Full baseline Phase 1 and Phase 2 inter-tidal mapping survey of the rocky habitats of Whitsand and Looe Bay MCZ. Final report.

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Performing Company:

Ecospan Environmental Ltd.
Unit 8 Strashleigh View
Lee Mill Industrial Estate
Plymouth
Devon
PL21 9GS

Tel: 01752 897198
Email: info@ecospan.co.uk
www.ecospan.co.uk

Sponsor: Natural England

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Ecospan Environmental Ltd. is registered in England No. 5831900

Author(s): M D R Field

Approved By: M J Hutchings

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1. Jules Webber — Natural England
2. Trudy Russell — Natural England
2. Mike Field — Ecospan Environmental Ltd

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1 EXECUTIVE SUMMARY

An inter-tidal Phase 1 habitat mapping survey and Phase 2 quantitative sampling survey of the littoral rock feature within the Whitsand and Looe Bay MCZ was undertaken on spring tides from the 27th September to the 2nd October 2019.

The survey was undertaken using standard methodology and also included an assessment of the abundance of Invasive Non-Native Species (INNS) with particular emphasis on pom pom weed *Caulacanthus okamurae* and the Pacific oyster *Magallana gigas*. Any areas that were significantly affected by Pacific oysters (defined as Abundant or Superabundant on the SACFOR scale) were noted.

To provide further information on the fauna and flora communities within each habitat type, quantitative (quadrats) and semi-quantitative (timed search) sampling was undertaken within each major Habitat type identified. Quantitative and semi-quantitative sampling effort varied with the size and distribution of each Habitat type, with more transects allocated to the largest Habitat types.

The Habitat types identified had distinct faunal and floral communities as determined using multi-variate statistics. The similarity in community structure of the fauna and flora within the Habitat types was relatively high with both the timed search and quadrat data giving very similar results.

The Pacific oyster was rarely observed to the west of Whitsand Bay, with only a few individuals being observed close to Looe. However, in Whitsand Bay they were occasional to frequent on most of the mid to lower areas of rock and common in some areas. Only two small areas in Whitsand Bay were observed to be significantly affected, but it was apparent that there had been deliberate attempts to remove the oysters from the rocks in the more easily accessed parts of the Bay.

Pom pom weed has become well established within the MCZ. The abundance varied substantially over small areas where it could be abundant in an area and rare only a few metres away. It was largely absent from the middle areas of Whitsand Bay, but was more prevalent in the west of the survey area and in the Rame Head area. It is thought that this might be due to the availability of suitable habitat. During the Phase 2 survey it was recorded in approximately 20% of the quadrats assessed and just over 40% of the timed searches.

Other INNS observed within the survey area were only observed infrequently and at low abundancies and included wire weed (*Sargassum muticum*), the Australasian barnacle (*Austominius modestus*) and harpoon weed (*Asparagopsis armata*). Only one Species of Conservation Importance (SOCI), the stalked jellyfish *Calvadosia campanulata* was observed during this survey.

Although there is no previous data with which to compare the results from this survey, the fauna and flora of the inter-tidal rock appear to be relatively pristine and therefore most of the attributes could be judged to be in favourable condition, but with very low confidence. The target for INNS however, is unlikely to have been met with regard to both the Pacific oyster and pom pom weed and therefore it has probably failed with regard to this attribute.

2 INTRODUCTION

The Whitsand and Looe Bay Marine Conservation Zone (MCZ) is an inshore site located on the south coast of Cornwall which was designated in 2013 [1]. The landward site boundary follows the coastline along the mean high-water mark, from Hore Stone near Talland Bay in the west, to a point between Queener Point and Long Cove on Rame Head to the east. The seaward boundary is formed by a straight line across the bay, with a small extension jutting out to the south around Looe Island (Fig. 1). The site covers an area of 5217ha and is approximately 25 meters deep at the deepest point. At the extreme eastern end of Whitsand Bay the MCZ overlaps with the Plymouth Sound and Estuaries Special Area of Conservation (SAC) [2].

Whitsand Bay is a 6 km stretch of sand, shingle and rock, with gullies that have been carved by strong tides and cross-currents. The MCZ encompasses a range of habitats supporting a diverse array of marine life. The site contains intertidal and subtidal sand and coarse sediment habitats, as well as intertidal rocky habitats.

The intertidal rocky habitats of the MCZ are characterised by a high diversity of invertebrates such as sponges, bryozoans, anemones and sea squirts with the rocks around Hannafore in Looe Bay being especially rich in intertidal species. These habitats also support a high diversity of seaweeds. The rare giant goby (*Gobius cobitis*) has also been recorded in mid-shore rockpools within the MCZ and stalked jellyfish (*Haliclystus sp., Calvadosia campanulata* and *Calvadosia cruxmelitensis*) are also known to occur within this MCZ [1].

The protected features within the intertidal areas of the site together with the management targets for each are shown in Table 1.

Table 1. Protected inter-tidal features of the Whitsand and Looe Bay MCZ

Protected Feature	Management target
Giant goby	Maintain in a favourable condition
High energy inter-tidal rock	
Inter-tidal coarse sediment	
Inter-tidal sand and muddy sand	
Low energy inter-tidal rock	
Moderate energy inter-tidal rock	
Seagrass beds	
Stalked jellyfish	

Although a subtidal survey was carried out in 2013/14 [3], to date no survey of the intertidal features of the site has been completed. Consequently, Ecospan Environmental Ltd were commissioned to undertake a Phase 1 and Phase 2 habitat survey of the inter-tidal rocks within the MCZ in the early autumn of 2019.

3 AIMS AND OBJECTIVES

The aims of this survey were to undertake a Phase 1 and Phase 2 intertidal survey of the rocky habitats within the Whitsand and Looe bay MCZ in order to produce a baseline for:

- High energy intertidal rock
- Moderate energy intertidal rock

- Low energy intertidal rock

Specifically, the objectives were to:

- Map the main rock Habitat types and their associated communities within the Whitsand and Looe Bay MCZ
- Acquire high quality biological data of suitable resolution to allow key attributes of condition to be assessed according to CSM guidance for the intertidal features (Table 2)
- Using the data collected, produce a biotope map for the intertidal rock features of the MCZ
- Record the presence and location of the alga *Caulacanthus okamurae* (in addition to the Invasive Non-Native Species (INNS))
- Note any areas that are significantly affected by the abundance of Pacific oysters (*Magallana gigas)*
- Map, quantify (using the SACFOR scale) and describe, where possible, habitats or species of conservation interest (HOCI and SOCI) that were encountered during the survey

Table 2. Key attributes of the MCZ and their management targets.

Feature	Attribute	Target
All	Distribution: presence and spatial distribution of biological communities	Maintain the presence and spatial distribution of (feature) communities, according to the map
All	Extent and distribution	Maintain the total extent and spatial distribution of the feature
All	Structure: non-native species and pathogens	Reduce the introduction and spread of non-native species and pathogens, and their impacts
All	Structure: species composition of component communities	Maintain the species composition of component communities

4 METHODS

4.1 Survey dates and access

All survey work was carried out over spring tides from the 27th September to the 2nd October 2019 by two teams of surveyors from Ecospan Environmental Ltd. The height of low water at Whitsand Bay varied between 0.6 and 1.2 m above chart datum on these dates.

Due to adverse weather conditions the vast majority of the survey was undertaken on foot. However, to access the areas around Looe Island, the Hore Stone and Rame Head, shore teams were deployed from Ecospan Environmental Ltd's MCA category 3 coded RIB *Pagrus*.

4.2 Inter-tidal surveys

To enable effective targeting of effort on FOCI and littoral habitat types which are notable and/or representative within the MCZ, a two phased survey approach was used. During both

phases the presence of potential anthropogenic influences (e.g. sewers, land drains, bait digging etc), SOCI, INNS or any other relevant factors were recorded and any obvious impacts noted. Habitats were assigned using the EUNIS classification [4] to a minimum of level 5 wherever possible.

4.2.1 Phase 1 habitat mapping survey

The aim of the Phase I survey was to map the distribution and extent of littoral rock habitat types, focusing on but not limiting the survey to HOCI, and the MCZ qualifying habitats and species. This was achieved by examining geo-referenced aerial photography and subsequently ground-truthing defined habitats to establish the habitat types present (as per Procedural Guidelines 1-1 Inter-tidal resource mapping using aerial photographs in the Marine Monitoring Handbook [5]).

The Phase 1 survey aimed to achieve 100% coverage of the littoral rock. Pre-determined transects were established at approximately 750 m intervals where rocky habitats existed. These transects were added to the aerial photographs (from the channel coast) and the midpoint loaded into a Garmin 78 dGPS which was used for all position fixing during the course of the survey. The sampled positions are shown in Table 3 and have been super-imposed on the aerial photography in Fig.1.

Table 3. Sampled positions of the Phase 1 transects (OSGB 36 BUG)

Station No.	Co-ordinate (OSGB 36 BUG)	
	East	North
R1	224162	51444
R2	224117	51574
R3	224743	51910
R4	225343	52232
R5	225604	51314
R6	225922	51458
R7	225727	52269
R8	225755	52883
R9	226226	53586
R10	227054	54036
R11	228329	54210
R12	229110	54281
R13	229836	54122
R14	230905	54068

Station No.	Co-ordinate (OSGB 36 BUG)	
	East	North
R15	231578	53789
R16	232279	53814
R17	233103	53829
R18	234167	53889
R19	234862	53859
R20	235504	53719
R21	236181	53677
R22	237190	53378
R23	238667	52604
R24	239272	52144
R25	239889	51813
R26	240500	51317
R27	241330	50591
R28	241912	49821
R29	241730	49117

The transects were run from the lower to the upper eulittoral zone. At each transect all habitat types present were identified and recorded using the EUNIS Habitat Classification. The abundance (using the SACFOR scale) of the main species observed within each major habitat type on the transect and the width of each zone was also recorded. The width of each zone was either marked on the aerial map or recorded using dGPS. A photograph of the mid shore habitat type within each transect will be taken with additional photographs of up-shore, down-shore and along-shore aspects to record zonation patterns.

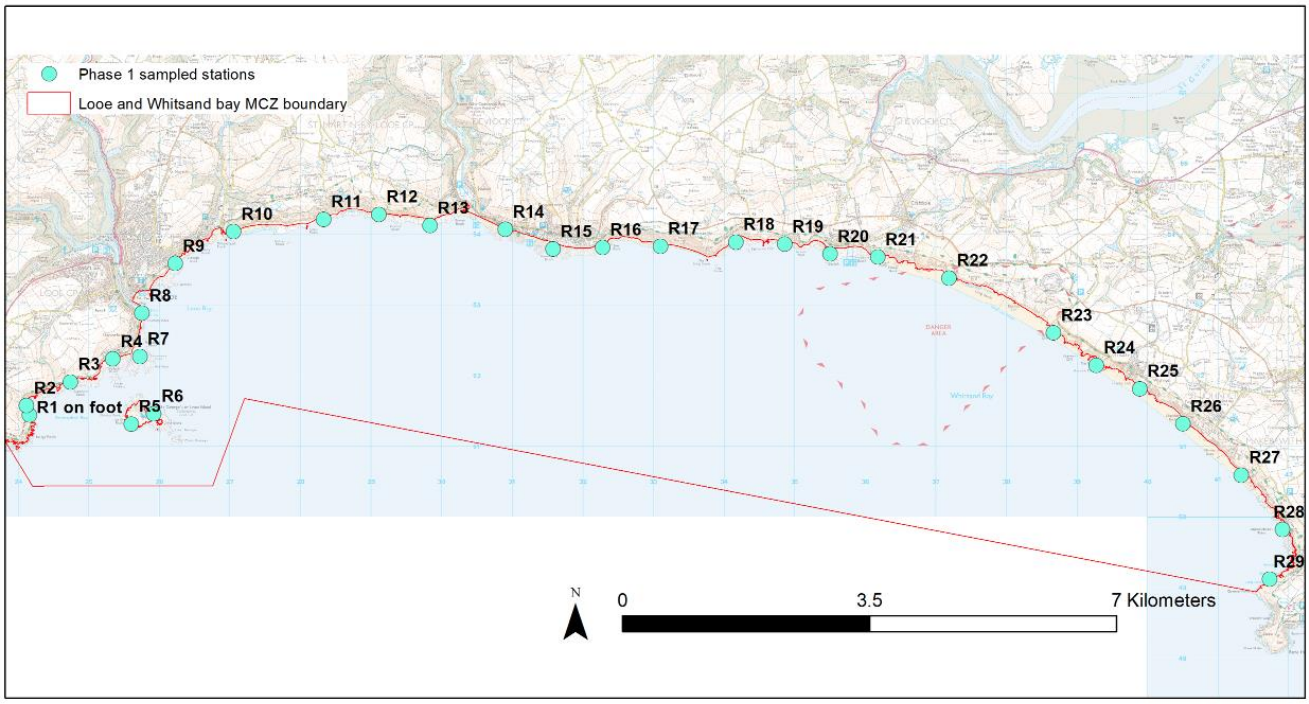


Figure 1. Map of the Whitsand and Looe Bay MCZ showing the Phase 1 transect positions.

Having habitat mapped the immediate area within and around each transect, the survey team then walked, or were ferried by boat to the next transect. Whilst traversing between transects any areas of rock that were potentially different habitat were investigated, and where necessary, assigned different habitat types. The boundaries of all habitat types were annotated on aerial photographs and recorded using dGPS where necessary.

4.2.2 Phase 2 quantitative sampling

The aim of the Phase II surveys was to provide data on the species composition (community structure) of component communities within the littoral rock habitats. The information gathered was then used to provide descriptions of the fauna and flora within the main littoral habitat types identified during the Phase I survey.

Given that all littoral rock habitat types are designated features within the MCZ, those habitat types which accounted for the greatest total area of littoral rock were allocated the largest number of transects. Within each Habitat type, transects were spread to encompass the whole spatial range within the MCZ as far as was practical. Overall, 40 transects were completed at 40 stations encompassing 10 Habitat types.

A 20m horizontal transect was centred on each Phase 2 station. To avoid sampling transitional zones, the transect was placed in the middle of the habitat type being targeted where possible. Three 0.25m^2 quadrats were then randomly placed along each transect. To achieve this, a random number table was used to generate 3 positions along each transect. To save time, the distances were measured by pacing rather than by using a tape measure. Each quadrat was assigned a unique number and photographed before sampling. At each station species lists and abundance data were collected. The positions of each transect are shown in Table 4.

Where possible, individual fauna were counted or % cover estimated, but for some species that may be very numerous (e.g. juvenile *Littorina* sp.), abundances were recorded using estimated counts. In addition, detailed habitat descriptions, using littoral habitat survey forms (similar in format to an MNCR Site form) which included aspects such as substrate characteristics, features and modifiers were recorded. The time, date and tidal height of each was also noted. Given the often very patchy nature of moderate-high energy littoral habitats, and in order to ensure that larger, less frequently occurring species were not missed, a two-minute timed search was also carried out on each transect during which all species observed were recorded according to the SACFOR scale.

Table 4. Phase 2 transect positions.

Habitat type	Station No.		Co-ordinates (OSGB36 BUG) East	North
A1.3141	A1	Start	225529	52202
		Finish	225512	52198
	A2	Start	226201	53549
		Finish	226187	53539
	A3	Start	235863	53820
		Finish	235836	53825
A1.112	C1	Start	225755	52679
		Finish	225745	52677
	C2	Start	236086	53697
		Finish	236073	53697
	C3	Start	239680	51948
		Finish	239664	51951
	C4	Start	241680	50182
		Finish	241668	50198
A1.122	CO1	Start	236450	53540
		Finish	236437	53545
	CO2	Start	239259	52094
		Finish	239242	52082
A1.123	H1	Start	225564	52041
		Finish	225551	52026
	H2	Start	225782	52124
		Finish	225775	52104
	H3	Start	241955	49302
		Finish	241975	49307
A1.1122	L1	Start	224641	51883
		Finish	224630	51867
	L2	Start	231779	53765
		Finish	231763	53774
	L3	Start	235213	53835
		Finish	235196	53833
A1.111	M1	Start	238722	52544
		Finish	238702	52534
	M2	Start	241674	50153
		Finish	241663	50169
	M3	Start	241884	49825
		Finish	241883	49845
A1.211	PC1	Start	224604	51854
		Finish	224587	51839
	PC2	Start	225101	51994
		Finish	225077	51984
	PC3	Start	225389	52252
		Finish	225377	52245

Habitat type	Station No.		Co-ordinates (OSGB36 BUG) East	North
A1.214	S1	Start	225619	52054
		Finish	225602	52045
	S2	Start	227745	54029
		Finish	227731	54026
	S3	Start	230121	54174
		Finish	230103	54178
	S4	Start	231593	53739
		Finish	231612	53745
	S5	Start	235556	53710
		Finish	235538	53703
	S6	Start	242000	49457
		Finish	242022	49464
	S7	Start	225992	51463
		Finish	225984	51474
A1.212	SP1	Start	225503	52251
		Finish	225485	52239
	SP2	Start	235525	53810
		Finish	235506	53804
	SP3	Start	226775	54018
		Finish	226766	53997
A1.213	V1	Start	225520	52240
		Finish	225503	52228
	V2	Start	227063	54028
		Finish	227049	54015
	V3	Start	229115	54247
		Finish	229099	54248
	V4	Start	230112	54242
		Finish	230126	54242
	V5	Start	231615	53800
		Finish	231596	53799
	V6	Start	235470	53732
		Finish	235450	53744
	V7	Start	225557	51558
		Finish	225547	51548
A1.221	VM1	Start	241932	49788
		Finish	241933	49770
	VM2	Start	241984	49589
		Finish	241990	49570

4.2.3 Pacific oysters.

The presence and an estimate of the density and extent of Pacific oysters was made whenever encountered during both phases of the survey.

Any areas that had been 'significantly' affected by the Pacific Oyster were mapped during the Phase 1 survey as well as any areas where they form a reef. The definition of what constituted

a significant effect was given by Natural England as 'Abundant' or 'Superabundant' on the SACFOR scale.

4.2.4 Anthropogenic pressures, INNS, HOCI, SOCI

The occurrence of anthropogenic inputs (such as outfalls, land drains etc) and pressures such as bait digging and shellfish extraction were photographed and recorded whenever encountered during the survey. Where seagrass beds are present, the extent was mapped. HOCI, SOCI and INNS were also recorded when encountered and their abundance estimated where appropriate (using the SACFOR scale).

5 RESULTS

5.1 Phase 1 habitat map

Overall 13 major Habitat types were observed during the course of the survey. The abundance of the conspicuous species recorded within each habitat type on each transects is shown in Table A1 of Appendix 2 and the area covered by each Habitat type in Table 5.

Table 5. Area of each of the Habitat types identified

Habitat type	Area m^2
A1.111	56,191
A1.112	188,508
A1.1122	56,667
A1.122	4,906
A1.1222	24,662
A1.123	68,653
A1.211	9,089
A1.212	17,572
A1.213	538,294
A1.214	444,232
A1.221	14,707
A1.222	7,670
A1.3141	37,011

The rock Habitat types that were present on the inter-tidal area of the Whitsand and Looe Bay MCZ together with the positions of the Phase 2 stations are shown in Figs 2 – 9.

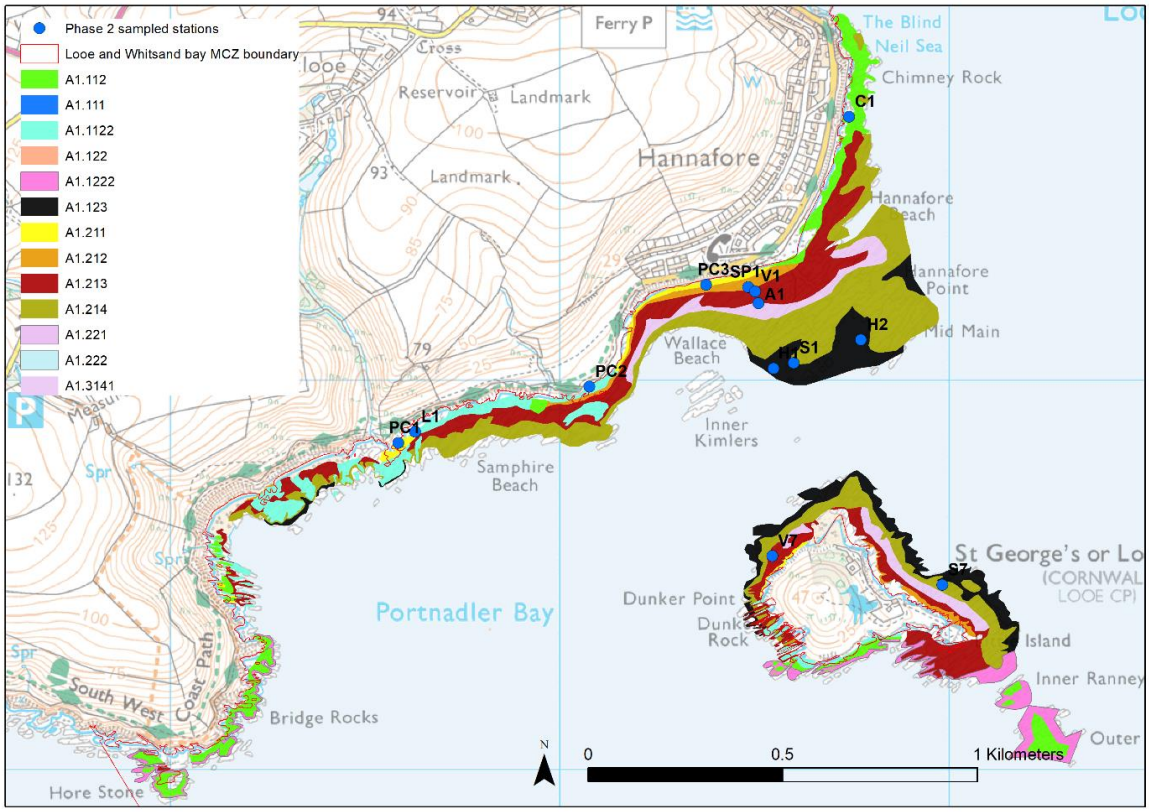


Figure 2. Map of the inter-tidal rock Habitat types present from the Hore Stone to West Looe.

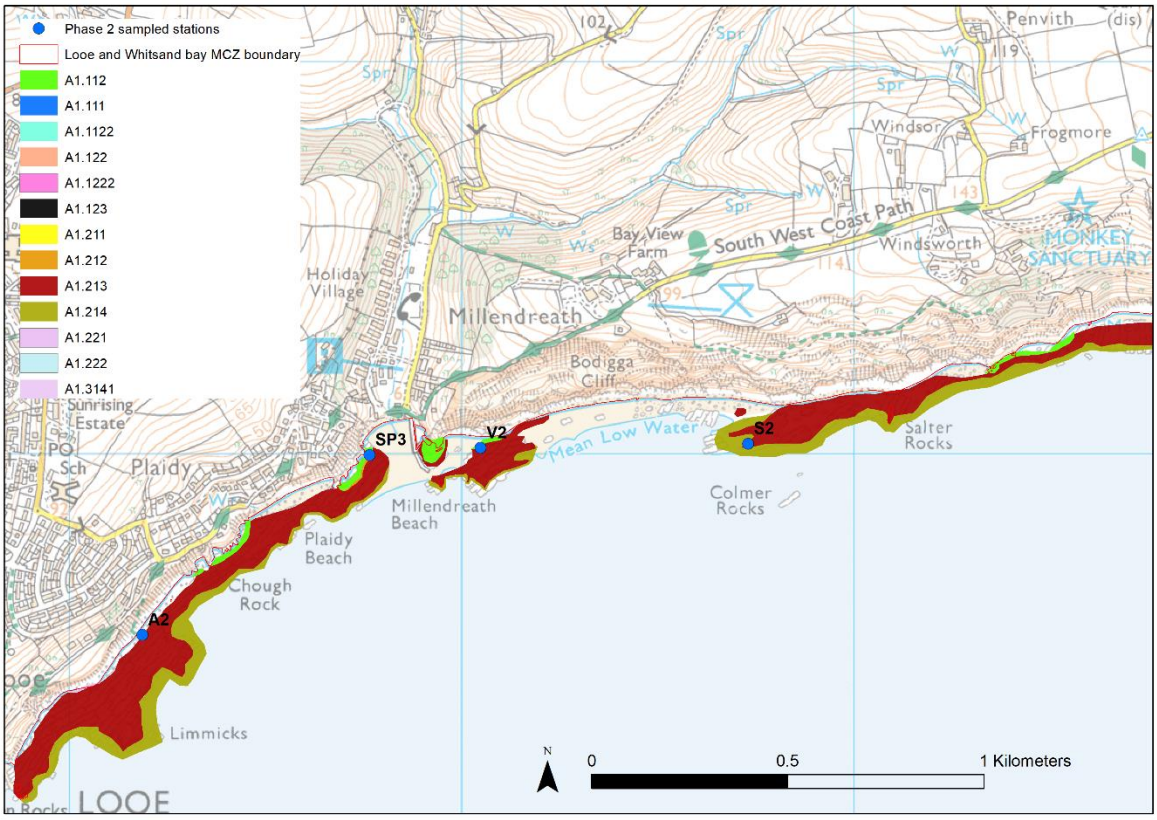


Figure 3. Map of the inter-tidal rock Habitat types present from east Looe to the east of Colmer Rocks

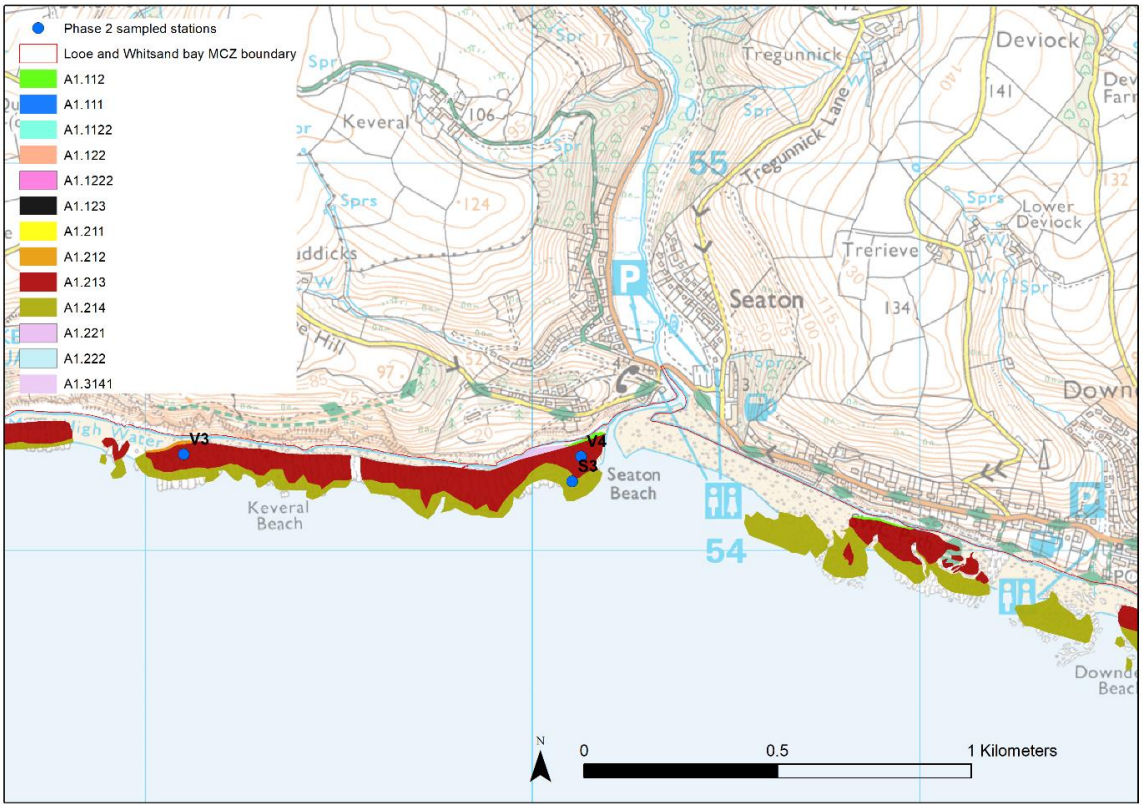


Figure 4. Map of the inter-tidal rock Habitat types present from Keveral Beach to Downderry.

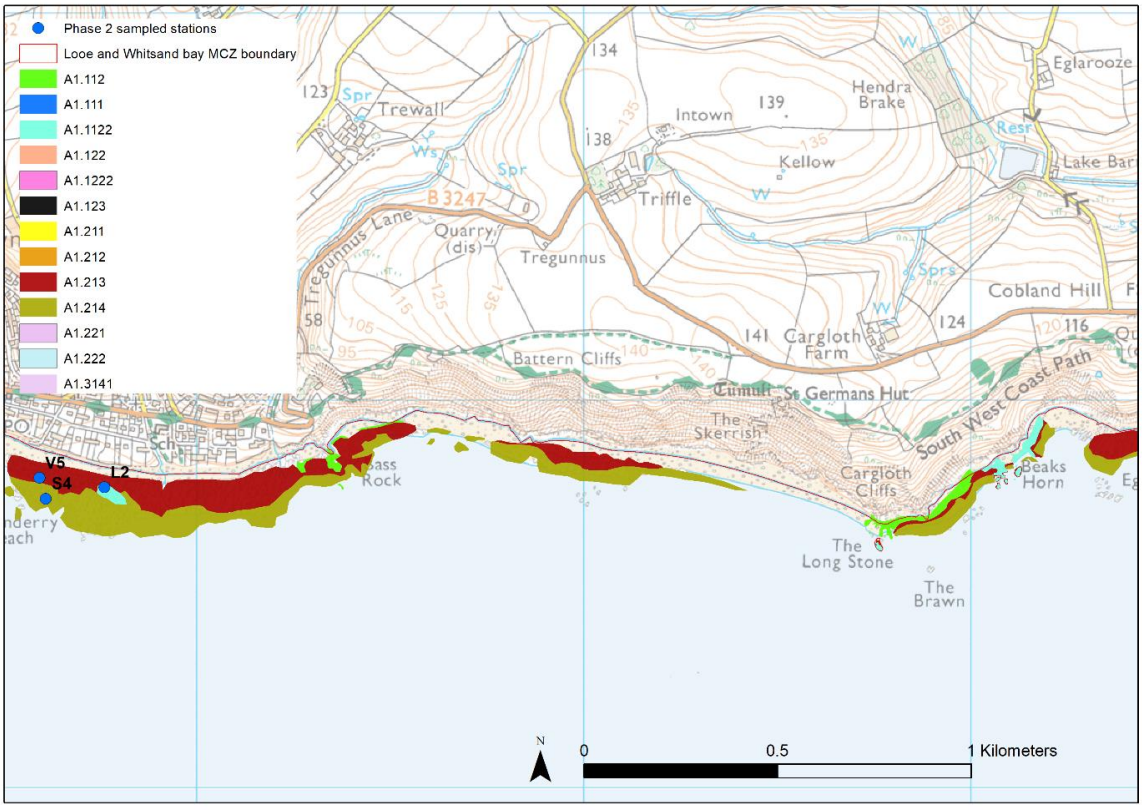


Figure 5. Map of the inter-tidal rock Habitat types present from Downderry to the Long Stone.

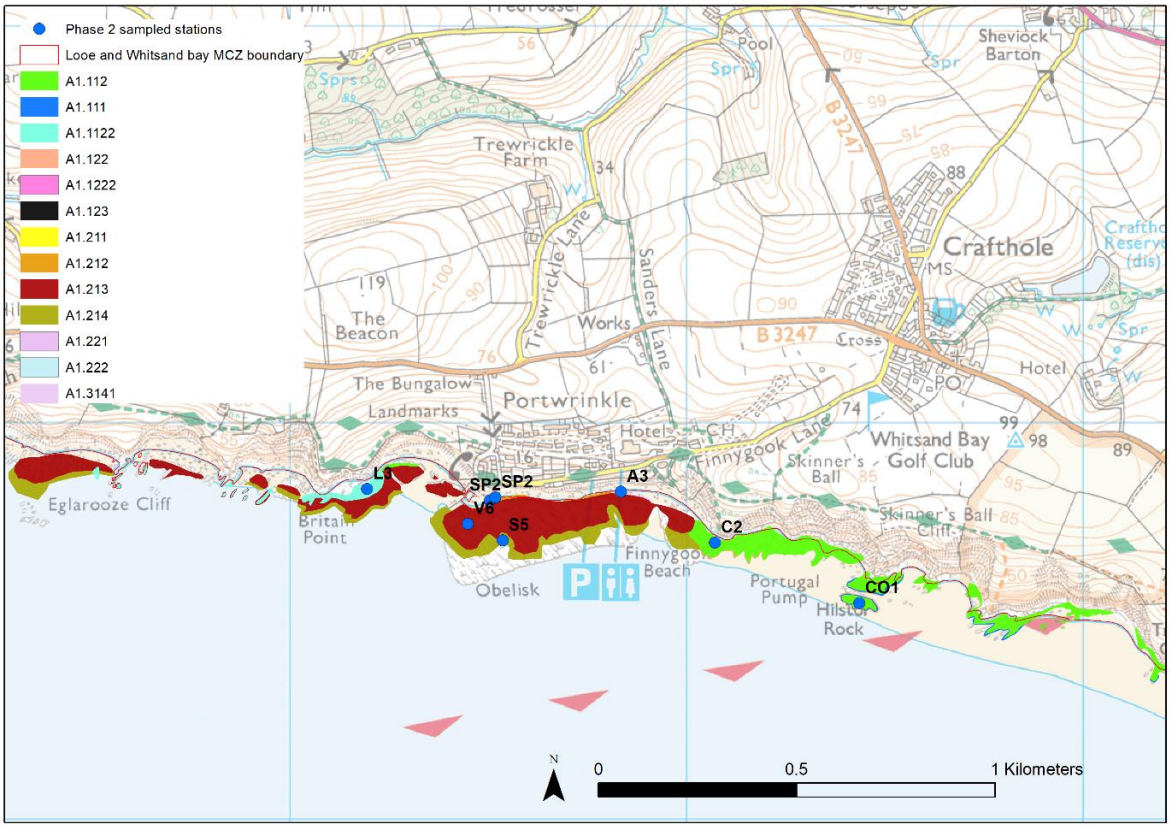


Figure 6. Map of the inter-tidal rock Habitat types present from the Long Stone to Oldhouse Cove.

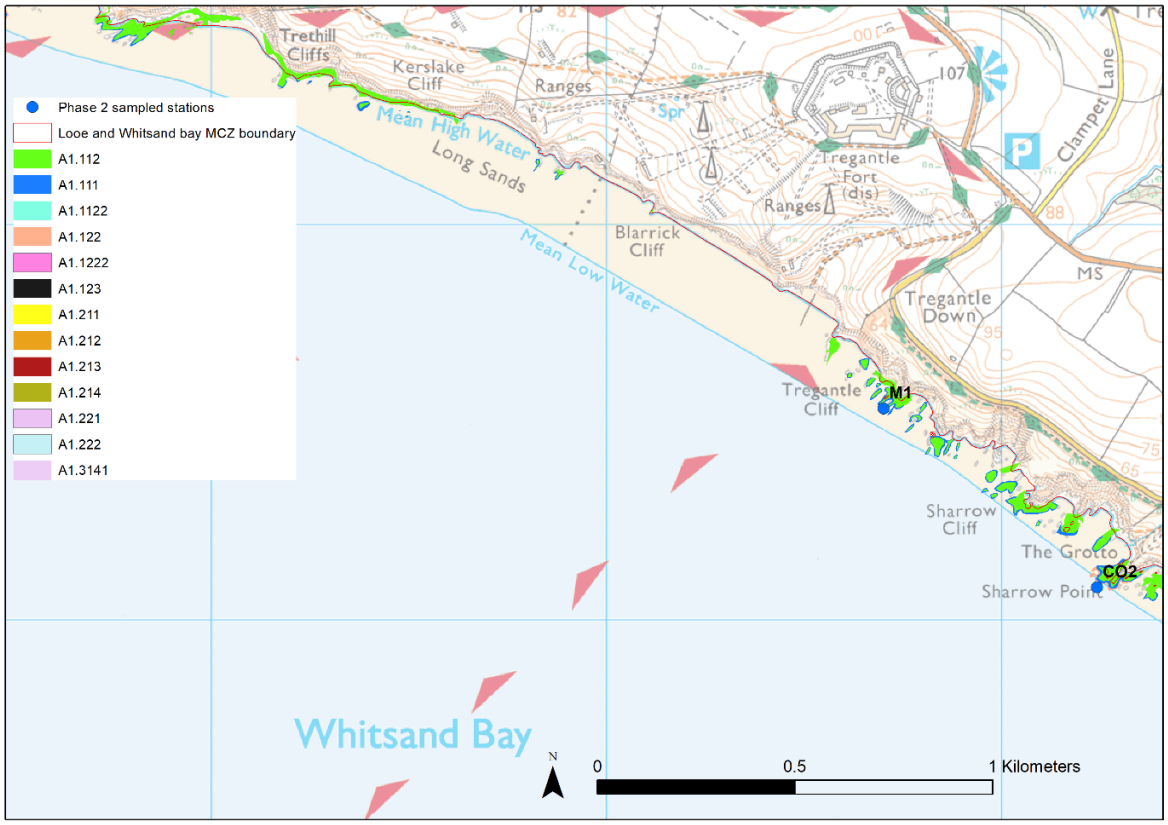


Figure 7. Map of the inter-tidal rock Habitat types present from Oldhouse Cove to the east of Tregantle Fort.

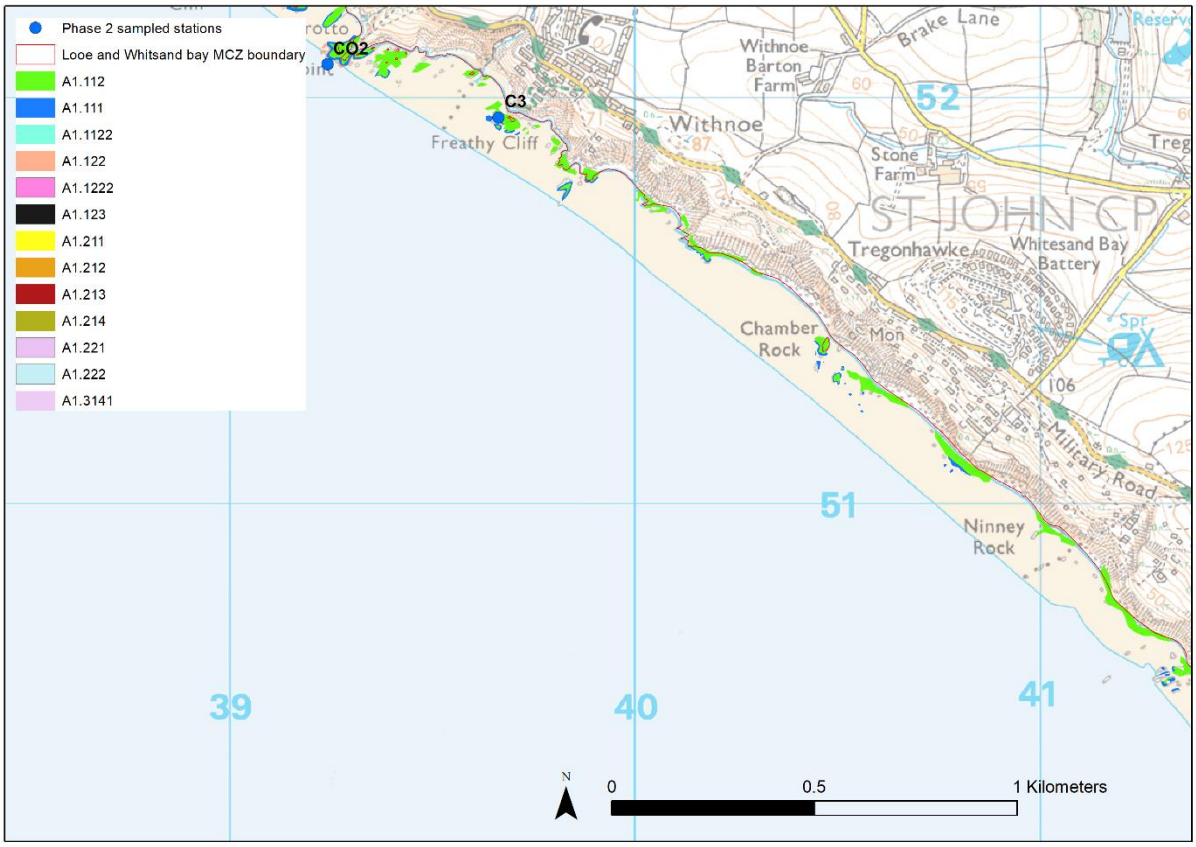


Figure 8. Map of the inter-tidal rock Habitat types present from Freathy to Ninnery Rock.

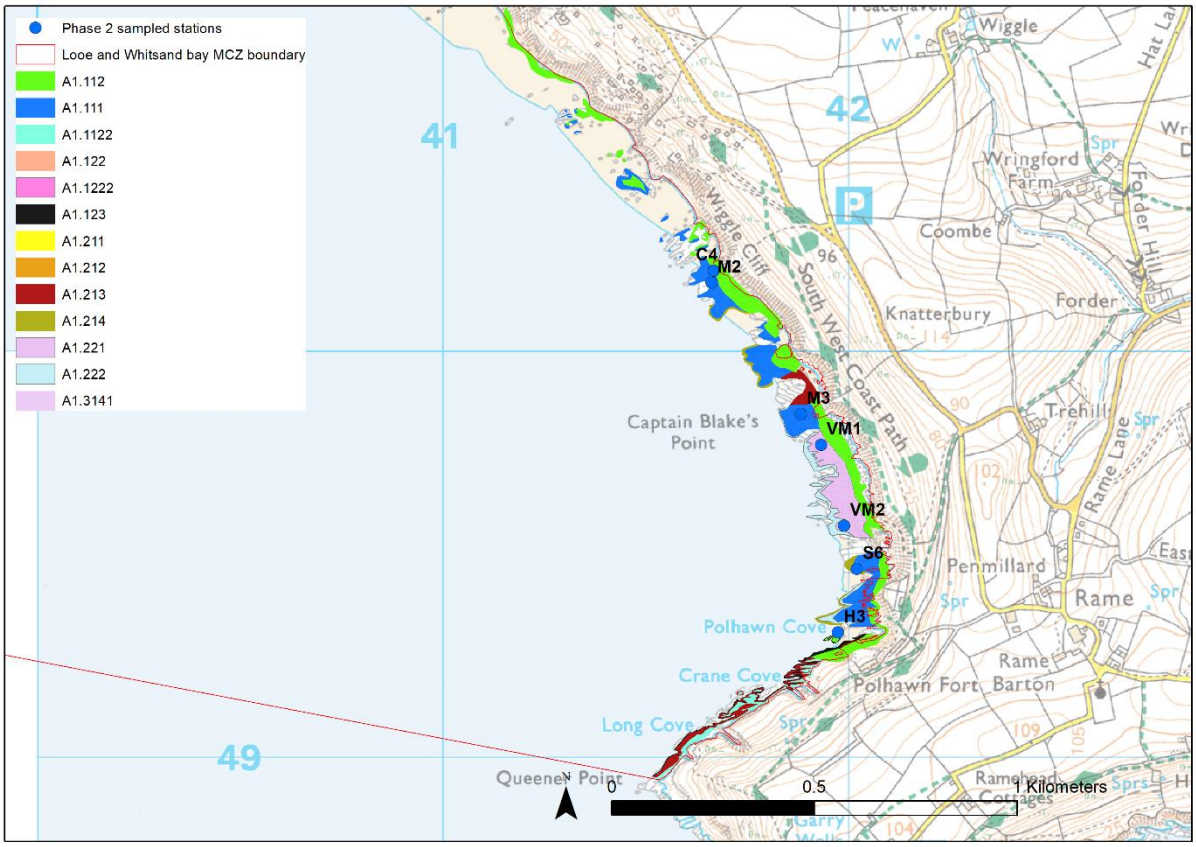


Figure 9. Map of the inter-tidal rock Habitat types present at the eastern end of Whitsand Bay and Polhawn.

It can be seen from Fig. 2 that on the more exposed shores of the Hore Stone in the far west of the MCZ, the mid and upper shore Habitat type is predominantly A1.112 (*Chthamalus spp*. on exposed upper eulittoral rock) but this gives way to A1.1222 (*Corrallina officianalis*, *Himanthalia elongata* and *Patella ulyssiponensis* on very exposed eulittoral rock) on the lower shore. This is also the habitat pattern on the south west corner of Looe Island, whereas the south eastern corner also has a wide band of A1.213 (*Fucus vesiculosus* and barnacle mosaics moderately exposed mid eulittoral rock) above the A1.1222 Habitat type. On the north side of Looe Island and the sheltered areas between the Hore Stone and West Looe the lowest Habitat type is a band of A1.123 (*Himanthalia elongata* and red seaweeds on exposed lower eulittoral rock). Above this there was a wide band of A1.214 (*Fucus serratus* on moderately exposed lower eulittoral rock) which was below the band of A1.213. At the top of the shore, barnacle Habitats dominated ((A1.112, A1.1122 (*Chthamalus spp*. and *Lichina pygmaea* on steep exposed upper eulittoral rock) or A1.211 (*Pelvetia canaliculata* and barnacles on moderately exposed littoral fringe rock)). In some of the less exposed areas there was also a band of A1.212 (*Fucus spiralis* on full salinity exposed to moderately exposed upper eulittoral rock) at the top of the shore. On the mid shore on the north side of Looe Island and the mainland directly north of the Island there was also a band of A1.3141 (*Ascophyllum nodosum* on full salinity moderately exposed to sheltered mid eulittoral rock).

From Looe to Portwrinkle (Figs 3-6) the predominant habitats were generally consistent. In many areas coarse sediments on the upper shore gave way to a wide band of A1.213 on the rocks of the mid shore below which was a band of the A1.214 Habitat type on the low shore. Where rock was present on the upper shore (such as Downderry and the Long Stone (Fig. 5), the barnacle Habitat types A1.112 and A1.1122 were observed.

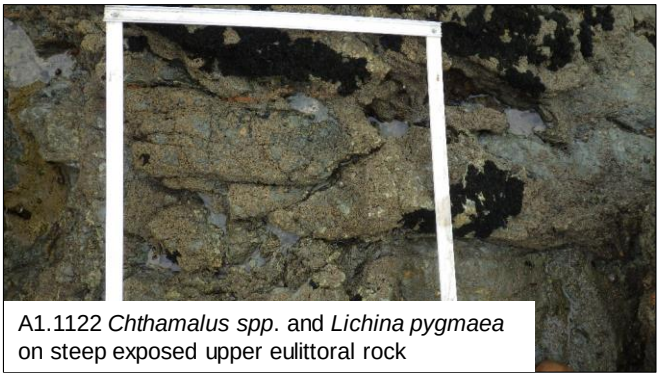
The majority of the shore In Whitsand Bay itself (from Portwrinkle to Captain Blake's Point (Figs 6-9)) was composed of sand with rocky outcrops and headlands. The Habitat type on the higher areas was A1.112, often with a band of A1.111 (*Mytilus edulis* and barnacles on very exposed eulittoral rock) below this. Where rocky outcrops extended as far as the very low shore a band of A1.122 (*Corallina officianalis* on exposed to moderately exposed eulittoral rock) was often present.

At the extreme eastern end of Whitsand Bay near Polhawn the shore was predominantly jagged rocks with some sandy patches and gullies with a relatively complex mix of Habitat types. The barnacle Habitat type A1.112 was present on the higher areas of rock, with a broad band of mussels and barnacles (A1.111) below this. In the mid-section of this area, A1.221 (*Mytilus edulis* and *Fucus vesiculosus* on moderately exposed mid eulittoral rock) replaced the A1.111 Habitat type below which was a band of A1.222 (*Mytilus edulis* and *Fucus serratus* on moderately exposed lower eulittoral rock). On the lower lying rocks in the sandy bay at Wiggle Cliff, there was also an expanse of the A1.213 (*Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock) Habitat type.

On the steep cliffs at from Palhawn to Crane Cove, A1.1122 dominated the upper shore below which there was a band of A1.213. On the extreme low water margin a thin band of the *Himanthalia* Habitat type A1.123 was present.

Photographs of the major Habitat types that were present within the inter-tidal portion of the MCZ are shown in Figs 10 – 11 and a brief description of each one given in Appendix 1.

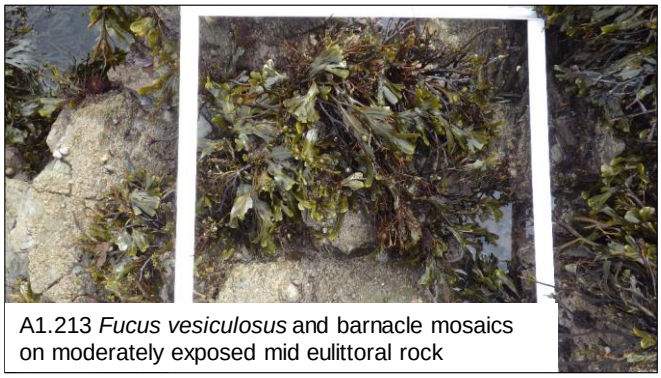
A1.112 *Chthamalus spp*. on exposed upper eulittoral rock



A1.1122 *Chthamalus spp*. and *Lichina pygmaea* on steep exposed upper eulittoral rock

A1.211 *Pelvetia canaliculata* and barnacles on moderately exposed littoral fringe rock

A1.212 *Fucus spira*lis on full salinity exposed to moderately exposed upper eulittoral rock



A1.213 *Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock

A1.214 *Fucus serratus* on moderately exposed lower eulittoral rock

Fig 10. Representative photographs of Habitat types present on the inter-tidal area within the Whitsand and Looe Bay MCZ.

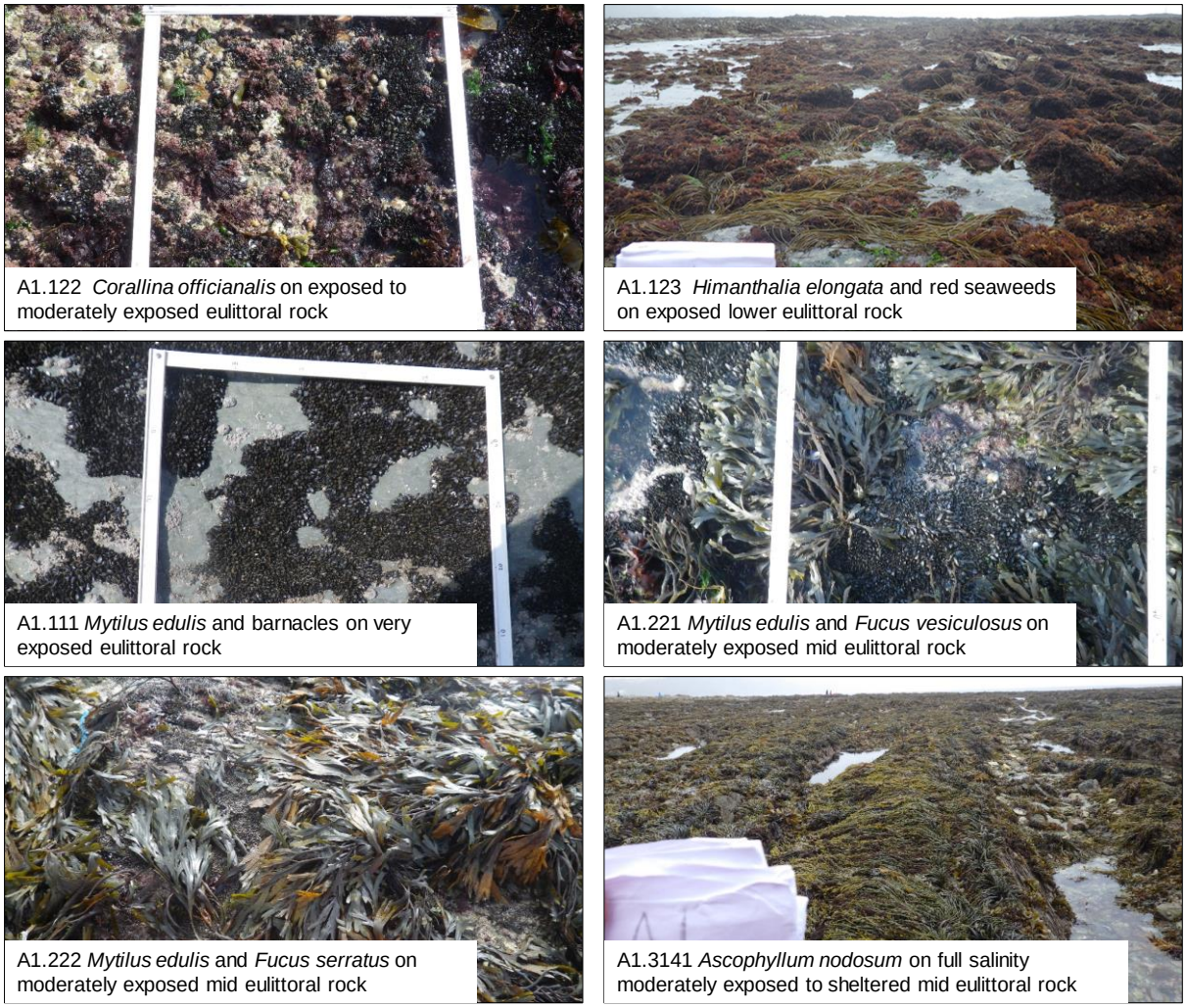


Fig 11. Representative photographs of Habitat types present on the inter-tidal area within the Whitsand and Looe Bay MCZ.

5.1.1 Species composition of the Habitat types

The species composition of each Habitat type as determined by the quantitative quadrats is shown in Tables A2 – A5 of Appendix 2. The data from the timed searches is shown in Tables A6 and A7.

The taxa that contribute most to the similarities within each of the Habitat types have been determined using the SIMPER routine in PRIMER [6] and are shown in Table 6 for the quantitative data and Table A8 of Appendix 2 for the timed search data. The quantitative similarities shown are based on the mean transect data (mean of the 3 quadrats on each transect) which has been fourth root transformed, but the abundances shown are the untransformed data. The abundances shown on the timed search data correspond to the transformed SACFOR to numerical data (6 being equivalent to superabundant and 1 being equivalent to rare).

It can be seen from these Tables that the species composition of each Habitat corresponds well with the EUNIS habitat descriptions [4], although there are variations between transects within each Habitat type.

Table 6. Taxa responsible for the similarities within each of the Habitat types (quantitative data).

Habitat type	Average similarity (%)	Taxon	Av.Abund	Contrib%	Cum.%
		Ascophyllum nodosum	31.5	47.3	47.3
		Vertebrata lanosa	1.0	26.5	73.8
A1.3141	35.7	*Chthamalus montagui*	0.02	8.8	82.7
		Melarhaphe neritoides	374.8	46.1	46.1
		Chthamalus montagui	54.7	29.2	75.3
A1.112	73.2	*Patella*	10.0	18.2	93.5
		Perforatus perforatus	11.5	13.6	13.6
		Corallina officinalis	18.0	13.2	26.8
		Nucella lapillus	11.5	12.8	39.7
		Mytilus edulis	14.5	12.2	51.8
		Ulva intestinalis	3.0	9.5	61.4
		Osmundea pinnatifida	2.4	8.8	70.2
		Spirobranchus lamarcki	1.0	6.3	76.5
A1.122	63.3	*Polysiphonia*	0.2	5.0	81.6
		Himanthalia elongata	21.0	17.9	17.9
		Corallina officinalis	8.6	11.1	29.0
		Chondrus crispus	4.2	10.3	39.3
		Spirobranchus lamarcki	2.0	10.1	49.4
		Mastocarpus stellatus	1.5	7.9	57.3
		Osmundea pinnatifida	0.7	7.8	65.1
		Ulva intestinalis	0.2	4.2	69.3
		Steromphala cineraria	0.7	3.7	73.0
		Ulva lactuca	0.5	3.7	76.7
		Ceramium	0.3	3.2	79.9
A1.123	52.6	*Cladostephus spongiosus*	0.1	3.2	83.0
		Chthamalus montagui	45.7	28.0	28.0
		Patella	16.3	22.4	50.4
		Lichina pygmaea	15.4	18.1	68.5
		Littorina saxatilis	9.0	10.6	79.1
A1.1122	59.9	*Melarhaphe neritoides*	28.0	9.2	88.3
		Mytilus edulis	53.1	33.4	33.4
		Chthamalus montagui	15.7	26.5	59.9
A1.111	70.2	*Patella*	16.0	26.4	86.3

Table 6 Ctd. Taxa responsible for the similarities within each of the Habitat types (quantitative data).

Habitat type	Average similarity (%)	Taxon	Av.Abund	Contrib%	Cum.%
		Littorina saxatilis	5.3	28.9	28.9
		Pelvetia canaliculata	13.0	27.4	56.3
		Melarhaphe neritoides	3.4	11.6	67.9
		Phorcus lineatus	0.6	11.4	79.3
A1.211	57.0	*Chthamalus montagui*	0.3	9.2	88.5
		Fucus serratus	56.4	21.9	21.9
		Corallinaceae	16.3	13.8	35.7
		Patella	5.6	10.7	46.4
		Osmundea pinnatifida	1.0	6.6	53.0
		Chondrus crispus	0.7	6.1	59.1
		Mastocarpus stellatus	1.3	5.3	64.4
		Lomentaria articulata	0.6	5.1	69.5
		Spirorbis spirorbis	0.6	3.9	73.4
		Spirobranchus lamarcki	0.2	3.7	77.1
		Corallina officinalis	0.4	2.7	79.8
A1.214	56.0	*Nucella lapillus*	0.1	2.6	82.4
		Chthamalus montagui	17.7	22.7	22.7
		Fucus spiralis	14.8	22.0	44.6
		Patella	11.0	19.2	63.8
		Littorina saxatilis	4.3	12.2	75.9
A1.212	59.4	*Melarhaphe neritoides*	11.0	9.2	85.1
		Fucus vesiculosus	51.6	22.0	22.0
		Patella	12.5	14.6	36.6
		Steromphala umbilicalis	7.1	11.8	48.3
		Corallinaceae	3.4	10.2	58.5
		Osmundea pinnatifida	2.7	9.3	67.8
		Chthamalus montagui	4.9	8.5	76.2
A1.213	64.2	*Nucella lapillus*	0.3	5.9	82.1
		Fucus vesiculosus	26.6	17.2	17.2
		Mytilus edulis	34.9	16.6	33.7
		Patella	6.4	10.9	44.6
		Actinia equina	3.5	9.2	53.9
		Semibalanus balanoides	1.9	9.0	62.9
		Chthamalus montagui	1.3	6.9	69.8
		Nucella lapillus	0.8	6.7	76.4
A1.221	69.3	*Corallina officinalis*	0.8	6.4	82.8

To investigate the similarities and differences in the community structure of each transect, the raw data was subjected to a fourth root transformation to reduce the influence of very abundant taxa having compared various transformations using shade plots within PRIMER. A Bray Curtis similarity matrix [7] was made using the transformed data which was then used to produce an MDS plot where the distance between the stations on the plot is a function of their similarity (i.e. the closer a station is to another station, the more similar the macrofauna assemblages). The resulting plot for the mean data on each transect is shown in Fig. 11 and the timed search data in Fig. 12.

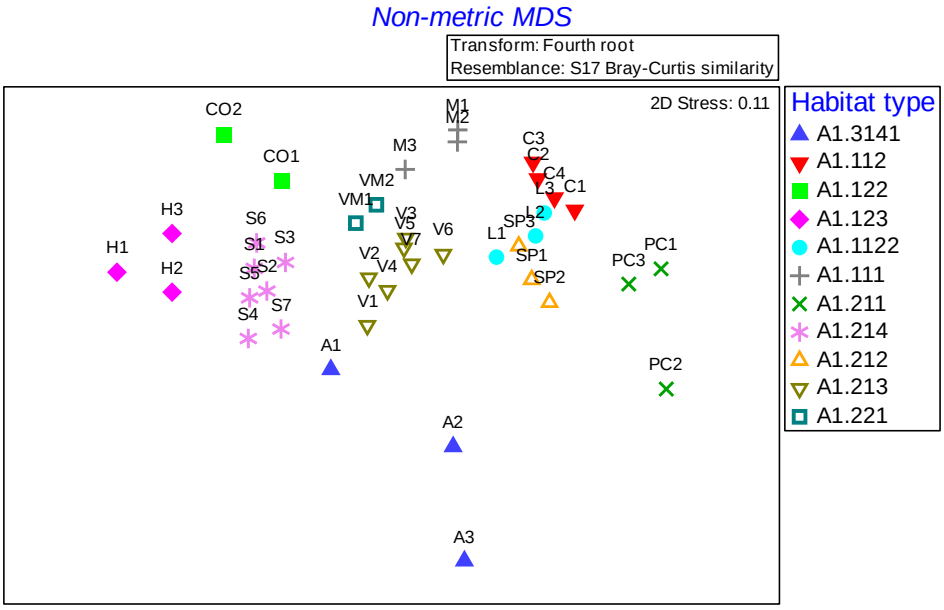


Fig. 11. MDS plot of community structure for each transect by Habitat type (mean quadrat data).

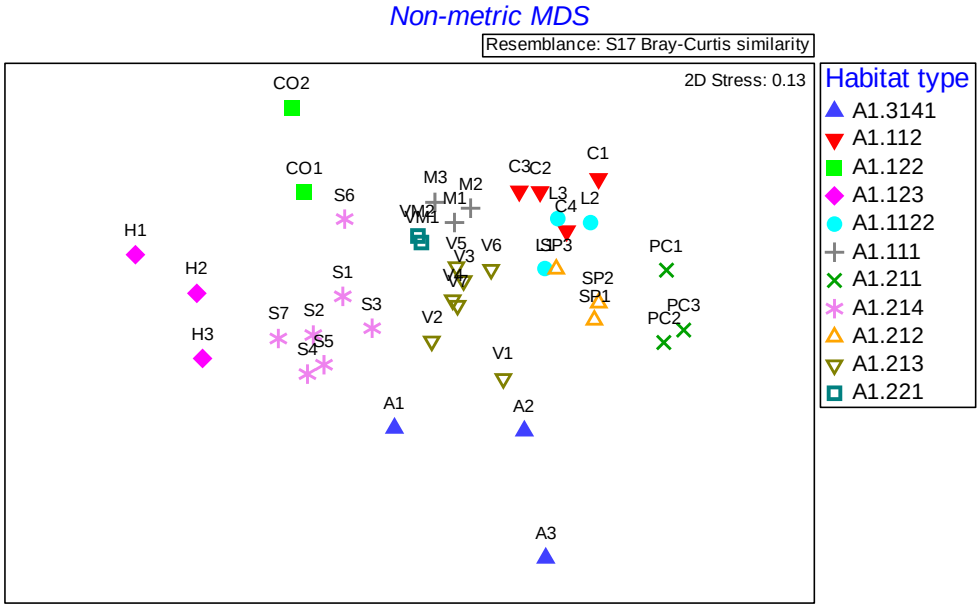


Fig. 12. MDS plot of community structure for each transect by Habitat type using the timed search data.

It is evident from these MDS plots that the community structure of the phase 2 transects separates well by Habitat type for both the quadrat and the timed search data. The data is also very similar for both the quadrat and timed search data. Given the spatial separation of some transects within each Habitat type, the mean similarities of transects within most Habitat types are reasonably high, although there is considerable variability within some Habitat types (e.g. A1.3141).

5.1.2 Fauna and flora diversity within each habitat type

The uni-variate statistics from the quadrat data for each transect and the average for each Habitat type are shown in Table 7 together with the number of taxa per timed search and the SACFOR score.

Table 7. Summary statistics (mean per quadrat) for each transect and Habitat type together with those for the timed search.

Habitat type	Transect	Mean No. taxa per quadrat	Mean number of individuals (N)	Margalef's species richness (M)	Pielou's eveness (J')	Shannon Weiner H'(log10)	Simpson's (1-Lambda)	No. taxa per search	SACFOR score
	A1	18.0	211.7	3.18	0.64	0.80	0.75	22.0	59.0
	A2	7.0	32.7	2.30	0.78	0.64	0.76	14.0	26.0
	A3	2.7	66.3	0.77	0.40	0.13	0.36	8.0	19.0
A1.3141	**Mean**	**9.2**	**103.6**	**2.08**	**0.61**	**0.52**	**0.62**	**14.7**	**34.7**
	C1	4.3	177.0	0.65	0.51	0.33	0.39	6.0	17.0
	C2	4.3	561.3	0.52	0.42	0.25	0.33	11.0	27.0
	C3	5.0	561.3	0.63	0.46	0.32	0.36	10.0	27.0
	C4	5.7	787.7	0.70	0.28	0.21	0.22	10.0	24.0
A1.112	**Mean**	**4.8**	**521.8**	**0.63**	**0.42**	**0.28**	**0.33**	**9.3**	**23.8**
	CO1	16.3	99.7	3.33	0.74	0.89	0.82	19.0	49.0
	CO2	13.3	114.3	2.63	0.75	0.84	0.79	22.0	39.0
A1.122	**Mean**	**14.8**	**107.0**	**2.98**	**0.74**	**0.87**	**0.81**	**20.5**	**44.0**
	H1	18.3	66.0	4.15	0.74	0.93	0.82	24.0	47.0
	H2	18.0	36.3	4.73	0.86	1.08	0.89	29.0	62.0
	H3	12.3	135.0	2.31	0.60	0.64	0.67	18.0	34.0
A1.123	**Mean**	**16.2**	**79.1**	**3.73**	**0.73**	**0.88**	**0.79**	**23.7**	**47.7**
	L1	10.7	227.7	1.79	0.64	0.65	0.70	19.0	41.0
	L2	5.7	103.7	1.05	0.67	0.50	0.59	8.0	23.0
	L3	7.0	447.7	0.99	0.60	0.51	0.58	12.0	31.0
A1.1122	**Mean**	**7.8**	**259.7**	**1.27**	**0.64**	**0.55**	**0.62**	**13.0**	**31.7**
	M1	5.3	90.3	0.98	0.73	0.51	0.61	16.0	34.0
	M2	4.3	114.3	0.71	0.61	0.36	0.46	13.0	26.0
	M3	9.3	122.7	1.74	0.60	0.56	0.61	18.0	34.0
A1.111	**Mean**	**6.3**	**109.1**	**1.14**	**0.65**	**0.48**	**0.56**	**15.7**	**31.3**
	PC1	4.3	44.0	0.88	0.70	0.43	0.58	8.0	17.0
	PC2	4.7	68.3	0.88	0.58	0.35	0.44	10.0	24.0
	PC3	7.3	99.7	1.43	0.73	0.61	0.69	11.0	28.0
A1.211	**Mean**	**5.4**	**70.7**	**1.06**	**0.67**	**0.46**	**0.57**	**9.7**	**23.0**
	S1	19.0	148.0	3.61	0.60	0.77	0.73	23.0	61.0
	S2	19.7	141.3	3.80	0.59	0.76	0.69	30.0	60.0
	S3	14.0	112.7	2.75	0.71	0.81	0.79	18.0	37.0
	S4	9.0	89.0	1.87	0.50	0.49	0.48	16.0	38.0
	S5	20.3	113.0	4.10	0.68	0.89	0.79	23.0	43.0
	S6	12.0	140.0	2.22	0.59	0.63	0.63	21.0	40.0
	S7	18.3	201.3	3.28	0.58	0.73	0.72	21.0	50.0
A1.214	**Mean**	**16.0**	**135.0**	**3.09**	**0.61**	**0.73**	**0.69**	**21.7**	**47.0**
	SP1	8.3	89.3	1.66	0.80	0.74	0.78	12.0	32.0
	SP2	8.0	151.3	1.41	0.79	0.71	0.77	10.0	30.0
	SP3	9.0	198.0	1.56	0.62	0.59	0.65	18.0	41.0
A1.212	**Mean**	**8.4**	**146.2**	**1.54**	**0.74**	**0.68**	**0.73**	**13.3**	**34.3**
	V1	11.7	103.0	2.31	0.65	0.69	0.68	18.0	45.0
	V2	14.3	106.3	2.85	0.55	0.64	0.60	21.0	48.0
	V3	11.0	111.7	2.12	0.72	0.75	0.76	16.0	36.0
	V4	11.7	137.3	2.17	0.62	0.66	0.64	16.0	36.0
	V5	10.7	166.0	1.90	0.76	0.77	0.77	16.0	37.0
	V6	11.0	147.0	2.00	0.77	0.79	0.79	20.0	43.0
	V7	14.3	125.0	2.77	0.61	0.70	0.68	19.0	44.0
A1.213	**Mean**	**12.1**	**128.0**	**2.30**	**0.67**	**0.71**	**0.70**	**18.0**	**41.3**
	VM1	13.0	112.7	2.54	0.77	0.85	0.82	19.0	47.0
	VM2	11.3	131.3	2.12	0.70	0.74	0.74	18.0	41.0
A1.221	**Mean**	**12.2**	**122.0**	**2.33**	**0.73**	**0.80**	**0.78**	**18.5**	**44.0**

It should be noted that the number of individuals in Table 7 is based on the sum of the percentage cover (for algae and numerous species such as barnacles) and the individual counts for each quadrat.

These statistics show that there is a positive trend in both the number of taxa and the diversity with decreasing tidal height above sea level. Lower shore Habitat types (such as A1.122, A1.123 and A1.214) have the greatest number of taxa and are more diverse than those on the mid shore (e.g. A1.213, A1.221) which are also more diverse than the upper shore Habitat types (e.g. A1.112, A1.211 and A1.212). This is a well-documented phenomenon which is a reflection of increasing environmental stress from desiccation, temperature extremes, and inundation by rain, with increased height on the shore.

The data also show that, on average, 57% more taxa were identified during the timed searches than from the quadrats. The increase in the number of taxa was particularly evident in the upper shore barnacle Habitat type A1.112 and the mid shore mussel and barnacle Habitat type A1.111. This underlines the importance of the timed search data as it gives more comprehensive data on the species composition of each Habitat type.

5.2 Anthropogenic pressures, INNS, HOCI, SOCI

5.2.1 Pompom weed *Caulacanthus okamurae*

Pompom weed was widely distributed across the survey area varying in abundance between rare and common.

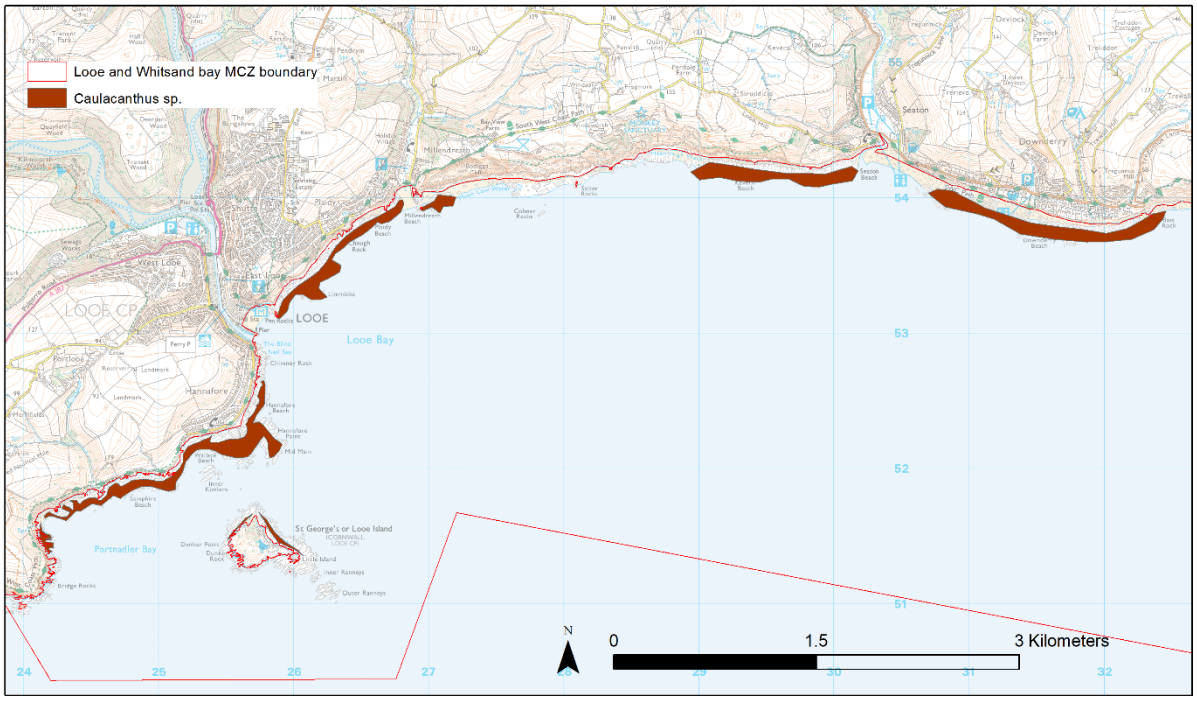


Figure 13. Distribution of pompom weed on the western end of the MCZ

The abundance varied substantially over small areas where it could be abundant in an area and rare only a few metres away. It was largely absent from the middle areas of Whitsand Bay, but was more prevalent in the west of the survey area and in the Rame Head area. It is thought that this might be due to the availability of suitable habitat. The distribution of pompom weed is shown in Figs 13 and 14. It was recorded in approximately 20% of the quadrats assessed and just over 40% of the timed searches.

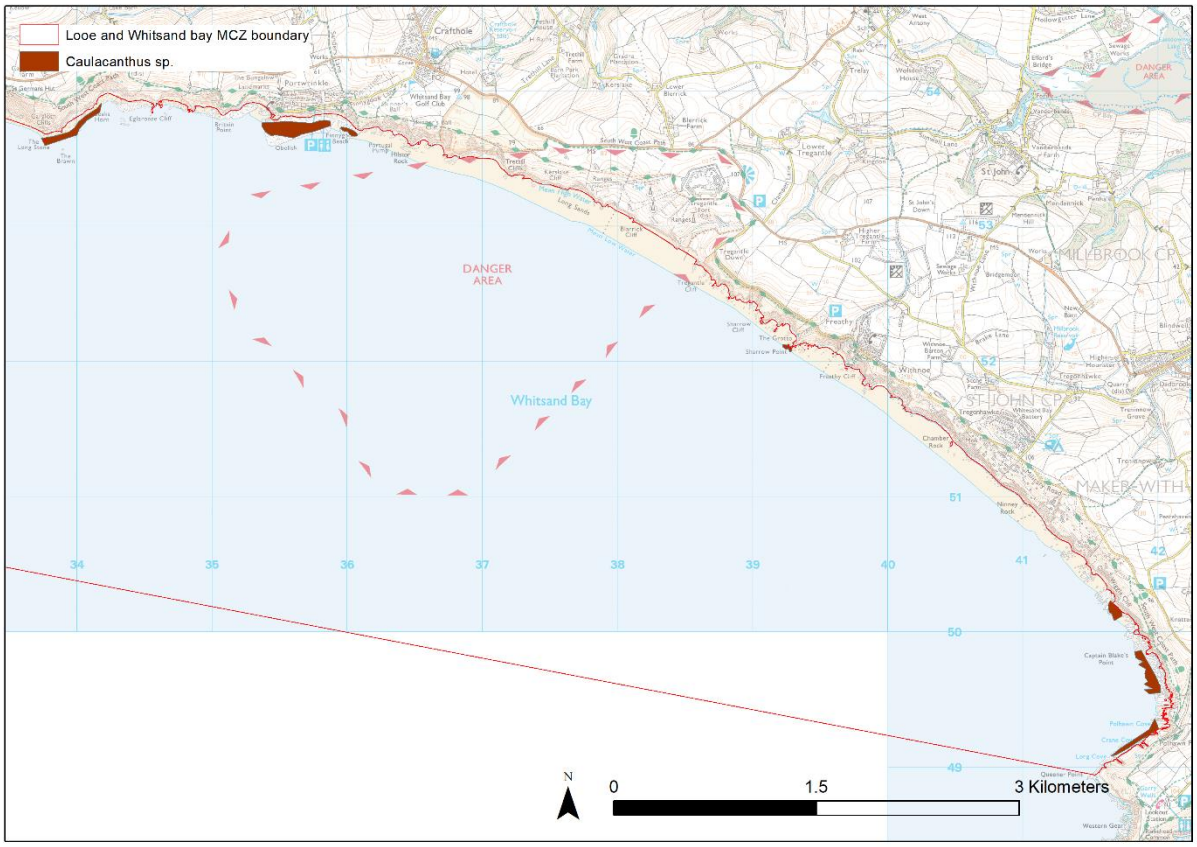


Figure 14. Distribution of pompom weed on the eastern end of the MCZ

5.2.2 Pacific oysters

The pacific oyster was rarely observed to the west of Whitsand Bay, with only a few individuals being observed close to Looe. However, in Whitsand Bay they were occasional to frequent on most of the mid to lower areas of rock and common in some areas. Two small areas were observed to be significantly affected, one between transects R21 and R22 at the western end of Whitsand Bay (Fig. 15) and one close to Freathy. In many of the more easily accessed areas of Whitsand Bay it was also apparent that there had been deliberate attempts to remove the oysters from the rocks.

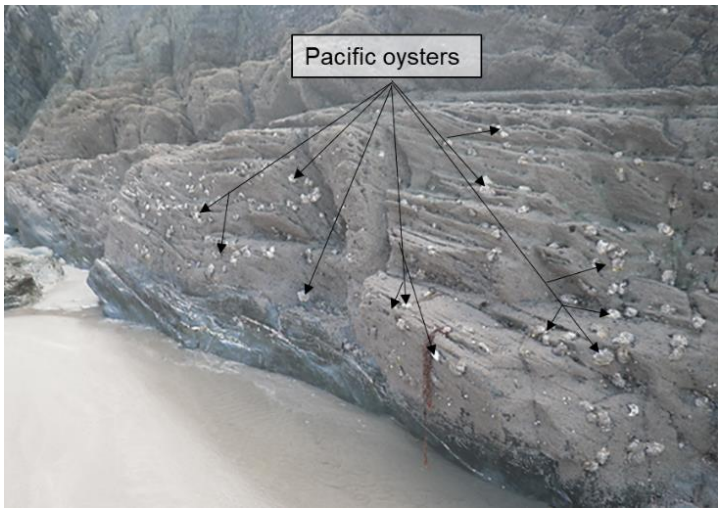


Figure 15. Area of rock between R21 and R22 significantly affected by Pacific oysters

The abundance of Pacific oysters over the area is illustrated in Fig. 16 where the timed search data and target notes have been added as points.

5.2.3 Other INNS.

A number of other INNS were observed within the survey area (Fig. 16). *Sargassum muticum* was observed at low abundances in a few rock pools across the survey area but at low densities and was recorded at one of the low shore Phase 2 stations (H1). The Australasian barnacle (*Austominius modestus*) was also observed occasionally, but generally at very low abundances. Harpoon weed (*Asparagopsis armata*) was also encountered at the low shore stations H1 and H2.

5.2.4 SOCI and HOCI

Only one SOCI was observed during the surveys. This was the stalked jellyfish *Calvadosia campanulata* which was observed on red algae close to seagrass to the north of Looe Island and the other on *Ulva lactuca* in a rockpool at Millendreath. These locations are shown on Fig. 16. One small area (a few square metres) of intertidal seagrass bed was also observed to the north of Looe Island.

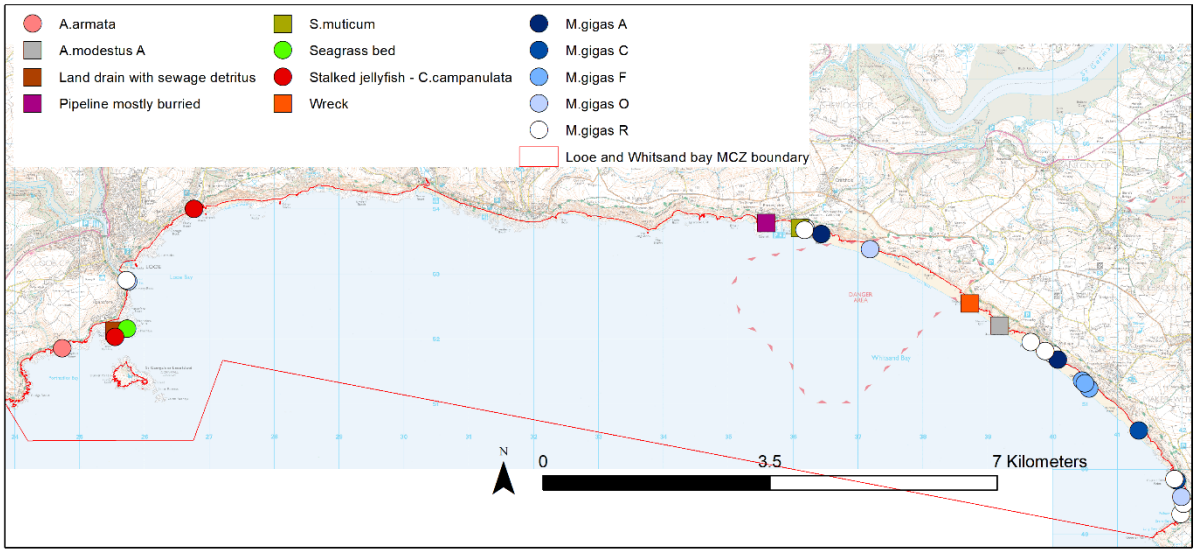


Figure 16 HOCI, SOCI, INNS and anthropogenic inputs.

5.2.5 Anthropogenic influences

Very few anthropogenic inputs were observed, other than a land drain (Fig. 17) opposite the Hannafore Café at Looe (between transects R4 and R7) and a sewer pipe at Portwrinkle. Some sewage litter was also observed close to the land drain at Looe. Plastic flotsam and jetsam was observed in several locations. This was composed primarily of old buoys, discarded netting, ropes, fish boxes and water bottles. Two wrecks were also encountered, one at Looe and the other at station M1 in Whitsand Bay (Fig. 18).

Figure 17. Land drain at Looe

Figure 18. Wreck (believed to be of the steam trawler Daisy near Freathy.

6 DISCUSSION

6.1 Attribute assessment

The targets for each of the inter-tidal rock feature attributes are shown in Table 8.

Unfortunately, as this is a baseline survey, it is not possible to make a condition assessment for any of the attributes as there has not been any previous surveys with which to compare the data. However, the MCZ has few pressures on much of the area (other than tourism) and

very few negative indicators or anthropogenic inputs were noted (one land drain, one small sewer, some flotsam and jetsam and two wrecks) and is relatively pristine. It is therefore suggested that for most of the attributes it could be said to be in favourable condition.

Table 8. Targets for each of the inter-tidal rock attributes for the MCZ.

Attribute	Target
Distribution: presence and spatial distribution of biological communities	Maintain the presence and spatial distribution of (feature) communities, according to the map.
Extent and distribution	Maintain the total extent and spatial distribution of the feature
Structure: non-native species and pathogens	Reduce the introduction and spread of non-native species and pathogens, and their impacts
Structure: species composition of component communities	Maintain the species composition of component communities

The attribute of most concern is structure: non-native species and pathogens as some of the INNS (e.g. Pompom weed and Pacific oyster) were quite abundant over large stretches of the MCZ. Although there had clearly been an effort to remove the oysters from large portions of Whitsand Bay, it is unlikely that the target to reduce the introduction and spread of INNS is being met.

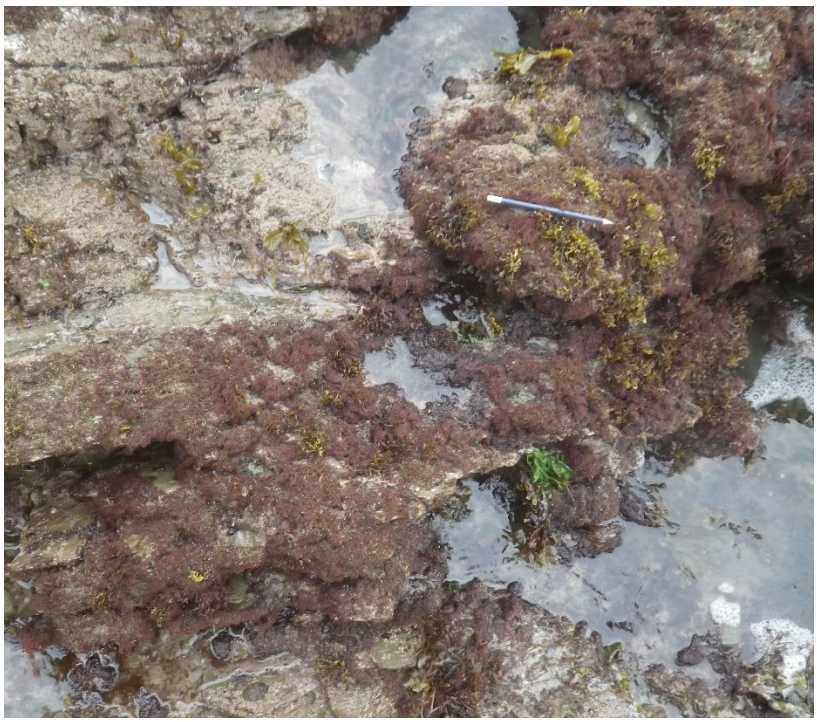


Figure 19. Pompom weed on rocks at Millandreath.

Pompom weed (Fig. 19) is a red alga occurring most commonly on the coasts of South Korea [8]. It was first identified as non-native when it was described in Spain and in the Bay of Biscay as far as south west France in the late 1990s. The species is now known to be present in Brittany and the south west of the U.K. and Pembrokeshire [9]. Since this species is a relatively

recent introduction to the U.K., given its distribution and abundance within the MCZ, it is probable that it is increasing in abundance and distribution within the MCZ. It is likely, therefore, that the site has failed against the target for this attribute. Although it was widespread across the survey area, it was only present at sufficient densities to affect the native communities in very small areas (patches of a few square metres) and is probably not therefore having a discernible effect on the community structure over the site as a whole.

6.2 Survey design

Both phases of this survey followed standard methodology. However, there is inevitably a conflict between the cost of the survey and the statistical power of the design. The strategy employed here was a Phase 1 survey to identify and map the Habitat types present, followed by stratified sampling within the Habitat types (the position of each transect was assigned to give a good spatial spread of transects over the area of each habitat type, but the quadrats were randomly assigned on each transect). The strategy was therefore designed to give robust data on the attributes that need to be measured (to facilitate condition assessment) and relies heavily on multi-variate statistical analysis of the data rather than a statistical analysis of the uni-variate data (e.g. No. taxa, species richness etc) which would require a great deal more sampling effort (cost) to provide a reasonable amount of power to detect change. Since these uni-variate statistics do not provide any information on the species composition and those responsible for any changes, it is considered that this is a reasonable compromise given the aims of the survey.

The number of Phase 2 transects within each Habitat type was to some extent proportional to the size and spatial spread of each. 45% of the sampling effort was undertaken in the three most widespread Habitat types (A1.112 *Chthamalus* spp. on exposed upper eulittoral rock, A1.213, *Fucus vesiculosus* and barnacle mosaics moderately exposed mid eulittoral rock, and A1.214, *Fucus serratus* on moderately exposed lower eulittoral rock). In these Habitat types 4 samples were taken in the A1.112 Habitat type with 7 transects being sampled in the other two. In the majority of other transects three sites were sampled, but no samples were taken in the A1.1222 *Corrallina officianalis, Himanthalia elongata* and *Patella ulyssiponensis* on very exposed eulittoral rock Habitat type due to its very small extent and only two in two other small Habitat types (A1.122 *Corallina officianalis* on exposed to moderately exposed eulittoral rock, and A1.221 (*Mytilus edulis and Fucus vesiculosus on moderately exposed mid eulittoral rock*).

An estimate of how well the number of samples taken represents the total species community can be gained from species accumulation plots. For the three most widespread Habitat types these are shown in Fig. 20 for both the mean transect data from quadrats and the timed search data. It can be seen from this Figure that for the mid and low shore Habitat types with 7 samples each, the sampling effort appears to be satisfactory with the species accumulation curves starting to plateau. In the upper shore Habitat type, the data suggests that a greater number of samples would be beneficial. However, it should be noted that these curves are concerned with the total number of species and the chief characterising species are more abundant and likely to be captured within the first few samples. This is demonstrated by the similarity between transects for both the timed search data and the quadrat data shown in the MDS plots (Figs 11 and 12) with mean similarities of over 60% in these Habitat types. However, if future budgets allow, a greater number of samples in the A1.112 Habitat type and in the less widespread Habitats would be beneficial.

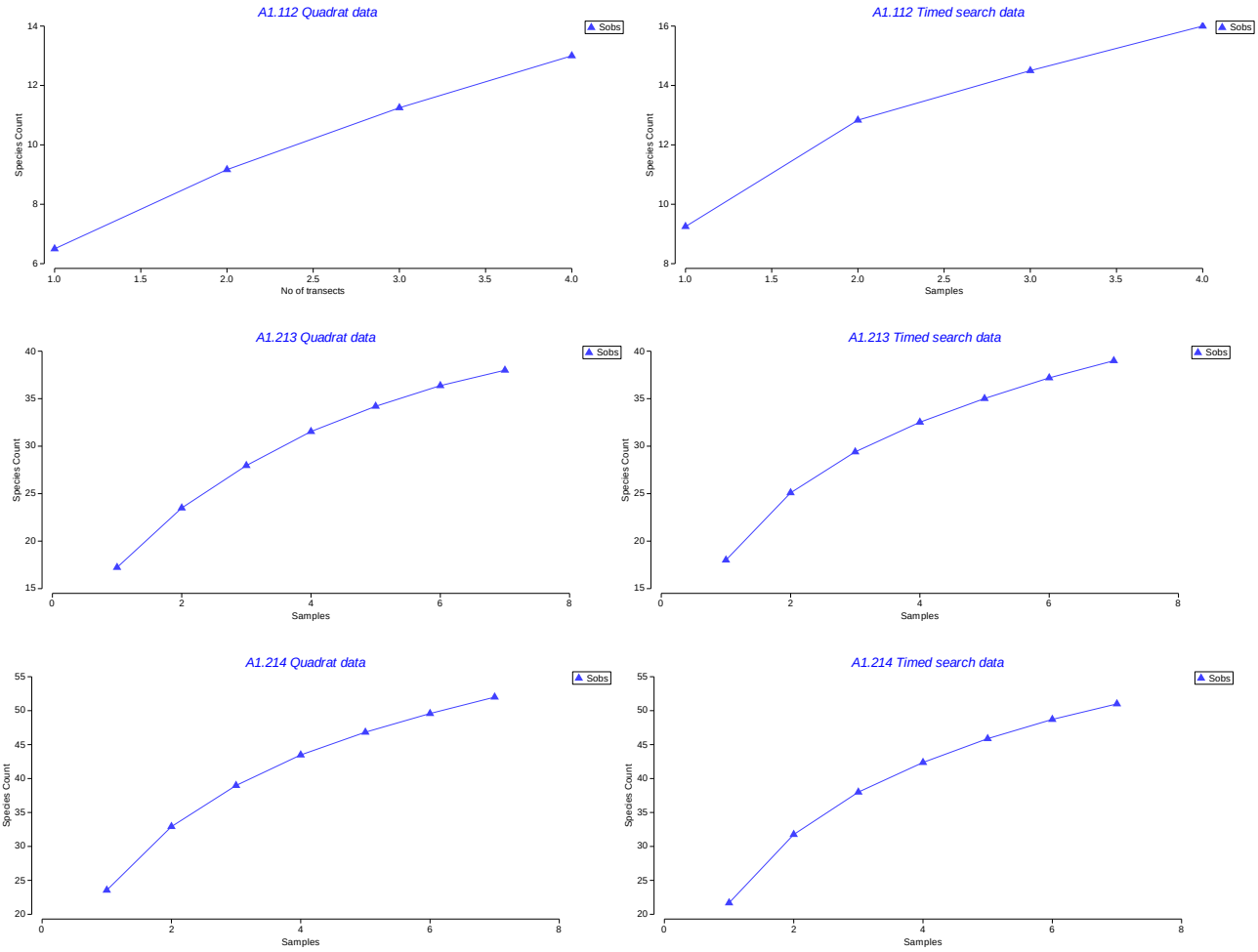


Figure 20. Species accumulation curves for the three predominant Habitat types within the MCZ. Quadrat data on the left and timed search data on the right.

The timed search and quadrat data give very similar results as shown on the MDS plots. Although it is considered that using both methods is probably best practice, sufficient data could probably be gained by using only one method. Since the timed search is quicker to undertake and results in a greater number of species at each station, some cost could be saved by only using this method if budgets were low without losing much information.

7 CONCLUSIONS

Although as discussed in section 6, there is no previous data with which to compare the results from this survey, the fauna and flora of the inter-tidal rock appear to be relatively pristine and therefore most of the attributes could be judged to be in favourable condition, but obviously with very low confidence. The target for INNS however, is unlikely to have been met with regard to both the Pacific oyster and pompom weed and therefore it has probably failed with regard to this attribute but with low confidence.

It is concluded that the current survey design meets the requirements of the condition assessment. However, if budgets change, it could be adapted to provide better data (i.e. more stations) or equally altered to accommodate a reduced budget.

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9 GLOSSARY

Term	Meaning
A1.111	*Mytilus edulis* and barnacles on very exposed eulittoral rock
A1.112	*Chthamalus* spp. on exposed upper eulittoral rock
A1.1122	*Chthamalus* spp. and *Lichina pygmaea* on steep exposed upper eulittoral rock
A1.122	*Corallina officianalis* on exposed to moderately exposed eulittoral rock
A1.1222	*Corrallina officianalis, Himanthalia elongata* and *Patella ulyssiponensis* on very exposed eulittoral rock
A1.123	*Himanthalia elongata* and red seaweeds on exposed lower eulittoral rock
A1.211	*Pelvetia canaliculata* and barnacles on moderately exposed littoral fringe rock.
A1.212	*Fucus spiralis* on full salinity exposed to moderately exposed upper eulittoral rock
A1.213	*Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock
A1.214	*Fucus serratus* on moderately exposed lower eulittoral rock
A1.221	*Mytilus edulis* and *Fucus vesiculosus* on moderately exposed mid eulittoral rock
A1.222	*Mytilus edulis* and *Fucus serratus* on moderately exposed lower eulittoral rock
A1.3141	*Ascophyllum nodosum* on full salinity moderately exposed to sheltered mid eulittoral rock
FOCI	Feature of conservation importance
Habitat type	Classification of a combination of the physical characteristics of the substrate and the biological community living there.
HOCI	Habitat of Conservation Importance
INNS	Invasive Non-native Species
MDS plot	Multi-Dimensional Scaling plot. Multi-variate statistical manipulation that represents the similarities in community structure between stations in two dimensions such that the distance between the stations is proportional to their similarity
SAC	Special area of conservation
SIMPER	Multi-variate routine in PRIMER to determine the taxa responsible for similarities within groups or differences between groups
SOCI	Species of Conservation Importance
SPA	Special Protection Areas
SSSI	Site of Special Scientific Interest

10 APPENDIX 1 (HABITAT DESCRIPTIONS)

A1.111 *Mytilus edulis* and barnacles on very exposed eulittoral rock

This Habitat type was found primarily within Whitsand Bay where it formed a thin band below the A1.111 Habitat type on the rocky outcrops of the mid to low shore towards the west of the Bay and a wider band at the western corner of the Bay between Wiggle Cliff and Polhawn. The communities were dominated by mussels which covered more than 50% of the substrate on average, with barnacles (predominantly *Chthamalus montagui* but also *Semibalanus balanoides*) being frequent to common. Limpets (*Patella sp*) were also common and the beadlet anemone (*Actinia equina*) was sometimes present within the damp cracks or overhangs.

A1.112 *Chthamalus* spp. on exposed upper eulittoral rock

This Habitat type was found on rock on the upper shore and was widespread within the MCZ being particularly prevalent on the rocks within Whitsand Bay as well as on the cliffs at Hore Stone and Bridge Rocks. It was characterised by a dense community of barnacles (predominantly *Chthamalus montagui*) with limpets being common or abundant. The winkle *Melarhaphe neritoides* was abundant and the rough periwinkle (*Littorina saxitilis*) was also common.

A1.1122 *Chthamalus* spp. and *Lichina pygmaea* on steep exposed upper eulittoral rock

This is a very similar habitat type to A1.112 being found in patches along the MCZ and within the A1.112 habitat type. The primary difference was the abundance of the lichen *Lichina pygmaea* which was generally common in quadrats within this Habitat type. It was typically present on vertical or steep rock faces at the top of the shore. Largest areas were found between Queener Point and Polhawn in the east, at Portwrinkle and to the south of Looe Island in the west of the MCZ.

A1.122 *Corallina officianalis* on exposed to moderately exposed eulittoral rock

This low shore Habitat type occupied a small area overall being typically present as a thin band on the low shore below the A1.111 Habitat type on those rocks extending to the extreme low shore within Whitsands Bay. The communities present were diverse averaging 15 taxa per quadrat and were comprised chiefly of *Corralina,* the barnacle *Perforatus perforatus* , limpets, the dogwhelk *Nucella lapillus* (common or abundant) and a variety of red algae including, *Ceramium* sp., *Lomentaria articulata, Mastocarpus stellatus* and *Osmundea pinnatifida* as well as the green seaweed *Ulva* sp.

A1.1222 *Corrallina officianalis*, *Himanthalia elongata* and *Patella ulyssiponensis* on very exposed eulittoral rock

This low shore species rich Habitat type was not sampled during the Phase 2 as it was primarily present on the Hore Stone and the Ranneys on the southern tip of Looe Island. The mix of fauna was similar to the A1.122 Habitat type but contained the wrack *Himanthalia* elongata. This also had a similar fauna and flora to the A1.123 Habitat type which was also present within the MCZ,

A1.123 *Himanthalia elongata* and red seaweeds on exposed lower eulittoral rock

As with the A1.122 and A1.1222 Habitat types, this was a diverse low shore habitat type which was predominantly present on the low shore north of Looe Island, but also at the base of the rocks at Queener Point and Polhawn. The number of taxa present varied between a mean of 16 per quadrat for the quantitative sampling and 25 for each of the timed search stations. The communities present consisted primarily of *Himanthalia elongata, Corrallina officianalis* but red seaweeds such as *Mastocarpus stellatus, Chondrus crispus, Rhodothamniella floridula* and *Osmundea pinnatifida* were also typically present. A number of different species of fauna were found, but typically included the grey top shell *Steromphala cineraria* and keel worm Spirobranchus *lamarkii.*

A1.211 *Pelvetia canaliculata* and barnacles on moderately exposed littoral fringe rock

This high shore Habitat type was only present in a narrow band at the top of the shore in the vicinity of Wallace and Samphire Beach near Looe. The communities were typically sparse with an average of just over 5 taxa recorded per quadrat but was usually dominated by *Pelvetia canaliculata,* the winkle *Melarhaphe neritoides* (which was abundant), the rough periwinkle (*Littorina saxitilis*) and the thick top shell *Phorcus lineatus*.

A1.212 *Fucus spiralis* on full salinity exposed to moderately exposed upper eulittoral rock

This Habitat type was not common within the MCZ being confined largely to a narrow strip at the top of the shore at Wallace Beach near Looe although other patches were present such as a Millendreath. It was typically found above the A1.213 Habitat type and had a variable cover of *Fucus spiralis* (between 3 and 50% in the quadrats). The fauna consisted primarily of limpets (*Patella* sp.), several species of winkle (e.g. *Littorina saxitilis*, *Littorina littorea*, *Littorina obtustata, Melarhaphe neritoides*) and the top shells (e.g. *Phorcus lineatus, Steromphala cineraria* and *Steromphala umbilicalis.* The barnacle *Chthamalus montagui* was also generally common.

A1.213 *Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock

This Habitat type was widely distributed on the mid shore regions to the west of Portwrinkle but was absent from the sandier areas of Whitsand Bay. It generally formed a wide band and was usually found above the A1.214 Habitat type over much of this area. The communities were relatively diverse, but were dominated by the wrack *Fucus vesiculosus*, the barnacle *Chthamalus montagui,* dogwhelks (*Nucella lapillus*) various species of winkles and top shells (particularly *Phorcus lineatus* and *Steromphala* sp.) and limpets. Pepper dulse (*Osmundea pinnatifida*) and the INNS Pom pom weed (*Caulacanthus* sp.) were also occasional or frequent within this habitat type.

A1.214 *Fucus serratus* on moderately exposed lower eulittoral rock

This low shore Habitat type was widespread to the West of Portwrinkle, forming a relatively wide band below the A1.213 Habitat type. The communities present were diverse (a mean of 22 taxa being observed within each timed search) but dominated by the serrated wrack *Fucus serratus*. Below this canopy there was an associated community of limpets (*Patella* sp.), the periwinkle *Littorina obtusata*, dogwhelks (*Nucella lapillus*), red algae such as *Mastocarpus*

stellatus, *Chondrus crispus*, *Lomentaria articulata* and *Osmundea pinnatifida* as well as encrusting coralline algae and *Corrallina officianalis*.

A1.221 *Mytilus edulis* and *Fucus vesiculosus* on moderately exposed mid eulittoral rock

This mid shore Habitat type was found in the eastern corner of Whitsand Bay on the jagged rocks between Captain Blake's Point and Polhawn between the A1.112 Habitat type and the A1.222 Habitat type. The communities were typically fairly diverse with an average of over 18 taxa observed on each timed search. The most conspicuous fauna were mussels (*Mytilus edulis*) and bladder wrack (*Fucus vesiculosus*), but barnacles (both *Chthamalus montagui* and *Semibalanus balanoides*) were common together with limpets (*Patella* sp.) and dogwhelks (*Nucella lapillus*). Beadlet anemones (*Actinia equina*) were also commonly observed in the cracks and crevices. Pink encrusting coralline algae, *Corrallina officianalis*, *Osmudea pinnatifida* and *Lomentaria articulata* were also occasionally found.

A1.222 *Mytilus edulis* and *Fucus serratus* on moderately exposed lower eulittoral rock

This Habitat type was found on the low shore in the eastern corner of Whitsand Bay below the A1.221 Habitat type. The fauna was typically fairly diverse, but was characterised by a fairly dense covering of mussels (*Mytilus edulis*) and the serrated wrack *Fucus serratus.* Due to the topography there was some overlap with the A1.221 Habitat type. Other than these characterising species, a number of red seaweeds were present including *Mastocarpus stellatus, Chondrus crispus* and *Corralina officianalis* and *Lomentaria articulata.* Barnacles (*Semibalanus balanoides* and *Perforatus perforatus*) were present on the bare patches along with limpets and dogwhelks.

A1.3141 *Ascophyllum nodosum* on full salinity moderately exposed to sheltered mid eulittoral rock

This Habitat type was primarily found between the A1.213 and A1.214 Habitat types on the rocks between Hannafore Beach and Wallace Beach near Looe and on the north eastern side of Looe Island. The communities were dominated by a canopy of knotted wrack (*Ascophyllum nodosum*) although there were also smaller amounts of other wracks such as *Fucus vesiculosus* and *Fucus serratus* present as well as encrusting coralline algae below. The fauna consisted primarily of limpets (Patella sp.), periwinkles (*Littorina obtusata*) and top shells (*Steromphala umbilicalis*). Beadlet anemones (*Actinia equina*) were also found within damp crevices and cracks where these were present.

11 APPENDIX 2

Table A1. Phase 1 fauna abundances within each habitat type at each transect.

Taxon	A1.211	A1.112	A1.211	A1.213	A1.1122	A1.112	A1.213	A1.1122	A1.212	A1.214	A1.211	A1.212	A1.112	A1.213	A1.214	A1.112	A1.1122	A1.213	A1.214
	R1	R1	R1	R1	R2	R2	R2	R3	R3	R3	R4	R4	R4	R4	R4	R5	R5	R5	R5
Anurida maritima											O								
Lichina pygmaea	F		F		O			O									A		
Verrucaria maura										O					C				
Orange sponge																			
Halichondria (Halichondria) panicea																			
Actinia equina																			
Actinia fragacea																			
Anemonia viridis																			
Lanice conchilega																			
Spirobranchus lamarcki																			
Spirorbis																			
Chthamalus montagui	O	O	A	C	O	O	O	C/A	F	C	O	F	O/F	C		C	A	C	
Chthamalus stellatus													O/F						
Semibalanus balanoides									O										
Perforatus perforatus																			
Idotea																			
Patella	O	C	F	C	O/R	O	O	R	F	F		O	F	C	C	A	A	C	
Phorcus lineatus											O			F					
Steromphala cineraria																			
Steromphala umbilicalis									O	F					F/C				C
Littorina littorea									C										
Melarhaphe neritoides																C	C		
Littorina obtusata														F	O				
Littorina saxatilis																			
Nucella lapillus														C					
Mytilus edulis																			
Magallana gigas																			
Asterias rubens																			
Rhodophyta																			
Rhodophyta turf				O															
Rhodothamniella floridula										R									O
Asparagopsis armata																			
Palmaria palmata																			O
Corallinaceae				C						C					F/C			C	
Corallina				O				F		C								C	
Mastocarpus stellatus										C					C			C	F
Chondrus crispus										O					F				F
Plocamium																			
Caulacanthus okamurae										C								O	C
Lomentaria articulata																			O
Ceramium ciliatum																			
Membranoptera alata																			
Osmundea pinnatifida										C				O	C			C	C
Polysiphonia										O									
Vertebrata lanosa														C					
Cladostephus spongiosus										R									
Dictyota dichotoma																			
Laminaria digitata																			
Ascophyllum nodosum														A	F/C				
Fucus serratus				O			R			A					A				A
Fucus spiralis									F/C			O	R						
Fucus vesiculosus				C			O						R	A				A	
Pelvetia canaliculata	O										O				C				
Himanthalia elongata				R						R									F
Ulva intestinalis																			
Ulva lactuca										R									
Cladophora rupestris										O					R				
Codium tomentosum																			

Table A1 (CTD). Phase 1 fauna abundances within each habitat type at each transect.

Taxon	A1.212	A1.213	A1.3141	A1.214	A1.123	A1.212	A1.213	A1.214	A1.123	A1.112	A1.214	A1.213	A1.214	A1.213	A1.214	A1.213	A1.214	A1.212	A1.213	A1.214	A1.213	A1.214
	R6	R6	R6	R6	R6	R7	R7	R7	R7	R8	R8	R9	R9	R10	R10	R11	R11	R12	R12	R12	R13	R13
Anurida maritima									O													
Lichina pygmaea																					R	
Verrucaria maura								O														
Orange sponge															R							
Halichondria panicea																						
Actinia equina										O	O	R		O								
Actinia fragacea																						
Anemonia viridis																						
Lanice conchilega								R														
Spirobranchus lamarcki									C													
Spirorbis								O														
Chthamalus montagui	C	C				O				C	F	O		A		A/C		O	A		A	
Chthamalus stellatus																						
Semibalanus balanoides										O									R		R	O
Perforatus perforatus																						
Idotea								O														
Patella	C	C		C		O		C		F	A	A	R	C/F	C	A/C		F	C/F	C	F	O
Phorcus lineatus						F						O		C								
Steromphala cineraria				O					O													
Steromphala umbilicalis		C	C	C			F	C	F			O									O	
Littorina littorea						F	O	F		C	F	O		C				R	O		O	
Melarhaphe neritoides																						
Littorina obtusata							O	O														
Littorina saxatilis																						
Nucella lapillus										O				O	O				F		O	O
Mytilus edulis																						
Magallana gigas										R												
Asterias rubens																						
Rhodophyta																						
Rhodophyta turf																						
Rhodothamniella floridula					C																	
Asparagopsis armata									F/O													
Palmaria palmata					O								R									
Corallinaceae			F	C			O	F	F	O	O											
Corallina			F	F					R	O	O				O					O		O
Mastocarpus stellatus			C	A	C		R	C	C													
Chondrus crispus				C	C										C					A		C
Plocamium									F													
Caulacanthus okamurae					C							O	O	R	C				O	R		R
Lomentaria articulata					O			F												O		O
Ceramium ciliatum									F													
Membranoptera alata					R																	
Osmundea pinnatifida		C		C																		O
Polysiphonia								O				O										
Vertebrata lanosa			C																			
Cladostephus spongiosus					O				O													
Dictyota dichotoma									O													
Laminaria digitata																				O		O
Ascophyllum nodosum			S				A					O				R		R				
Fucus serratus				S	O		C	S			C		F		F		F		O	A		A
Fucus spiralis	F		C			C/F								R				A				
Fucus vesiculosus		F					C					A	O	A		O					A/C	
Pelvetia canaliculata																						
Himanthalia elongata					S				C													
Ulva intestinalis																O			R			O
Ulva lactuca								C	F					R	O				O			
Cladophora rupestris			C	C			R															
Codium tomentosum					R																	

Table A1 (CTD). Phase 1 fauna abundances within each habitat type at each transect.

Taxon	A1.112 R14	A1.213 R14	A1.214 R14	A1.213 R15	A1.214 R15	A1.112 R16	A1.213 R16	A1.214 R16	A1.213 R17	A1.214 R17	A1.1122 R18	A1.213 R18	A1.214 R18	A1.1122 R19	A1.213 R19	A1.212 R20	A1.213 R20	A1.214 R20	A1.112 R21	A1.122 R21	A1.112 R22	A1.112 R23	A1.111 R23
Anurida maritima																							
Lichina pygmaea							R				F			F		R	F		O				
Verrucaria maura										O			O					O					
Orange sponge										O			O							O			O
Halichondria panicea																							
Actinia equina																				F	F	R	R
Actinia fragacea																		F					
Anemonia viridis																							
Lanice conchilega																							
Spirobranchus lamarcki								R												O			
Spirorbis																							
Chthamalus montagui	F	C	F	C	F	O	O		A		F	A	A	A	C	A	A	C	A		F	A	A
Chthamalus stellatus																							
Semibalanus balanoides																			C			C	A
Perforatus perforatus																				C	O		
Idotea																							
Patella	C	C		C		O	F	C	C	C	F	C	A	R	C	C	A	C	C	R	F	C	C
Phorcus lineatus											O	F				C			C		F	C	C
Steromphala cineraria																							
Steromphala umbilicalis		O	O	O	O			F		F		C	C					O					
Littorina littorea			O		O	O										O						R	R
Melarhaphe neritoides											F			F			F						
Littorina obtusata			O		O											R							
Littorina saxatilis																							
Nucella lapillus			O		O				O				C					F	O		F	C	A
Mytilus edulis																					O	O	A
Magallana gigas																			R		O		
Asterias rubens																							O
Rhodophyta													C		O								
Rhodophyta turf																							
Rhodothamniella floridula								R		O										O	O		
Asparagopsis armata																							
Palmaria palmata								O		O										C			
Corallinaceae		C	F	C	F			F		O			C		F			F		F			
Corallina		F	F	F	F			F		C								C		A			
Mastocarpus stellatus			C		C			C		F								C		O			
Chondrus crispus								F												C			
Plocamium																							
Caulacanthus okamurae		F	C	O	C								C					C					
Lomentaria articulata			O		O			R		O										F			
Ceramium ciliatum																							
Membranoptera alata																							
Osmundea pinnatifida		O	O	O	O			O	C									O		C			
Polysiphonia																							
Vertebrata lanosa																							
Cladostephus spongiosus			R		R			R										R					
Dictyota dichotoma																							
Laminaria digitata																				C			
Ascophyllum nodosum							O		O							R	O						
Fucus serratus		O	A	O	A			A		A		F	C					A					
Fucus spiralis			O		O											A							
Fucus vesiculosus	R	S		S			F		C			C			C		A		O	R	O		
Pelvetia canaliculata																							
Himanthalia elongata																							
Ulva intestinalis	O								F												O		
Ulva lactuca			O		O															R			
Cladophora rupestris		C	O	C	O																		
Codium tomentosum																							

Table A1 (CTD). Phase 1 fauna abundances within each habitat type at each transect.

Taxon	A1.112/A1.111	A1.122	A1.112	A1.111	A1.112	A1.111	A1.112	A1.111	A1.112	A1.111	A1.1122	A1.213	A1.123
	R24	R24	R25	R25	R26	R26	R27	R27	R28	R28	R29	R29	R29
Anurida maritima													
Lichina pygmaea	O								R		F		
Verrucaria maura													
Orange sponge	R					R		R					O
Halichondria panicea													O
Actinia equina	C		R	R	O	O			F			O	
Actinia fragacea													
Anemonia viridis	R												
Lanice conchilega													
Spirobranchus lamarcki													
Spirorbis													
Chthamalus montagui	A		A	A	S	A	A	C	A	C	A	A	
Chthamalus stellatus													
Semibalanus balanoides	C				F		O				F	F	
Perforatus perforatus	O					C		A				O	F
Idotea													
Patella	C		A	C	F	C	C		C		C	C	O
Phorcus lineatus					R						R	R	
Steromphala cineraria													
Steromphala umbilicalis	O										R	R	
Littorina littorea													
Melarhaphe neritoides											C		
Littorina obtusata													
Littorina saxatilis											R		
Nucella lapillus	C		C	C		A	C	C		O	O	C	
Mytilus edulis	C	A	C	C	O	A	O	A	O	A	R		
Magallana gigas			R		R	F	R	C	R	C			
Asterias rubens	R												
Rhodophyta													
Rhodophyta turf													
Rhodothamniella floridula										O			
Asparagopsis armata													
Palmaria palmata		A											
Corallinaceae											R	R	
Corallina		O								O		R	C
Mastocarpus stellatus										O			F
Chondrus crispus													R
Plocamium													
Caulacanthus okamurae	R					R				O			
Lomentaria articulata		O								O			O
Ceramium ciliatum													
Membranoptera alata													
Osmundea pinnatifida	O							O					F
Polysiphonia													O
Vertebrata lanosa													
Cladostephus spongiosus													
Dictyota dichotoma													
Laminaria digitata		O											O
Ascophyllum nodosum													
Fucus serratus										O			
Fucus spiralis													
Fucus vesiculosus								R	R	O		C	
Pelvetia canaliculata					R								
Himanthalia elongata													A
Ulva intestinalis		F						R		R		R	
Ulva lactuca													R
Cladophora rupestris													
Codium tomentosum													

Table A2. Fauna and flora abundances within each quadrat (Habitats A1.111, A1.112 and A1.1122).

		A1.111									A1.112												A1.1122								
		M1			M2			M3			C1			C2			C3			C4			L1			L2			L3		
Taxon	Qualifier	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Anurida maritima	N																														
Lichina pygmaea	%												1	1							1	6	35	10		12	15	10	30	70	60
Verrucaria maura	%																									10					
Verrucaria mucosa	%																						2	1	1						
Rivularia bullata	%																								1						
Porifera - orange	%									1																					
Halichondria panicea	%																														
Dynamena pumila	%																														
Actinia equina	N	5						1	3	2							5														
Anemonia viridis	N																														
Urticina felina	N																														
Eulalia viridis	N								1														1		1						
Sabellaria alveolata	%																														
Lanice conchilega	N																														
Hydroides	N																														
Spirobranchus lamarcki	%																														
Spirorbis (Spirorbis) spirorbis	%																														
Verruca stroemia	%																														
Chthamalus montagui	%	35	15	7	15	20	10	35	10	10	10	10	90	98	90	80	60	60	50	85	65	50	15	70	15	80	20	90	75	90	30
Semibalanus balanoides	%	15	15	3				2	15								20	20	50												
Balanus crenatus	%																														
Perforatus perforatus	%	1																													
Perforatus perforatus	%									1																					
Austrominius modestus	%			2				1		1																					
Gammaridae	N																														
Ligia oceanica	N																												1		1
Pagurus bernhardus	N																														
Galathea squamifera	N																														
Necora puber	N																														
Carcinus maenas	N								1														1								
Lepidochitona cinerea	N																														
Patella	N	5	33	14	25	29	4	40	31	3	4	3	6	24	37		44	21	12	24	25	3	19	24	11	16	13	30	17	9	15
Phorcus lineatus	N						1														6		2				4	5	2		
Steromphala cineraria	N																							5							
Steromphala umbilicalis	N																						4		1		1				
Calliostoma zizyphinum	N																														
Littorina littorea	N																														
Melarhaphe neritoides	N										95	120	150	500	450	400	540	500	300	800	750	520	110	120	15				350	300	180
Littorina obtusata	N																														
Littorina saxatilis	N									1	5	12	25							11	2	11	25	25	65		1		45	20	45
Nucella lapillus	N	1					1			5																					
Ocenebra erinaceus	N																														
Tritia reticulata	N																														
Onchidella celtica	N																														
Mytilus edulis	%	5	45	70	80	70	85	40	65	85				1	1					1	3										
Magallana gigas	N																1														
Bryozoa crust	%																														
Asterias rubens	N																														
Botryllus schlosseri	%																														
Rhodophyta	%																														
Rhodothamniella floridula	%																														
Asparagopsis armata	%																														
Gelidium crinale	%																														
Gelidium spinosum	%																														
Palmaria palmata	%																														
Grateloupia filicina	%																														
Corallinaceae	%															1							5	1	5				1	1	1
Corallina officinalis	%									1													1								
Mastocarpus stellatus	%																														
Chondrus crispus	%																														
Chondracanthus acicularis	%																														
Plocamium	%																														
Furcellaria lumbricalis	%																														
Catenella caespitosa	%																														
Caulacanthus okamurae	%				2					1																					
Gastroclonium ovatum	%																														
Lomentaria articulata	%								5																						
Ceramium	%									1																					
Plumaria plumosa	%																														
Acrosorium ciliolatum	%																														
Cryptopleura ramosa	%																														
Hypoglossum hypoglossoides	%																														
Membranoptera alata	%																														
Osmundea pinnatifida	%								5	1																					
Polysiphonia	%																														
Vertebrata lanosa	%																														
Phaeophyceae	%																														
Leathesia marina	%																														
Cladostephus spongiosus	%																														
Dictyota dichotoma	%																														
Desmarestia aculeata	%																														
Laminaria digitata	%																														
Ascophyllum nodosum	%																														
Fucus serratus	%																														
Fucus spiralis	%													1									1	1	90		1	1			
Fucus vesiculosus	%																		1							2					
Pelvetia canaliculata	%																														
Himanthalia elongata	%																														
Sargassum muticum	%																														
Ulva intestinalis	%				1																										
Ulva lactuca	%																														
Cladophora rupestris	%																														
Codium	%																														

Table A3. Fauna and flora abundances within each quadrat (Habitats A1.122, A1.123, A1.211 and A1.212)

		A1.122						A1.123									A1.211									A1.212								
		CO1			CO2			H1			H2			H3			PC1			PC2			PC3			SP1			SP2			SP3		
Taxon	Qualifier	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Anurida maritima	N																							4	5									
Lichina pygmaea	%																												1					
Verrucaria maura	%																			45	15		50	15	20									
Verrucaria mucosa	%	1	1	1					1	1	1	2	1																					
Rivularia bullata	%																																	
Porifera - orange	%		1		1		5			1					1																			
Halichondria panicea	%				1									1	1																			
Dynamena pumila	%																																	
Actinia equina	N																																	
Anemonia viridis	N													1																				
Urticina felina	N	1		1																														
Eulalia viridis	N	1	1	4									2																					
Sabellaria alveolata	%																																	
Lanice conchilega	N																																	
Hydroides	N																																	
Spirobranchus lamarcki	%	3	2	1	1		5	1	1	2	2	1	1	5	3	5																		
Spirorbis (Spirorbis) spirorbis	%										1		1																					
Verruca stroemia	%																																	
Chthamalus montagui	%																1		2		1		5	1	1	15	20	10	40	5	15	7	15	85
Semibalanus balanoides	%																																	
Balanus crenatus	%					2								1																				
Perforatus perforatus	%																																	
Perforatus perforatus	%	3	25	20	25	15	2								1																			
Austrominius modestus	%						2							1																				
Gammaridae	N																																1	
Ligia oceanica	N																																	
Pagurus bernhardus	N																																	
Galathea squamifera	N												1																					
Necora puber	N																																	
Carcinus maenas	N																																	
Lepidochitona cinerea	N																																	
Patella	N	9	9	12	11										3									1	1	6	13	9	11	9	3	28	14	20
Phorcus lineatus	N																2	12	2	1	9			1					29	41	28	8	3	2
Steromphala cineraria	N							4	2	9	4	3	1													14	11	3						
Steromphala umbilicalis	N																											1				2	3	
Calliostoma zizyphinum	N																																	
Littorina littorea	N																							1			1	3	75	30	55			
Melarhaphe neritoides	N																25	15	35				50	2	10	50	30	20				50	65	##
Littorina obtusata	N																				1					2	1		1	2	1			
Littorina saxatilis	N																15	1	14	4	8	1	16	1	8	12	3	1	15	14	25	3		3
Nucella lapillus	N	18	17	1	56	4	11					1	1																					
Ocenebra erinaceus	N																																	
Tritia reticulata	N																																	
Onchidella celtica	N																																	
Mytilus edulis	%	45	30	15	15	1	12																									1		
Magallana gigas	N				1																													
Bryozoa crust	%							1	1	1																								
Asterias rubens	N				1																													
Botryllus schlosseri	%									1				1	1	1																		
Rhodophyta	%							1	2	1																								
Rhodothamniella floridula	%										1		5		5	5																		
Asparagopsis armata	%								1	1	1																							
Gelidium crinale	%																																	
Gelidium spinosum	%																																	
Palmaria palmata	%				5																													
Grateloupia filicina	%							1	2	1																								
Corallinaceae	%	5	1	2							1	1	1		2	5																	1	
Corallina officinalis	%	5	10	15	25	20	60	3	2	1	5	1	1	60	60	60																		
Mastocarpus stellatus	%							3	2	1	1	1		15	5	1																		
Chondrus crispus	%	2						15	15	20	3	5	1		5	5																		
Chondracanthus acicularis	%									1	2	1	1																					
Plocamium	%					2	5																											
Furcellaria lumbricalis	%								1																									
Catenella caespitosa	%																												1	1	1	5	2	
Caulacanthus okamurae	%																															1		
Gastroclonium ovatum	%	1				1				1					1																			
Lomentaria articulata	%														1																			
Ceramium	%	7	1	2			5	1	1	3	2	1	1																					
Plumaria plumosa	%																																	
Acrosorium ciliolatum	%																																	
Cryptopleura ramosa	%															1																		
Hypoglossum hypoglossoides	%						10																											
Membranoptera alata	%	1		1																														
Osmundea pinnatifida	%	3	2	1	3	7	1	2	1		1	1	1	5	5																			
Polysiphonia	%		1	1	1		1	1	1	1					1																			
Vertebrata lanosa	%																																	
Phaeophyceae	%																				2				2	1		2						
Leathesia marina	%							1	1	2	1	1	1																					
Cladostephus spongiosus	%					5	7	5	1		1				1																			
Dictyota dichotoma	%										1																							
Desmarestia aculeata	%										1																							
Laminaria digitata	%																																	
Ascophyllum nodosum	%																																	
Fucus serratus	%										1																							
Fucus spiralis	%																				1					20	5	15	20	25	7	50	20	3
Fucus vesiculosus	%	1																																
Pelvetia canaliculata	%																5		3	35	75	7	30	40	35									
Himanthalia elongata	%							30	20	15	7	12	10	20	50	65																		
Sargassum muticum	%								2																									
Ulva intestinalis	%	1	1	10	7	3	2	1		1	1	1	1		1																			
Ulva lactuca	%	1		1		1	1	2	3	2	5	2	1																					1
Cladophora rupestris	%																																	

Table A4. Fauna and flora abundances within each quadrat (Habitats A1.213 and A1.221)

Taxon	Qualifier	A1.213																						A1.221					
		V1			V2			V3			V4			V5			V6			V7			VM1			VM2		
		A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Anurida maritima	N																												
Lichina pygmaea	%																1												
Verrucaria maura	%																												
Verrucaria mucosa	%																												
Rivularia bullata	%																												
Porifera - orange	%			1													1												
Halichondria panicea	%																												
Dynamena pumila	%																												
Actinia equina	N	2															1						4	2	1	2	11	7
Anemonia viridis	N																												
Urticina felina	N																			2	4	1							
Eulalia viridis	N				2																			1					
Sabellaria alveolata	%																												
Lanice conchilega	N																												
Hydroides	N																												
Spirobranchus lamarcki	%																												
Spirorbis (Spirorbis) spirorbis	%				1	1	1							1														3	
Verruca stroemia	%																												
Chthamalus montagui	%	1			2		1	15	25	10	15	5		30	55	60	35	15	15	5	7	3	5		2		3	30
Semibalanus balanoides	%				1		1	1	1	1				10	10	10				1	1	1		1	40	1	2	3
Balanus crenatus	%																												
Perforatus perforatus	%																												
Perforatus perforatus	%							1		1													1	1	2	1			
Austrominius modestus	%																			1	1	1							
Gammaridae	N																												
Ligia oceanica	N																												
Pagurus bernhardus	N																												
Galathea squamifera	N																												
Necora puber	N																												
Carcinus maenas	N	1				1																							
Lepidochitona cinerea	N					1																							
Patella	N	5	9	1	13	32	9	41	29	11	32	14	15	16	17	13	24	19	7	2	7	7	1	6	8	6	14	11
Phorcus lineatus	N				4		1	6	3	2	4	5	2		2	2	6	14	4			1	6					
Steromphala cineraria	N				5	3	4	1	1				1										1						
Steromphala umbilicalis	N	13	29	18	3	4	3	3	4	2	12	3		34	2	4	7	7	16	27	32	12			2	9	4	5
Calliostoma zizyphinum	N																												
Littorina littorea	N	4	5	5								1		1											4				
Melarhaphe neritoides	N																50	40	30	30	10								
Littorina obtusata	N	4	4			3	1						3	1	1			3							3		2		
Littorina saxatilis	N	2															3												
Nucella lapillus	N	1		1		1	1	2		1	2	1		3	1		4		1		1	1		8	5	4	2		
Ocenebra erinaceus	N																												
Tritia reticulata	N																												
Onchidella celtica	N																					1							
Mytilus edulis	%																					1	30	30	10	60	70	35	
Magallana gigas	N																												
Bryozoa crust	%																												
Asterias rubens	N																												
Botryllus schlosseri	%																												
Rhodophyta	%																												
Rhodothamniella floridula	%																												
Asparagopsis armata	%																												
Gelidium crinale	%																												
Gelidium spinosum	%																												
Palmaria palmata	%																												
Grateloupia filicina	%																												
Corallinaceae	%	1	2	10	3	1	1	3	1	5		5	10	25	10	15	5	7	5	1	5	2			5	3			
Corallina officinalis	%	1	1	1		1			5		5	5	5		5								1	5		5		7	
Mastocarpus stellatus	%				5	2					5										1	1							
Chondrus crispus	%	1																											
Chondracanthus acicularis	%																												
Plocamium	%																												
Furcellaria lumbricalis	%																												
Catenella caespitosa	%				2	2														1	1	3							
Caulacanthus okamurae	%					3			2	15	7	5	1		1				2			2					3	1	
Gastroclonium ovatum	%																												
Lomentaria articulata	%					1																	1	5					
Ceramium	%																1									2			
Plumaria plumosa	%																												
Acrosorium ciliolatum	%																												
Cryptopleura ramosa	%																												
Hypoglossum hypoglossoides	%																												
Membranoptera alata	%																												
Osmundea pinnatifida	%	5	3	5	2	2	3	8	10	5	1	2		10	2	10	1	1	1	3	2	5	10	20	5		1	1
Polysiphonia	%																							1					
Vertebrata lanosa	%												10							1									
Phaeophyceae	%																												
Leathesia marina	%																												
Cladostephus spongiosus	%																												
Dictyota dichotoma	%																												
Desmarestia aculeata	%																												
Laminaria digitata	%																												
Ascophyllum nodosum	%	5											1							1									
Fucus serratus	%																							30					
Fucus spiralis	%																												
Fucus vesiculosus	%	45	55	60	60	70	60	35	35	50	70	70	90	75	25	45	20	25	70	50	60	75	25	20	30	25	25	35
Pelvetia canaliculata	%																												
Himanthalia elongata	%																												
Sargassum muticum	%																												
Ulva intestinalis	%														2											1			
Ulva lactuca	%				1	1						1	1							1			5	1					
Cladophora rupestris	%	5	1	2							2		1																
Codium	%																												

Table A5. Fauna and flora abundances within each quadrat (Habitats A1.214 and A1.3141)

		A1.214																						A1.3141								
		S1			S2			S3			S4			S5			S6			S7			A1			A2			A3		
Taxon	Qualifier	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Anurida maritima	N																						6								
Lichina pygmaea	%																														
Verrucaria maura	%																														
Verrucaria mucosa	%	1		1	3	2	1						3	5	3																
Rivularia bullata	%																														
Porifera - orange	%	1	1					1				1			1					1	1										
Halichondria panicea	%							1																							
Dynamena pumila	%																5	1	5												
Actinia equina	N																						6	3	2	1					
Anemonia viridis	N																														
Urticina felina	N																														
Eulalia viridis	N	1						1			1																				
Sabellaria alveolata	%										3			1	1																
Lanice conchilega	N														2																
Hydroides	N																														
Spirobranchus lamarcki	%	1	1	3	1	2	1		1	1	1		1	1	1				2												
Spirorbis (Spirorbis) spirorbis	%	3	3	1	1	2	1	1	1				1	1	1	1				15	10	15		1	1						
Verruca stroemia	%	2	2	1																											
Chthamalus montagui	%																						1					2		1	
Semibalanus balanoides	%																														
Balanus crenatus	%																														
Perforatus perforatus	%																						1	1	19						
Perforatus perforatus	%																40	15	10	1											
Austrominius modestus	%																														
Gammaridae	N																						10	15							
Ligia oceanica	N																														
Pagurus bernhardus	N								1																						
Galathea squamifera	N																														
Necora puber	N		1																												
Carcinus maenas	N				1															1	1			1							
Lepidochitona cinerea	N												1																		
Patella	N	9	10	2	2	14	22	7	8	21	1		5	12	27	5	2	3	2	9	10	5	2	8	5			4			
Phorcus lineatus	N								1	1																					
Steromphala cineraria	N	3	16	18									2							3	6	6			1						
Steromphala umbilicalis	N	1			10	3				1				1						4	20	6	10	20	22		1				
Calliostoma zizyphinum	N		1											1						1											
Littorina littorea	N																						1	4	8						
Melarhaphe neritoides	N																														
Littorina obtusata	N				1	1							1			1	1			1		1	1	6	2		1	2			
Littorina saxatilis	N																											1			
Nucella lapillus	N	1	1		1		1			2				3				3			2	1		2	1						
Ocenebra erinaceus	N	1			1										1																
Tritia reticulata	N																			1											
Onchidella celtica	N																														
Mytilus edulis	%	10	20	3															1												
Magallana gigas	N																														
Bryozoa crust	%	1	1	1	2	1	1						1	1	1					1	1	2									
Asterias rubens	N																														
Botryllus schlosseri	%					1			1					1					1												
Rhodophyta	%																														
Rhodothamniella floridula	%															1			1	1						1					
Asparagopsis armata	%																														
Gelidium crinale	%	1	1																												
Gelidium spinosum	%	1																													
Palmaria palmata	%				3	10	5									1															
Grateloupia filicina	%																														
Corallinaceae	%	50	35	35	1	25	55	15	25	15	15		5	15	10	3	15	5	25	70	85	35	50	30	60						1
Corallina officinalis	%				2	1	5	20	30	5			1	10	10	2			5					1	5						
Mastocarpus stellatus	%				1	2	2	6	3		1	15	5	20	10	45			1	3	10	2									
Chondrus crispus	%	1	3	1	1	2	1	2	1				1	1	2	2		5	10	1	1	1	1		1	1					
Chondracanthus acicularis	%																														
Plocamium	%													1																	
Furcellaria lumbricalis	%																														
Catenella caespitosa	%																														
Caulacanthus okamurae	%				2			1	1	1								1													
Gastroclonium ovatum	%																														
Lomentaria articulata	%	1	1		2	1	2	1					3	3	1	2	1	2	15	1	1	1	2	1	1						
Ceramium	%				2		1																								
Plumaria plumosa	%				1		1							1	1	1				1	1	1									
Acrosorium ciliolatum	%							1						2	1	1															
Cryptopleura ramosa	%													2	1	1															
Hypoglossum hypoglossoides	%																														
Membranoptera alata	%				1		2							1		1				3	1	1									
Osmundea pinnatifida	%	1	1		1	5	2	5	2	5			3	2	1	1	5	1	3	1	1	1		3	2						
Polysiphonia	%																						1	1							
Vertebrata lanosa	%																						1	1	1	1	1	1	1	1	1
Phaeophyceae	%																														
Leathesia marina	%																														
Cladostephus spongiosus	%	1					1	1	7	15					1				1												
Dictyota dichotoma	%				1		1																								
Desmarestia aculeata	%																														
Laminaria digitata	%				1																										
Ascophyllum nodosum	%																						90	85	95	1	1	60	95	98	1
Fucus serratus	%	50	40	90	75	45	85	45	50	25	90	80	25	60	15	30	70	75	85	85	95	70	10	1	5						
Fucus spiralis	%																									5		10			
Fucus vesiculosus	%																										1	1			
Pelvetia canaliculata	%																														
Himanthalia elongata	%	1	1																												
Sargassum muticum	%																														
Ulva intestinalis	%											1	1					1	1												
Ulva lactuca	%	1	1	1					1	5		2	1							1	1			1		1					
Cladophora rupestris	%	2	1	1									1							2	1	2	6		20	1					
Codium	%																														

Table A6. Timed search fauna and flora abundances for each Phase 2 station (Habitat types A1.111, A1.112, A1.1122, A1.122, A1.123, A1.211, and A1.212).

	A1.111			A1.112				A1.1122			A1.122		A1.123			A1.211			A1.212		
Taxon	M1	M2	M3	C1	C2	C3	C4	L1	L2	L3	CO1	CO2	H1	H2	H3	PC1	PC2	PC3	SP1	SP2	SP3
Anurida maritima					R													F			
Lichina pygmaea				R	R		R	C	C	C									R	R	
Rivularia bullata								R													R
Verrucaria maura								R									F	F			
Verrucaria mucosa														R							
Porifera - orange			R										R								
Halichondria panicea															R						
Calvadosia cruxmelitensis													R								
Actinia equina	F	O	O	R	R	O															O
Actinia fragacea											O										
Anemonia viridis															R						
Urticina felina											O	R									
Eulalia viridis								O			F			O							
Sabellaria alveolata																					
Lanice conchilega																					
Spirobranchus lamarcki											C		R	C							
Spirorbis spirorbis														F	F						
Chthamalus montagui	F	F	C	A	A	A	A	A	S	A						R	O	R	A	F	A
Semibalanus balanoides	O		F			C															
Balanus crenatus												R									
Perforatus perforatus	R		R								A	O			R						
Austrominius modestus	R		R									R									
Gammaridae																					R
Galathea squamifera														R							
Cancer pagurus																					
Necora puber																					
Carcinus maenas								O													
Xantho hydrophilus													F								
Lepidochitona cinerea												R									
Patella	C	C	C	C	C	C	C	A	A	A	C				R	F	O	O	F	A	A
Phorcus lineatus	O	O			O	R	F	F	F	O		O				O	F	F		A	C
Steromphala cineraria								O					F	C					C		
Steromphala umbilicalis	O	R						F	O								R		O	R	O
Calliostoma zizyphinum													O	O							
Littorina littorea	R								R							R		O	O		O
Melarhaphe neritoides					A	C	C	F		C						F		F	F	F	F
Littorina obtusata			R														O	O	F	F	
Littorina saxatilis				C			F	O	R	C						F	F	C	F		F
Nucella lapillus	F	O	F		O	C	R				A	C		O							
Ocenebra erinaceus																					
Mytilus edulis	A	A	A	O	C		R			O	A	O									R
Magallana gigas			R			R									R						
Venerupis corrugata													R								
Bryozoa crust													R	R							
Asterias rubens	R											O									
Botryllus schlosseri													R		R						
Porphyra purpurea		R																			
Rhodothamniella floridula														R	O						
Asparagopsis armata													O	R							
Palmaria palmata											R			O							
Corallinaceae crust	O	R	R		R	R	R	O		R	R			O	O				R		R
Corallina officinalis	R	O	O				R	R		R	C	C	O	F	A						R
Mastocarpus stellatus											R	R	O	F	F						
Chondrus crispus											O		C	C	O						
Chondracanthus acicularis													O	F							
Plocamium																					
Catenella caespitosa																				R	O
Caulacanthus ustulatus		R	R					R		R					R						R
Gastroclonium ovatum													R		R						
Lomentaria articulata			R								R	R		O						C	
Ceramium											O	O	O	O							
Plumaria plumosa																					
Hypoglossum hypoglossoides												O									
Membranoptera alata																					
Osmundea pinnatifida	O		R								O		O	O	O						
Polysiphonia												O	R		R						
Vertebrata lanosa												O									
Phaeophyceae																	O	R	R		
Leathesia marina													O	O							
Cladostephus spongiosus												O	O	O	R						
Dictyota dichotoma														R							
Desmarestia aculeata														R							
Laminaria digitata											O	R									
Ascophyllum nodosum																					
Fucus								R													
Fucus serratus										R		R		R							
Fucus spiralis								R								R	R		C	C	C
Fucus vesiculosus		R	R			R															
Pelvetia canaliculata					R											F	A	C			
Himanthalia elongata													A	A	A						
Sargassum muticum													R								
Cystoseira														O							
Ulva intestinalis	R	R	R					R	R	R	O	F	O	R							R
Ulva lactuca								R			R	R	F	O							O
Cladophora rupestris																					
Codium tomentosum												R									

Table A7. Timed search fauna and flora abundances for each Phase 2 station (Habitat types A1.213, A1.214, A1.221 and A1.3141).

	A1.213							A1.214							A1.221		A1.3141		
Taxon	V1	V2	V3	V4	V5	V6	V7	S1	S2	S3	S4	S5	S6	S7	VM1	VM2	A1	A2	A3
Anurida maritima																			
Lichina pygmaea						R													
Rivularia bullata																			
Verrucaria maura																			
Verrucaria mucosa		R				R		O	R			R		R					
Porifera - orange										R			R				R		
Halichondria panicea											R								
Calvadosia cruxmelitensis																			
Actinia equina	O				R	O	O						R		O	F	F	O	F
Actinia fragacea																			F
Anemonia viridis																			
Urticina felina									O										
Eulalia viridis		O						O											
Sabellaria alveolata											R	R							
Lanice conchilega												R							
Spirobranchus lamarcki								C	O		R		R	O			O		
Spirorbis spirorbis		O						F	R		O	R		F			F		
Chthamalus montagui	O		C	F	A	C	F	A	R	O			O		C	F		R	
Semibalanus balanoides		R	R	R	O	R	R			R			O		C	F			
Balanus crenatus																			
Perforatus perforatus			R										C	R	O	R			
Austrominius modestus						R													
Gammaridae	O													O			O		
Galathea squamifera																			
Cancer pagurus														R					
Necora puber								O						R					
Carcinus maenas	O								O								O		
Xantho hydrophilus																			
Lepidochitona cinerea																			R
Patella	F	C	C	C	C	C	C	C	F	F	F	C	O	C	C	C	C	F	
Phorcus lineatus		O	F	F	F	F	F			O			R		R				O
Steromphala cineraria		C	R	R				C	O								O		
Steromphala umbilicalis		O	F	F	F	F	C	F	O	O		O				F	C	O	
Calliostoma zizyphinum								O											
Littorina littorea	F	F			R		F								R		C		
Melarhaphe neritoides	C	F				F													
Littorina obtusata	C	F	O	O				F	O	R	O	O			O		F	C	O
Littorina saxatilis	C					O												O	
Nucella lapillus	O	F	F	O	O	F	F	O	O	O			F	F	A	O			
Ocenebra erinaceus								O	O			R							
Mytilus edulis							R						F		C	C			
Magallana gigas													R			O			
Venerupis corrugata																			
Bryozoa crust								R	R										
Asterias rubens																			
Botryllus schlosseri									R										
Porphyra purpurea																			
Rhodothamniella floridula												R	R	R				R	
Asparagopsis armata																			
Palmaria palmata			R						F	O	O	O							
Corallinaceae crust	R	R		O	F	R		C	C		A	O		A	O	O	A	R	
Corallina officinalis		R		O	O	R	R	F	O		F	O	O	O	O	O	F		
Mastocarpus stellatus		F					O		F	A	A	C	R	F					
Chondrus crispus	R							F	O	R	R	F	F	C			R	R	
Chondracanthus acicularis										O			R						
Plocamium												R							
Catenella caespitosa							R											R	
Caulacanthus ustulatus		O	O	O	R	O	R		F		R				R	R	R		
Gastroclonium ovatum																			
Lomentaria articulata		R				R			O	O	O	O	O		O	O	O		
Ceramium						R		R	O	R									
Plumaria plumosa									R			R		O					
Hypoglossum hypoglossoides																			
Membranoptera alata									R			R		O					
Osmundea pinnatifida	O	F	F	O	O	F	C		O	O	O	O	O	R	O	R	O		
Polysiphonia															R	R	R		
Vertebrata lanosa	O						R										C	R	O
Phaeophyceae																			
Leathesia marina																			
Cladostephus spongiosus						R		R				R							
Dictyota dichotoma									R										
Desmarestia aculeata																			
Laminaria digitata									O										
Ascophyllum nodosum	F	R		O			O							R			A	A	A
Fucus																			
Fucus serratus	R		R	R			O	A	A	S	S	S	A	S	F	O			
Fucus spiralis																	R		
Fucus vesiculosus	A	A	A	A	A	A	A								C	C		R	R
Pelvetia canaliculata																			
Himanthalia elongata																			
Sargassum muticum																			
Cystoseira																			
Ulva intestinalis			R	R	R			R			R	R	R		R	R			
Ulva lactuca		R	R		R		R	R	O	R			R	R					
Cladophora rupestris	O				R			F	R	R		R		C			C	R	
Codium tomentosum																			

Table A8. Taxa responsible for the similarities within each of the Habitat types (timed search data).

Habitat type	Average similarity (%)	Taxon	Av.Abund	Contrib%	Cum.%
		Ascophyllum nodosum	5.0	37.6	37.6
		Actinia equina	2.7	17.1	54.8
		Littorina obtusata	3.0	17.0	71.7
A1.3141	41.5	*Vertebrata lanosa*	2.3	9.6	81.3
		Chthamalus montagui	5.0	33.9	33.9
		Patella	4.0	27.1	61.0
		Melarhaphe neritoides	3.3	12.3	73.2
		Mytilus edulis	1.8	4.8	78.0
A1.112	62.8	*Phorcus lineatus*	1.5	4.1	82.1
		Nucella lapillus	4.5	19.1	19.1
		Corallina officinalis	4.0	19.1	38.1
		Perforatus perforatus	3.5	9.5	47.6
		Mytilus edulis	3.5	9.5	57.1
		Ceramium	2.0	9.5	66.7
		Ulva intestinalis	2.5	9.5	76.2
A1.122	47.7	*Urticina felina*	1.5	4.8	81.0
		Himanthalia elongata	5.0	21.3	21.3
		Chondrus crispus	3.3	11.0	32.2
		Corallina officinalis	3.3	9.9	42.1
		Mastocarpus stellatus	2.7	9.9	52.0
		Osmundea pinnatifida	2.0	8.5	60.5
		Cladostephus spongiosus	1.7	5.5	66.0
		Spirorbis spirorbis	2.0	4.2	70.1
		Steromphala cineraria	2.3	3.7	73.8
		Corallinaceae crust	1.3	2.8	76.6
		Calliostoma zizyphinum	1.3	2.4	79.0
A1.123	50.1	*Chondracanthus acicularis*	1.7	2.4	81.5
		Chthamalus montagui	5.3	23.8	23.8
		Patella	5.0	23.8	47.6
		Lichina pygmaea	4.0	19.1	66.7
		Phorcus lineatus	2.7	11.1	77.7
A1.1122	67.3	*Littorina saxatilis*	2.3	6.1	83.9
		Mytilus edulis	5.0	21.8	21.8
		Patella	4.0	17.5	39.3
		Chthamalus montagui	3.3	13.1	52.4
		Nucella lapillus	2.7	10.1	62.4
		Actinia equina	2.3	8.7	71.2
		Corallina officinalis	1.7	5.9	77.0
A1.111	73.4	*Corallinaceae crust*	1.3	4.4	81.4

Table A8 Ctd. Taxa responsible for the similarities within each of the Habitat types (timed search data).

Habitat type	Average similarity (%)	Taxon	Av.Abund	Contrib%	Cum.%
		Pelvetia canaliculata	4.0	21.9	21.9
		Littorina saxatilis	3.3	19.9	41.8
		Phorcus lineatus	2.7	15.2	57.0
		Patella	2.3	13.3	70.3
		Melarhaphe neritoides	2.0	6.7	77.0
A1.211	66.1	*Chthamalus montagui*	1.3	6.6	83.7
		Fucus serratus	5.6	22.0	22.0
		Patella	3.3	11.7	33.7
		Mastocarpus stellatus	3.0	8.1	41.8
		Chondrus crispus	2.4	7.1	48.9
		Corallinaceae crust	2.9	6.0	54.9
		Corallina officinalis	2.0	5.9	60.8
		Osmundea pinnatifida	1.6	5.2	66.0
		Lomentaria articulata	1.4	4.2	70.2
		Nucella lapillus	1.7	3.9	74.1
		Littorina obtusata	1.4	3.0	77.2
		Spirorbis spirorbis	1.4	2.6	79.7
A1.214	52.3	*Palmaria palmata*	1.3	2.5	82.2
		Fucus spiralis	4.0	19.5	19.5
		Patella	4.3	17.7	37.2
		Chthamalus montagui	4.3	17.7	54.9
		Melarhaphe neritoides	3.0	14.6	69.5
		Steromphala umbilicalis	1.7	6.4	75.9
A1.212	60.1	*Phorcus lineatus*	3.0	6.3	82.2
		Fucus vesiculosus	5.0	19.5	19.5
		Patella	3.9	14.5	34.0
		Nucella lapillus	2.6	8.9	42.8
		Osmundea pinnatifida	2.7	8.9	51.7
		Chthamalus montagui	3.0	8.3	60.0
		Phorcus lineatus	2.4	7.6	67.5
		Steromphala umbilicalis	2.6	7.6	75.1
		Caulacanthus ustulatus	1.4	4.0	79.1
A1.213	62.5	*Semibalanus balanoides*	1.0	2.8	81.9
		Patella	4.0	11.4	11.4
		Mytilus edulis	4.0	11.4	22.9
		Fucus vesiculosus	4.0	11.4	34.3
		Chthamalus montagui	3.5	8.6	42.9
		Semibalanus balanoides	3.5	8.6	51.4
		Actinia equina	2.5	5.7	57.1
		Nucella lapillus	3.5	5.7	62.9
		Corallinaceae crust	2.0	5.7	68.6
		Corallina officinalis	2.0	5.7	74.3
A1.221	79.6	*Lomentaria articulata*	2.0	5.7	80.0