithon calcareum, C. crispus*	High	Maerl beds	A5.51
9	10.3	Bedrock	-	*L. hyperborea, Corallinaceae* crusts, dark encrusting reds, *U*	High	*Laminaria hyperborea* park with dense foliose red seaweeds on exposed upper infralittoral rock.	A3.1152

DDV Station	Depth (m)	Substrate	Visible Fauna	Algae Present (attached only)	Energy	Designated Biotope	EUNIS code
9	9.6	Bedrock	-	*Laminaria* sp., foliose red.	High	*Laminaria hyperborea* park with dense foliose red seaweeds on exposed upper infralittoral rock.	A3.1152
9	9.8	Bedrock	Hydrozoa	*L. hyperborea*, possibly *N. punctatum* or *R. divaricata, Ulva*	High	*Laminaria hyperborea* park with dense foliose red seaweeds on exposed upper infralittoral rock.	A3.1152
9	9.7	Bedrock	Gibbula sp	*L. hyperborea, S. muticum,* foliose reds, *Ulva* sp., Corallinace	High	*Laminaria hyperborea* park with dense foliose red seaweeds on exposed upper infralittoral rock.	A3.1152
10	10.2	Bedrock	-	*L. hyperborea*, foliose red, indet. green.	High	*Laminaria hyperborea* park with dense foliose red seaweeds on exposed upper infralittoral rock.	A3.1152
10	11.2	Bedrock	-	*L. hyperborea*	High	*Laminaria hyperborea* park with dense foliose red seaweeds on exposed upper infralittoral rock.	A3.1152
11	16.5	G & maerl	-	Corallina spp. *Lithothamnium coralloides* or *Phymatolithon calcareum, C. crispus*, *D. japonica,* various foliose reds.	High	Maerl beds	A5.51
11	15.8	G & maerl	*Pentapora foliacea*	*Corallina spp. Lithothamnium coralloides* or *Phymatolithon calcareum, L. hyperborea*, *Halidrys siliquosa* unknown foliose red.	High	Maerl beds	A5.51
11	15.8	G & maerl	-	Foliose red algae (rare)	High	Maerl beds	A5.51
12	15.3	Bedrock	Hydrozoa, Porifera	*Laminaria hyperborea*, Corallinaceae crusts, C*orallina* spp., encrusting brown, dark encrusting reds, various foliose reds	High	*Laminaria hyperborea* park with dense foliose red seaweeds on exposed upper infralittoral rock.	A3.1152
12	15.3	Bedrock	-	*Laminaria hyperborea*, Corallinaceae crusts, C*orallina* spp. *Delesseria sanguinea*, encrusting brown, dark encrusting reds, various foliose reds	High	*Laminaria hyperborea* park with dense foliose red seaweeds on exposed upper infralittoral rock.	A3.1152
12	15.3	Bedrock	-	*Laminaria hyperborea*, Corallinaceae crusts, C*orallina* spp. *Delesseria sanguinea*, encrusting brown, dark encrusting reds, various foliose reds	High	*Laminaria hyperborea* park with dense foliose red seaweeds on exposed upper infralittoral rock.	A3.1152
13	8.1	S	Annelida/amphipod tubes	*Dasysiphonia japonica*	High	Sublittoral sands and muddy sands	A5.2
13	7.8	S	Annelida/amphipod tubes	*Dasysiphonia japonica*, *Ulva* sp.	High	Sublittoral sands and muddy sands	A5.2
13	7.5	S	Annelida/amphipod tubes	*Dasysiphonia japonica, Ulva* sp.	High	Sublittoral sands and muddy sands	A5.2

DDV Station	Depth (m)	Substrate	Visible Fauna	Algae Present (attached only)	Energy	Designated Biotope	EUNIS code
14	8	S	Annelida/amphipod tubes	Some unattached green	High	Sublittoral sands and muddy sands	A5.2
14	8.1	S	Annelida/amphipod tubes	-	High	Sublittoral sands and muddy sands	A5.2
14	8.3	S	Annelida/amphipod tubes	-	High	Sublittoral sands and muddy sands	A5.2
15	11.1	gS	Annelida/amphipod tubes, burrow holes in sediment, crab.	Indet 'fluffy' alga (occasional)	High	Sublittoral sands and muddy sands	A5.2
15	11.1	gS	Annelida/amphipod tubes, burrow holes in sediment, crab.	Indet 'fluffy' alga (occasional)	High	Sublittoral sands and muddy sands	A5.2
15	11.1	gS	Annelida/amphipod tubes, burrow holes in sediment, crab, Gastropoda	Indet 'fluffy' alga (occasional)	High	Sublittoral sands and muddy sands	A5.2
16	12.8	gS, G	-	*Dasysiphonia japonica*	High	Circalittoral coarse sediment	A5.14
16	12.3	gS, G	*Urticina felina*	*Chorda filum, Laminaria* sp., foliose reds, *Dasysiphonia japo*	High	Circalittoral coarse sediment	A5.14
16	11.5	gS, G	Gibbula sp.	*Chorda filum, Laminaria* sp., foliose reds, *Ulva* sp.	High	Circalittoral coarse sediment	A5.14
17	11.3	Bedrock, G, S	Scaphapoda	*Dasysiphonia japonica, Ulva sp.,* foliose reds, Corallinaceae crusts, dark encrusting reds, *Laminaria* sp.	High	*Laminaria hyperborea* park with dense foliose red seaweeds on exposed upper infralittoral rock.	A3.1152
17	11.3	Bedrock, G, S	-	*L. hyperborea* , Corallinaceae crusts, dark encrusting reds.	High	*Laminaria hyperborea* park with dense foliose red seaweeds on exposed upper infralittoral rock.	A3.1152
17	11.2	Bedrock, G, S	-	*L. hyperborea, Saccharina latissima,* various foliose reds.	High	*Laminaria hyperborea* park with dense foliose red seaweeds on exposed upper infralittoral rock.	A3.1152
18	7.6	gS	Annelida/amphipod tubes	*Dasysiphonia japonica* , *Ulva* sp.	High	Sublittoral sands and muddy sands	A5.2
18	7.6	gS	Annelida/amphipod tubes	*Dasysiphonia japonica* , *Ulva* sp.	High	Sublittoral sands and muddy sands	A5.2
18	7.5	gS	Annelida/amphipod tubes	*Dasysiphonia japonica* , *Ulva* sp.	High	Sublittoral sands and muddy sands	A5.2
19	12.6	gS	Annelida/amphipod tubes	*Dasysiphonia japonica* , *Ulva* sp.	High	Sublittoral sands and muddy sands	A5.2
19	12.6	gS	Gibbula, Gastropoda	*Dasysiphonia japonica*	High	Sublittoral sands and muddy sands	A5.2

DDV Station	Depth (m)	Substrate	Visible Fauna	Algae Present (attached only)	Energy	Designated Biotope	EUNIS code
19	12.5	gS	Macropodia	*Dasysiphonia japonica, Ulva sp.,* foliose reds	High	Sublittoral sands and muddy sands	A5.2

Appendix 7b. Biotope designation rationale - intertidal observations at Longue Hogue South in May 2019.

Intertidal Station	Substrate	Visible Fauna	Algae Present (attached only)	Energy	Designated Biotope	EUNIS code
1	C, gS, S	*Patella* , *Cirripedia* , *Gibbula* sp., *Steromphala* sp.	*Enteromorpha* (Frequent), possibly *Blidingia* spp., *Fucus serratus* (Rare)	High	Littoral mixed sediment	A2.4
2	C/bedrock	*Patella* , *Cirripedia* , *Gibbula* sp., *Steromphala* sp., *Littorina*	*S. muticum* in pools (O), some fine green films (O), *Corallina officinalis (O),* *Ulva* in pools	High	Mussel and/or barnacle communities	A1.11
3	C/bedrock	*Patella* , *Cirripedia* , *Littorina* sp.	Some green films (Rare)	High	Mussel and/or barnacle communities	A1.11
4	Bedrock	*Cirripedia* highly abundant on rock surface. *Patella* & *Porifera* also present., *Littorina* .	*S. muticum* in pools (O)	High	Mussel and/or barnacle communities	A1.11
5	C, G & S	Occasional large cobbles present with *Patella, Littorina* .	*Fucus* abundant, *Enteromorpha*	High	Littoral mixed sediment	A2.4
6	Bedrock	*Patella* , *Cirripedia* , *Littorina* sp., *Porifera* spp. etc.	*Fucus, C. officinalis* , *Osmundea pinnatifida, Mastocarpus stellatus, Enteromorpha, Ulva., sp.*	High	*Semibalanus balanoides, Fucus vesiculosus* and red seaweeds on exposed to moderately exposed eulittoral rock	A1.1132
7	Bedrock	*Patella* , *Cirripedia* , *Littorina* sp., *Porifera* spp. *Gibbula, Steromphala*	*Fucus, C. officinalis* , *O. pinnatifida, M. stellatus, Enteromorpha, Ulva., sp.*	High	*Semibalanus balanoides* , *Fucus vesiculosus* and red seaweeds on exposed to moderately exposed eulittoral rock	A1.1132

Appendix Plate 1 – Photographs of each of the macrofaunal grab samples collected during the 2019 benthic survey of Longue Hogue South, Guernsey

RHDLHS0419 01 (17 in the field)

RHDLHS0419 02 (18 in the field)

RHDLHS0419 03 (19 in the field)

RHDLHS0419 04 (13 in the field)

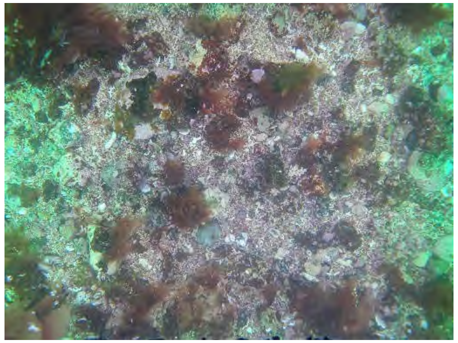
RHDLHS0419 05

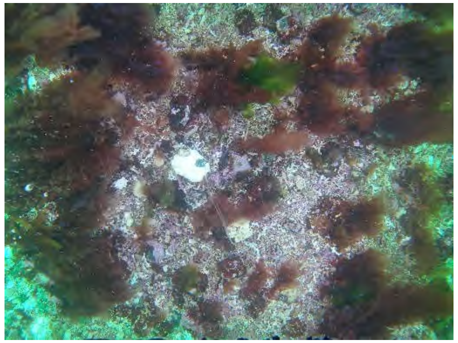
RHDLHS0419 06 (01 in the field)

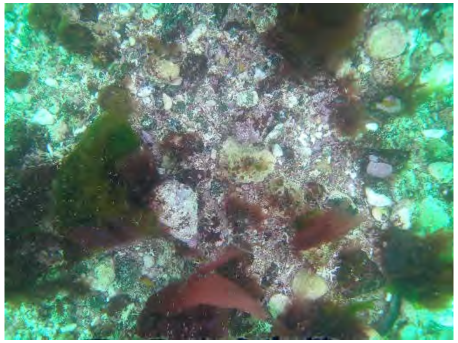
RHDLHS0419 07 (23 in the field)

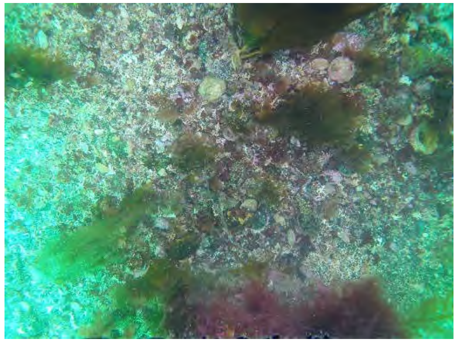
RHDLHS0419 08 (07 in the field)

Appendix Plate 2 – Stills collected at Longue Hougue South during the 2019 DDV survey, Guernsey


RHDLHS0419 01


RHDLHS0419 01


RHDLHS0419 01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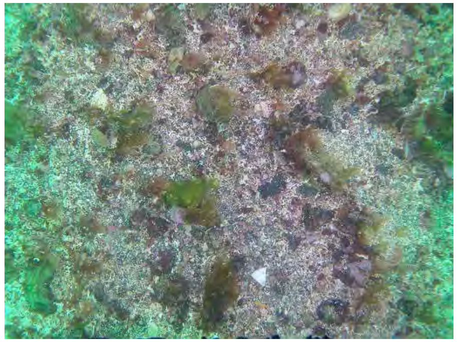
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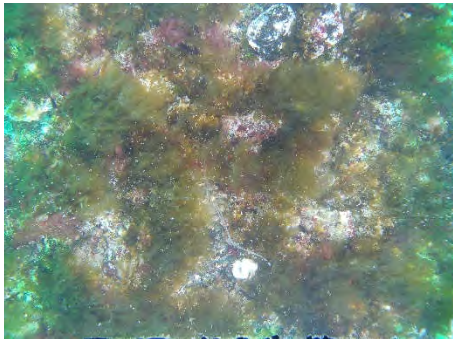
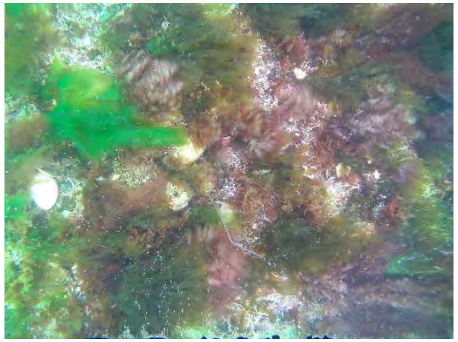

RHDLHS0419 03


RHDLHS0419 04

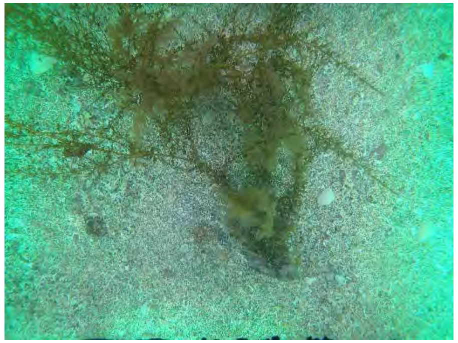

RHDLHS0419 04


RHDLHS0419 04

RHDLHS0419 05

RHDLHS0419 05

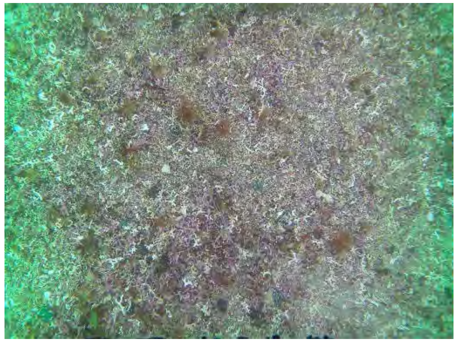
RHDLHS0419 05



RHDLHS0419 06

RHDLHS0419 07

RHDLHS0419 07



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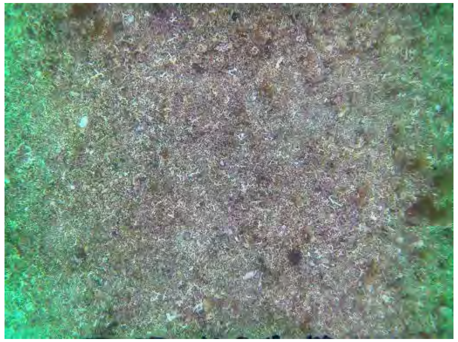

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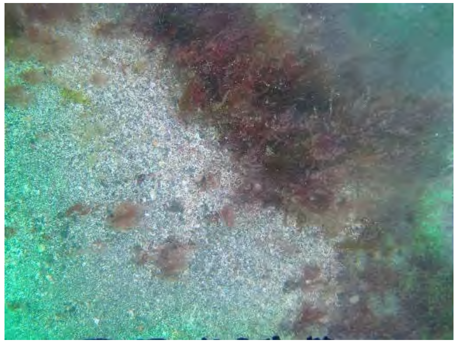
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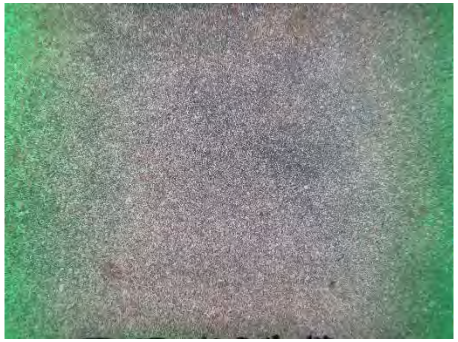
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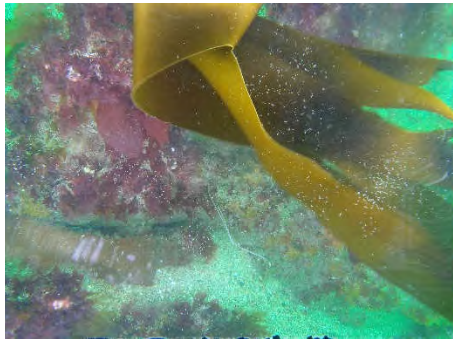
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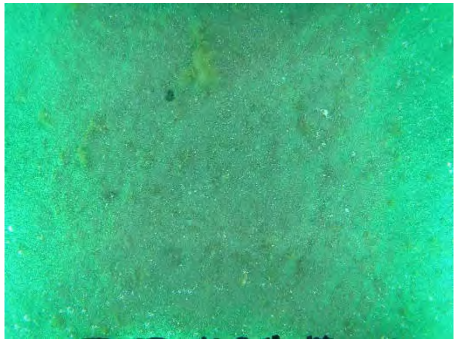
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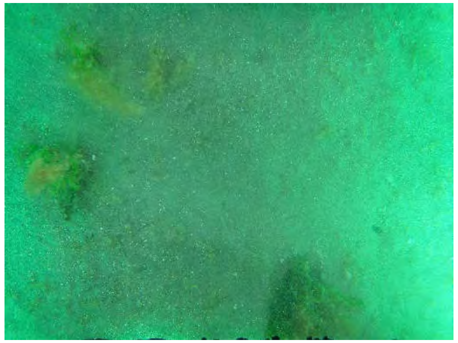
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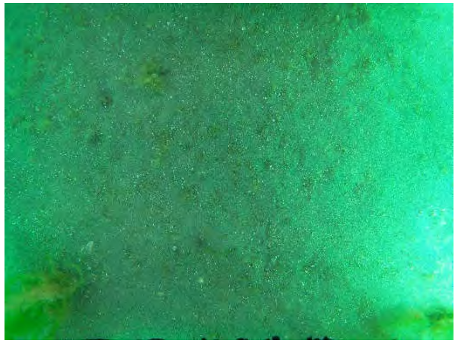
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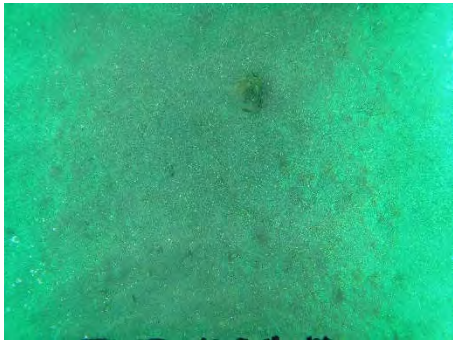
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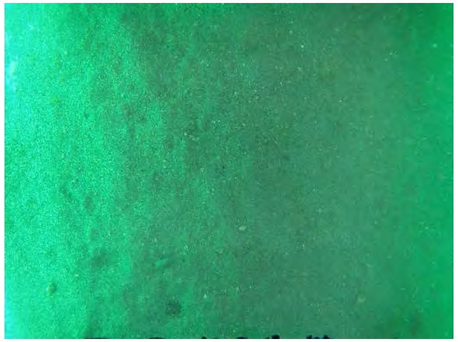
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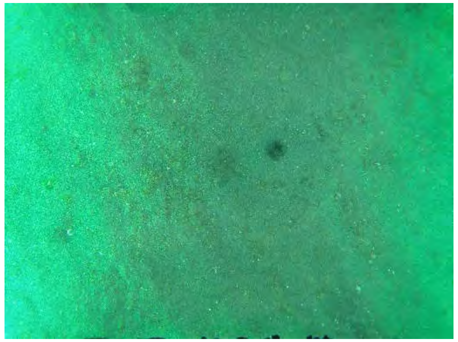
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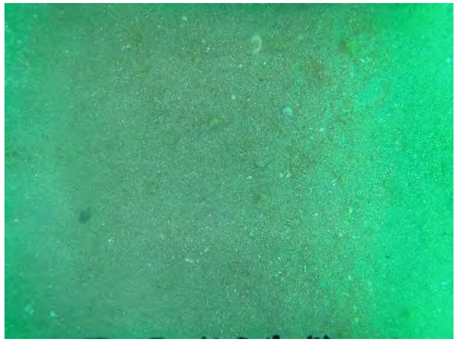
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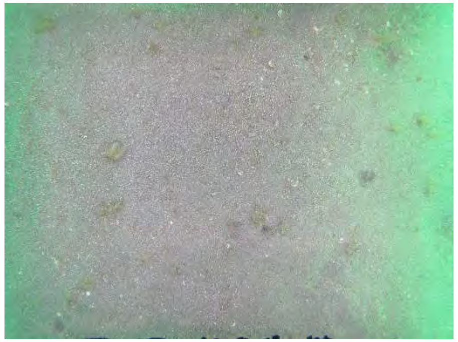
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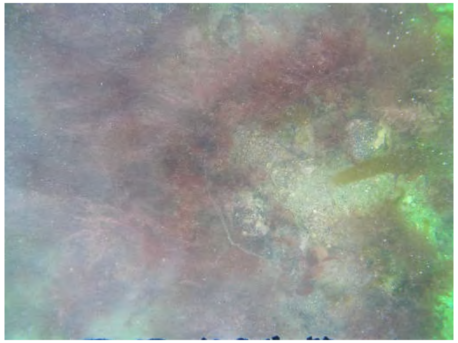
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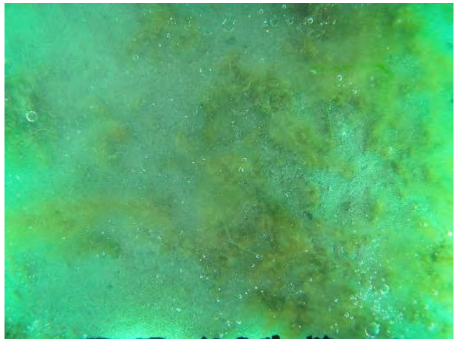
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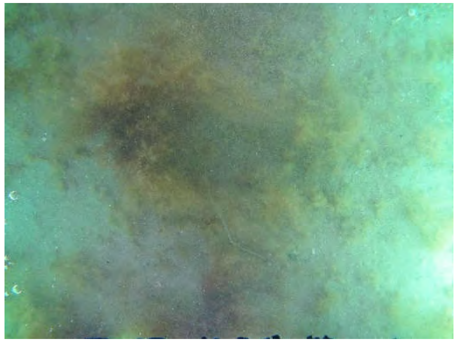
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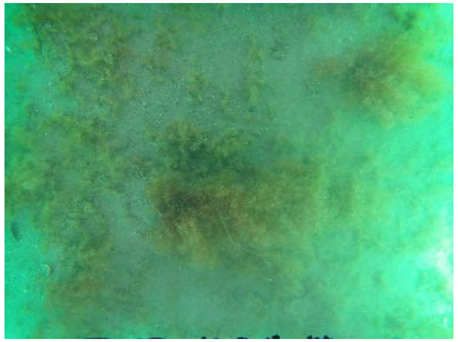
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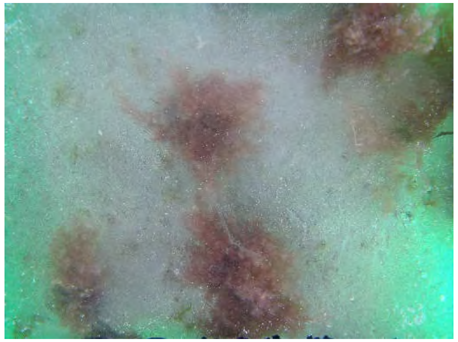
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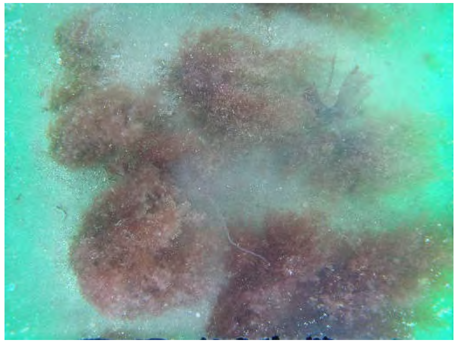
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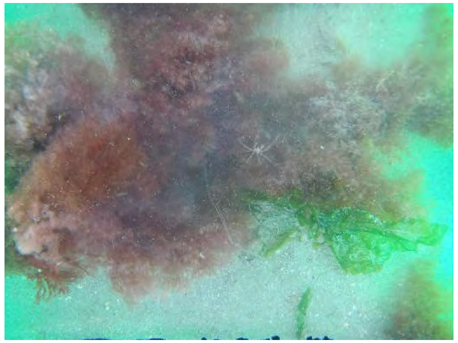
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