A report to the
Nature Conservancy Council
from the
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ROCKY SHORE SURVEYS OF THE ISLES OF SCILLY MARCH 27TH TO APRIL 1ST 1983 AND JULY 7TH TO 15TH 1983.

VOLUME 1. SURVEY REPORT.

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SYNOPSIS

1. These surveys were carried out to describe the habitats, communities and species on littoral rock throughout the archipelago and to classify the sites described according to their scientific interest and probable nature conservation importance.

2. Sites were selected from maps and charts to ensure that as wide a range of habitats as possible was surveyed in the time available. Systematic surveys were carried out of open-shore communities and records of the abundance of conspicuous species were obtained from the main subzones on the shore. These results enable the classification of different shore types based on communities present and topographical features. Particular attention was given to the description of other habitats such as rockpools, boulders and caves. Colour transparency photographs were taken of the shores and habitats present and of species. Algae were collected and pressed to provide a reference herbarium of Isles of Scilly algae. In order to map the distribution of different shore types, survey results, observations of shores made whilst travelling between sites, aerial photographs and photographs held by NCC were used.

3. Forty-six sites were described during the two periods of survey and a total of 128 algal, 13 lichen and 237 animal taxa were recorded. Nine different shore types were described ranging from those exposed to very severe wave action at Bishop Rock and the Western Rocks, to those very sheltered from wave action in the channels between islands, and from the bedrock shores of the seaward-facing coasts to the boulders and boulders on sand of the enclosed coasts. Separate descriptions were made of the communities present under boulders, in boulder caves and in rockpools.

4. The rocky shore communities present in the Isles of Scilly were distinctly southern in character but the fauna of open shores was somewhat impoverished when compared with mainland shores, probably as a result of the isolation of the islands. In the assessment of the nature conservation importance of shores, special features of shores in the Isles of Scilly were considered to be: the high diversity of habitats and therefore of communities and species along the coastline; the presence of many southern species; the high scientific interest of adjacent terrestrial areas; the potential for development of interpretative facilities; the high intrinsic (scenic) appeal of the coast. Particularly high importance was given to the presence of exceptionally exposed shores and the presence of sheltered shores amongst the islands which include very rich underboulder communities.

5. Recommendations for future work included:

   - that rapid surveys by boat and/or foot should be made to provide accurate maps of the location and extent of different shore types and to ensure that all of the main habitats and communities have been included in the assessment of shores;
   - that a collation of available information on the shores of the Isles of Scilly is undertaken;
   - that biologists with experience of Isles of Scilly shores should be asked to assess the scientific interest and conservation value of shores with which they are familiar and that a search of the literature should be carried out to ensure the listing of all species of high scientific interest;
   - that the categories included in the NCC rocky shore recording sheet should be thoroughly reviewed and a new sheet developed.

ROCKY SHORE SURVEYS IN THE ISLES OF SCILLY

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1. INTRODUCTION

1.1. Aims of survey

The Isles of Scilly are one of seven areas currently being considered by the Nature Conservancy Council as potential statutory marine nature reserves. The information required to manage such areas includes descriptions of the habitats and communities present and their extent, together with an assessment of the nature conservation importance of those habitats and communities and of the species present in them.

The specific objectives of the survey reported here were:

- To describe the habitats, communities and species on littoral rock throughout the archipelago.
- To classify the sites described according to their scientific interest and probable nature conservation importance, both in the context of the Isles of Scilly and south-west Britain.

1.2. Location, area and climate

The Isles of Scilly archipelago is a small group of granite islands situated around longitude 6°20' W, latitude 49°55' N, approximately 45 km west of the nearest mainland at Land's End. The location of the Isles of Scilly and a map of the islands is shown in Fig. 1 (which folds out of the back of the report in bound copies). The group includes five relatively large inhabited islands, St. Mary's, St. Martin's, Tresco, Bryher and St. Agnes, the uninhabited but quite large Samson and Annet, and innumerable small islands and rocks. The total length of coastline at low water is very approximately 108 km including about 11 km of predominantly sandy shore. All of the islands and rocks within the archipelago lie within an area measuring 16 km east to west and 13 km north to south.

The climate of the Isles of Scilly is mild. Harvey (1969) describes some of the main features of the climate and these are listed below.

Mean air temperature (1921-1950)

Annual	11.4°C
Winter (February)	7.6°C
Summer (August)	16.2°C

Mean rainfall (1916-1950)

Annual	830.8 mm
June	44.2 mm
November	91.7 mm

Mean surface seawater temperature (taken at the Sevenstones Light vessel)

Annual	12.42°C
March	9.60°C
August	16.60°C

The tidal range is given as from 4.3 to 2.0 m at neap tides and from 5.7 to 0.7 m above chart datum at spring tides (Admiralty, 1982).

Salinity is stated by Harvey (1969) as rarely departing from 35.2°/oo.

There is little freshwater runoff from the islands and no major rivers, so that waters near to the islands remain near to full salinity. A few very sheltered bays and the lagoon at Porth Hellick may be subject to lowered salinity during heavy rain.

Residual currents in the region of the Isles of Scilly are, according to Cooper (1961) and Lee and Ramster (1981), predominantly from the north, bringing water from the area of the Nymphe Bank off Southern Ireland. These conclusions are based mainly on work carried out in the spring. However, recent work (Simpson et al., 1982) demonstrates how previously published information might be misleading. They described the presence of a north-going residual current in July 1979 based on the results of recording current meters moored around the islands and it might be that, as suggested by Cooper (1961), during the summer residual currents near to the surface will 'approach more nearly to the direction of the wind'. The 'Land's End Corner Current' described by Cooper (1961) appears to stay close to the mainland coast and, whatever the overall conditions of residual movements are in the region of Scilly, they appear to recruit mainly over large areas of open Atlantic water.

Simpson et al. (1982) also describe how the Isles of Scilly act as a 'stirring rod', enhancing mixing of the water column by accelerated tidal streams and thus bringing cold deep water to mix with warmer surface water and decreasing the surface temperature by about 1°C in the example given by Simpson et al. (1982) for June 1979 and about 2°C in the measurements made in July 1979. Generalised records of seawater temperatures are difficult to apply in some areas of Scilly and in the context of rocky shores which are exposed to the atmosphere for a substantial period of time. Local warming of the shallow waters in the inner region of the archipelago may well occur. Also, the mild air temperatures with very low frequency of frosts will doubtless be of importance to many species susceptible to cold air temperatures.

1.3. Previous studies

The extent of previous studies is described by Harvey (1969) who also provides a general description of shore communities in the Isles of Scilly. The paper by Harvey is an introduction to the series of papers published or to be published in the Journal of Natural History on the marine flora and fauna of the Isles of Scilly. In addition to these papers, Russell (1968) provides a list of marine algae. Crisp and Southwood (1958) include references to the fauna of the Isles of Scilly in their paper on the distribution of intertidal animals along the coast of the English Channel. The SMBA/MBA Intertidal Survey Unit, which carried out descriptive surveys and shore assessments for the NCC, did not visit the islands but provided a brief description based on previous work (Powell et al., 1978). Smith and Gault (1983) describe shores visited at the same time as our March/April survey.

Many of the previous studies in the Isles of Scilly have been aimed at describing the distribution of species rather than describing the communities present and providing an assessment of the different types of communities present in different habitats. Thus there is little information available on which to base or compare our work.

However, the rocky shore communities present in the British Isles have been described by several workers, and the studies of Crisp and Southward (1958), Ballantine (1961) and Lewis (1964) have provided particularly useful information against which to describe the rocky shore communities present in the Isles of Scilly and assess their biogeographical features and their similarity/dissimilarity with shores elsewhere in the British Isles. The experience of team members in rocky shore survey was also important.

The studies of marine algae of the Lizard Peninsula in South Cornwall described by Price (1980, 1981) are particularly important in comparing the Isles of Scilly with other locations.

2. METHODS

2.1. Survey

2.1.1. Time of survey. The first survey period was chosen to take advantage of the very low spring tides in March/April at a time when, because of probable bad weather, we could only expect to survey the less-exposed shores. The second survey period in July was chosen to use good spring tides at a time of year when settled weather was probable and the most wave-exposed sites could be reached.

2.1.2. Selection of sites. Sites were selected during the planning stage from inspection of maps and charts to ensure that as wide a range of habitats as possible was surveyed in the time available. Also, the previous experience of NCC staff provided a list of sites of known or possible nature conservation interest. The exact location of sites and the survey of local habitats such as rockpools, surge gullies and boulders, which could not be predicted from maps, was left to survey staff. During the two surveys, sites were described in all of the pre-selected areas and at several other locations. Two or sometimes three sites were surveyed in one tide. During the March/April survey, another survey team, Dr. Shelagh Smith and Fraser Gault, surveyed other shores, and their work is reported separately. Dr. Roger Mitchell and Sarah Fowler (NCC) worked on some of the same shores as our team and on some different shores, and their results are incorporated here.

2.1.3. Description of habitats and general description of shores. The NCC Rocky Shore Recording Sheet (Appendix 1) developed by the SMBA/MBA team was used to provide information on the location and physical features of sites. Also, a general description in words of the main features of each site including slope, aspect, substratum type, biological communities present and the heights of the main subzones or occurrence of main species was made. In the March/April survey, this description was only structured inasmuch that the description started at the top of the shore. In July, the description was structured to be more concise and to include a brief description of the main communities and the heights on the shore at which they were present.

2.1.4. Systematic survey of open-shore communities. In order to provide lists of the abundance of conspicuous species present in all of the main communities and on the exposed surfaces of sloping bedrock or boulder shores, the following instructions were given to survey staff.

1. On reaching the shore, the team leader should decide what sort of survey will be carried out. Normally a systematic description of the abundance of species in the main communities present at different heights on the open shore will be completed and descriptions of the communities in other major habitats present will be made. For some shores where time does not permit a full survey or where the shore is very similar to one previously surveyed, a brief description is made. Where some important subsidiary habitat such as rockpools, underboulder or cave areas requires detailed survey, this may take precedence over the open-shore survey.

2. For open-shore surveys, the botanist and zoologist agree on the line of the survey belt. Using the tidal height predictions made for half-hour intervals through the day, they establish the height of sea level above chart datum and starting at a + .0 or +.5 m station near sea level, level up the shore with the cross-staff level, marking each 0.5 m interval with chalk. The botanist and zoologist should then agree on the location of each of the distinctly different communities they are to survey, which will normally be on the Lower Shore (LS), Lower Midshore (LMS), Midshore (MS), Upper Midshore (UMS), Upper Shore (US) and Splash Zone (Spl.).

Record the abundance of all of the algae and animals which can be seen in each of the agreed areas, surveying across a c. 5 m width of shore. The quantity of each species is to be recorded according to the abundance scale (shown in Appendix 2).

3. For surveys of other habitats, describe the species present and give an estimate of their abundances.

4. Take photographs of the shore with views up and down the shore, from the side (as far as possible with the sea and sky on the left), and of each community present. Also, take photographs of some of the main species present. Take three photographs of each subject.

5. Make a sketch of the site location and of the site profile or of any other features felt to be important (such as the distribution of species in rockpools).

In the March/April survey a checklist of species (Appendix 3) was used to ensure consistent recording of those species, and only the species present were listed in the information tabulated each evening. For the July survey, a species checklist/recording sheet was prepared for use on each shore (Appendices 4 and 5).

2.1.5. Description of communities in other habitats. Survey staff were instructed to describe the communities present in habitats such as rockpools, under overhangs, under boulders and in wave surge gullies. It was often difficult to use any objective scale of abundance in such situations and a general description was made.

2.1.6. Samples. Samples were collected of species which could not be identified in the field. Also, algae were collected to provide a reference collection. Most of the samples were identified in the evening following shore work and some were identified on return to Pembroke. Algae were pressed onto paper or card. During the July survey, samples of dogwhelks (Nucella lapillus) were collected for analysis of shell size in relation to the wave exposure of sites for John Crothers (Leonard Wills Field Centre, Nettlecombe Court, Somerset).

2.1.7. Photographs. Colour transparency photographs were taken of each shore to illustrate the whole shore, particular communities or habitats, and species. Three photographs of each subject were taken and separated into two sets for the NCC and one set for OPRU. Each photograph was labelled and catalogued.

2.2. Data analysis and presentation

2.2.1. Assessment and description of shore types. In order to provide an initial separation of sites, the approximate exposure grade of each site was determined by the biologically defined exposure scale of Ballantine (1961). Determination was undertaken in the field or from site description later. The scale was derived from studies in Pembrokeshire and many features of the shore communities present in the Isles of Scilly prevented its precise use. The separation of shore types was further refined by considering the special features of Scilly shores and the substratum types present. The main features of each shore type were described.

2.2.2. Illustration of different shore types. Of the nine shore types described, six were selected for illustration as examples of widely-different communities/habitats. The remaining three shore types were intermediate in the communities present or only slightly different to those illustrated. Data on the abundance of species in the main communities identified were tabulated and an illustration of the shore type prepared based on a particular site.

2.2.3. Distribution of species. Data sheets were prepared for each of the species recorded during survey or from collected specimens. Notes on presence, abundance, location on the shore and habitat preferences at each site surveyed were transcribed to the species sheets. This provided a basis for summarising the ecology of species and listing the sites at which they were found.

2.2.4. Mapping the distribution of shore types. A colour code was selected for each rocky shore type defined in the description of shore types. The assessment of shore type for each of the locations visited was marked on a copy of the Ordnance Survey 1:25,000 map and the likely nearby extent of that shore type extrapolated away from each site was coloured in, aided by some recall of the shore communities observed between sites. Photographs of shores taken from the air in 1983 for the NCC Regional Office were used to help in mapping the extent of shore types as were photographs of shores obtained from various sources and held by NCC at Huntingdon. Records of shell shape of Nucella lapillus obtained from various sites by John Crothers were used as a further aid. Information from the coloured large-scale map was transferred to separate small-scale maps for this report.

3. RESULTS

3.1. Introduction

This volume includes the following information:

- A description of the rocky shore types (habitats and communities) encountered during surveys and their distribution.
- Descriptions of the communities present under boulders, in boulder caves and in rockpools.
- A comparison of the rocky shore communities and species present in the Isles of Scilly with other areas of South-west Britain.
- An assessment of the scientific interest and nature conservation importance of rocky shore sites and species in the Isles of Scilly.
- Recommendations for future work.
- Descriptions of each site surveyed (Appendix 6).
- An annotated species list (Appendix 7).
- Maps showing the distribution and extent of each shore type (Appendix 8).

The following end-products have been presented separately:

- A set of 158 habitat and 42 species photographs.
- A catalogue of the photographs taken.
- Pressed specimens of algae ('Isles of Scilly surveys, 1983. Pressed specimens of algae. Volume 1. Collection of littoral algae made in March/April').
- Two sets (one original, one photostat) of all field data (Volume 2 of this report).
- Two copies of the Ordnance Survey 1:25 000 scale map with the different rocky shore types in dicated in different colours.

Forty-six sites were described during the two periods of survey and a total of 128 algal, 13 lichen and 237 animal taxa have been recorded. The location of sites is shown in Fig. 1 and listed in Table 1. The sites range from those most exposed to severe wave action at Bishop Rock and the Western Rocks, to those very sheltered from wave action in the channels between the islands, and from the bedrock shores of the seaward-facing coasts to the boulders and boulders on sand of the enclosed coasts.

TABLE 1

Littoral survey sites in the Isles of Scilly, March/April and July 1983

Site number	Site name	Ordnance Survey grid reference SV:	Survey staff	Date surveyed
1	Porth Cressa	906 099	DR, FB	27.3.83
2	Dutchman's Carn	909 095	KH, TB	27.3.83
3	Morning Point (rockpools)	901 098	KH, TB	27.3.83
4	North Tresco	883 167	KH, TB	28.3.83
5	West Merchant's Point	892 161	KH, TB	28.3.83
6	Droppy Nose Point	872 143	DR, FB	28.3.83
7	Stony Porth	872 142	DR, FB	28.3.83
8	Great Porth, Old Kelp Pit	874 144	DR, FB	28.3.83
9	Barrel of Butter	872 089	KH, TB	29.3.83
10	S. of Little Smith Brow	873 089	KH, TB	29.3.83
11	Tins Walbert	872 087	KH, TB	29.3.83
12	Little Castle Vean (upper pool)	878 077	DR, FB	29.3.83
13	Castle Vean (lower pool)	877 077	DR, FB	29.3.83
14	Castle Vean	877 077	DR, FB	29.3.83
15	English Island Point	938 152	KH, TB	30.3.83
16	S. of Popplestone Corner	940 162/939 160	KH, TB	30.3.83
17	Pernagie	919 173	DR, FB	30.3.83
18	St. Warna's Cove	879 079	SF	29.3.83
19	Pernagie Point (rockpool)	920 173	DR, FB	30.3.83
20	Darrity's Hole (Gap Point)	932 113	KH, TB	31.3.83
21	Porth Hellick	928 104/926 104	KH, TB	31.3.83
22	Near Samson Hill	882 153	DR, FB	31.3.83
23	Hangman Island	882 157	DR, FB	31.3.83
24	Carn Near	891 133	KH, TB	1.4.83
25	Bar Point	918 129	DR, FB	1.4.83
26	Long Crow	890 134	KH, TB	1.4.83
27	Crow Point	892 132	KH, TB	1.4.83
28	E. side of Innisidigen	924 127	DR, FB	1.4.83
29	Great Rag Ledge	883 135	RM	
30	Plumb Island, Tresco	886 148	RM, SF	1.4.83
31	Puffin Island, near Samson	883 135	RM, SF	31.3.83
32	Bishop Rock	807 064	KH	7.7.83
33	Round Island	901 178	SW, MW	10.7.83
34	Rosevear (West)	838 059	SW, MW	11.7.83
35	Rosevear (East)	840 059	SW, MW	11.7.83
36	White Island (East) (Camper Porth)	926 172	SW, MW	12.7.83
37	White Island (West)	921 172	SW, MW	12.7.83
38	White Island (West) (boulders)	921 926	SW, MW	12.7.83
39	Maiden Bower	849 145	SW, MW	13.7.83
40	Seal Rock (East)	855 140	SW, MW	13.7.83
41	The Brow (Hellweathers)	864 075	SW, MW	14.7.83
42	Tean Plat Point, St. Agnes	887 076	SW, MW	14.7.83
43	Menawethan (North)	954 136	SW, MW	15.7.83
44	Menawethan (South)	955 137	SW, MW	15.7.83
45	Hanjague	958 151	SW, MW	15..83
46	Shipman Head	873 165	KH	10.7.83

3.2. Description of shore types

The following list of nine shore types is ordered from the most wave-exposed to the most wave-sheltered. The initial sorting of sites, based on those elements of the Ballantine (1961) exposure scale which can be applied to the Isles of Scilly, has been refined during cross-checking of all site descriptions and species lists to ensure that the sites included in each shore type do have the features defined in the description, and that account has been taken of the topographical and substratum characteristics of the Isles of Scilly shores in separating sites. The sites are numbered and an exposure grade given for shores considered near-equivalents to each other using the same numbering and titles as Ballantine (1961). However, because more exposed sites are present in the Scillies archipelago than in Pembrokeshire, a grade '1a' for 'Super-exposed' shores has been assigned. Also, grade 5 ('Fairly sheltered') has been divided into descriptions of shores which do not (5a) and do (5b) extend to a sandy lower shore.

The species included in these descriptions have been selected from long lists to include dominant species and species characteristic of particular shore types. To help in the selection of species, a list of all of the species recorded as Common or higher abundance at any one site was made.

Any abundance notations used here refer to the scale given in Appendix 2.

Users of this classification of shore types should remember that the descriptions represent points along a continuum of change and communities encountered will often fall between two of the 'types' described here.

1a. West-facing, steeply sloping bedrock shores exposed to the full force of prevailing wind-driven waves and swell ('Super-exposed' shores) (sites 32 and 34).

These west-facing shores on offshore rocks are usually steeply sloping and are of bedrock. Communities are characterised by a small variety of species in belts which are greatly expanded form those of less-exposed shores. Alaria esculenta is present only as scattered plants on the lower shore and Laminaria digitata is absent. Corallina officinalis dominates the shore to about +4 m and patches of encrusting calcareous algae, Gigartina stellata and Chondrus crispus are present. Laurencia pinnatifida is present in small amounts. Palmaria palmata is absent. Chthamalus spp. extends to a height of over +10 m and, on high parts of the shore, is coated by Ralfsia verrucosa. Littorina nigrolineata and L. rudis are present but L. neritoides could not be found. Actinia equina is Rare, Nucella lapillus is absent. Scattered clumps and individuals of large Mytilus edulis are present. Sagartia elegans occurs in rockpools. Fucoid algae and Himanthalia elongata are absent. Bifurcaria bifurcata may be present.

Patches of Lichina pygmaea are Frequent high on the shore (+9 to +11 m at site 34) and Verrucaria maura extends a considerable distance upwards from the splash zone but, at the sites visited, reached the top of rocks or was stopped by bird lime. These shores are more exposed than the 'Extremely exposed' shores of Pembrokeshire and do not include several species characteristic of such shores: Himanthalia elongata, Fucus vesiculosus f. linearis and L. neritoides, while A. esculenta is more sparse than on less-exposed shores.

1b. West- and north-facing, steeply sloping bedrock shores exposed to very strong wave action ('Extremely exposed' shores) (sites 33, 39, 41 and 45).

These steeply sloping and often broken bedrock shores occur on the outer rocks and islands on the north- and west-facing coasts where there is no shelter or minimal shelter from offshore rocks and islands or from a gradually sloping seabed away from the shore. Hanjague is east-facing but vertical. Many species characteristic of exposed areas occur in greatest abundance on this type of shore. Alaria esculenta is Common on the lower shore although Laminaria digitata is only Rare. Pikea californica may be present.

or Occasional. Corallina officinalis dominates much of the lower shore to mid-tide level with sparse patches of encrusting calcareous algae. Palmaria palmata is Rare or Occasional on the lower shore. Gigartina stellata and Chondrus crispus are present from mid- to upper shore. Pikea californica may be Frequent. Himanthalia elongata is widely scattered or absent. Fucus vesiculosus f. linearis forms a band of often-dense clumps above mid-tide level. Patches of Lichina pygmaea are Frequent or Common in the splash zone above about +7 m.

Species of Chthamalus and Patella aspera occupy a wide belt with some P. vulgata in the splash zone at +7 m. Upper-shore Chthamalus are usually coated in patches of Ralfsia verrucosa. Littorina saxatilis, L. rudis, L. nigrolineata and L. neglecta all occur and a few L. neritoides may be found. Actinia equina is usually only Occasional. Mytilus edulis is Frequent at some stations. Nucella lapillus is often absent.

The communities present on these shores are generally similar to those of 'Extremely exposed' shores in Pembrokeshire (Ballantine, 1961), except for biogeographical differences. However, L. neritoides is not as abundant as might have been expected and N. lapillus continues to be absent on many of the shores.

Site 41 (The Brow, Hellweathers) is included in this shore type although the presence of Nucella lapillus and of large numbers of Actinia equina suggest a slightly more sheltered shore.

2. Rock slopes on wave-exposed coasts ('Very exposed' shores) (sites 4, 9, 35 and 40).

These shores are open to considerable wave fetch but are sheltered from the full force of wave action by aspect, the presence of offshore rocks nearby or a gradually sloping seabed beyond the low-tide level. A gradually sloping shore may also be an important features at sites open to apparently uninterrupted wave fetch. Site 35 was an impoverished example of this community.

Lower- and mid-shore communities are dominated by Corallina officinalis and encrusting calcareous algae with Frequent to Abundant Himanthalia elongata and with scattered Alaria esculenta, Laminaria digitata and Saccorhiza polyschides on the lower shore. Patches of Gigartina stellata, Chondrus crispus and Laurencia pinnatifida are Frequent. Bifurcaria bifurcata is present. The variety of Rhodophyta is generally high. Fucus vesiculosus f. linearis forms a wide band of scattered plants on the mid- and upper shore. Pelvetia canaliculata may be present in local shelter. Lichina pygmaea is Common on the upper shore and Caloplaca spp., Ramalina siliquosa and Xanthoria parietina may be present in the splash zone. Chthamalus stellatus and C. montagui extend to the upper shore at +6 m and are generally Abundant. Patella aspera extends to the midshore and P. vulgata from the lower mid-shore to the upper shore at +6 m. Amongst the littorinids, L. neglecta is often particularly abundant and extends to about +6 m while L. neritoides is often present in large amounts and extends to +9 m. A few L. saxatilis, L. nigrolineata and L. rudis are present. Actinia equina is often present in large numbers over most of the shore. Nucella lapillus is present. Widely scattered small Mytilis edulis are present.

3. Rock slopes on the seaward-facing shores of the outer islands but sheltered by aspect or offshore rocks ('Exposed' shores) (sites 6, 37 and 42).

The topographical or geographical factors which make communities on these shores different to those of the preceding type are not clear but local shelter probably is important. A striking aspect of these shores is the very 'bare' appearance of most of the shore which is dominated by limpets and barnacles.

Lower-shore communities are dominated by encrusting calcareous algae with patches of Corallina officinalis and Himanthalia elongata present. Laminaria digitata, L. ochroleuca and Saccorhiza polyschides are present on the lower shore. Alaria esculenta and Bifurcaria bifurcata may be present. Gigartina stellata and usually Chondrus crispus and Laurencia pinnatifida are Occasional or Frequent on the lower shore together with Palmaria palmata and several other Rhodophyta. Fucus vesiculosus f. linearis forms a broad band of scattered plants extending up towads a broken belt of Pelvetia canaliculata. F. serratus and F. vesiculosus may be present in small amounts on the lower shore.

Lichina pygmaea may be Common on the upper shore, and splash-zone areas are colonised by a wide variety of lichens.

Chthamalus stellatus is present on the lower to mid-shore, and C. stellatus on the upper shore but not in high densities. Patella aspera is restricted to the lower shore and P. vulgata extends up to about +6 m. Littorinid molluscs in the Littorina saxatilis group, including L. nigrolineata, are Rare, and L. neglecta Frequent. L. neritoides is Common on the upper shore and splash zone. L. mariae may be present. Actinia equina is present in extremely large numbers on the shore. Mytilus edulis are small and very widely scattered. Nucella lapillus is present in generally small numbers.

4. Rock slopes on east-facing or locally sheltered shores of the outer islands ('Semi-exposed' shores) (sites 2, 14, 16, 20, 36, 43 and 44).

Shores of this type occur along extensive lengths of east-facing rocky coastline and on other exposed coasts where there is local shelter by headlands or offshore rocks.

The communities are very similar to those of 'Exposed' shores but with Fucus serratus, F. vesiculosus (often without bladders), F. spiralis and Littorina obtusata present in quantity. The mid-to upper-shore area is limpet/barnacle-dominated and very bare in appearance.

5a. Bedrock and large boulder slopes near the open coast but within bays ('Fairly sheltered' shores) (sites 5, 21 and 38).

These shores are generally of bedrock above about mid-tide level and large boulders below. The slope is fairly gradual. The shores do not extend to sandy areas.

The lower-shore boulders are dominated by encrusting calcareous algae including some Mesophyllum lichenoides with patchy Corallina officinalis. Laminaria digitata, L. saccharina and Saccorhiza polyschides are present together with Himanthalia elongata and sometimes Bifurcaria bifurcata. Gigartina stellata, Chondrus crispus and Laurencia pinnatifida are present together in patches, and Palmaria palmata is generally Occasional to Frequent. There is usually a rich lower-shore algal flora. Fucus serratus is Common or Abundant on the shore at mid-tide level and below while Fucus vesiculosus and F. spiralis are Occasional to Frequent and Pelvetia canaliculata forms a clear belt on the upper shore.

Lichina pygmaea is Occasional to Frequent on the upper shore and Verrucaria maura extends into the splash zone. A wide variety of lichen species occurs in the supralittoral.

Underboulder and open-shore animal species are often rich on the lower shore. Patella aspera is present but sparse on the lower shore as is Chthamalus stellatus. Gibbula cineraria is present in large amounts on the lowest shore whilst G. umbilicalis and Monodonta lineata are present in small numbers further up the shore. Mytilis edulis is absent or Rare. Numbers of Littorina obtusata and L. mariae

have been surprisingly low amongst the dense fucoids at the sites studied although juveniles may be present in large numbers. Nucella lapillus is Occasional or Frequent. In the upper and midshore areas Patella vulgata is Abundant together with Chthamalus stellatus and C. montagui. Littorina neglecta is Common here together with L. neritoides. L. neritoides extends to the upper shore and beyond to about +.5 m joined by L. saxatilis and L. nigrolineata.

5b. Bedrock and boulder slopes near the open coast but within bays and extending to sand or sandy rock on the lower shore ('Fairly sheltered' shores) (sites 1, 7 and 18).

Differences between this type of shore and type 5a relate to the presence of sand on the lower shore. Communities are very similar to those of type 5a except that Audouinella sp. colonises sandy rock.

6. Bedrock and boulder shores extending to sand and sheltered from strong wave action ('Sheltered' shores) (sites 8, 15, 17, 24, 25 and 35).

These bedrock and boulder shores extending to a sandy lower shore occur in the sheltered area around the southern entrance to the Bryher-Tresco channel and probably on the south side of Tresco and the northern shores of St. Mary's. The very extensive boulder shore between Plumb Island and Porth Morran (site 17) is included in this shore type and similar shores are probably also present in the Eastern Isles, south-west St. Helen's, and in bays on many of the main islands.

Lower-shore algal communities are dominated by encrusting calcareous algae with Mesophyllum lichenoides and patches of Corallina officinalis or by Audouinella sp. where the rock is near sand. The calcareous algae are often overgrown by foliose algae including extensive patches of a mixture of Chondrus crispus, Gigartina stellata and Laurencia pinnatifida. A few plants of Cystoseira spp. and Asparagopsis armata are often present. Laminaria digitata, L. ochroleuca, L. saccharina and Saccorhiza polyschides are all present where boulders extend to the lowest shore. Himanthalia elongata and Bifurcaria bifurcata are Common to Abundant. Midshore areas are colonised by dense Fucus serratus and F. vesiculosus with scattered Ascophyllum nodosum present. Fucus spiralis followed by Pelvetia canaliculata is Frequent to Common on the upper shore.

Lichina pygmaea is Occasional and Verrucaria maura Common in a narrow band followed by rich lichen communities.

Lower-shore animal communities including underboulder communities are rich with many rarely-encountered species present. Limpets and barnacles are Rare amongst the dense algae. Gibbula cineraria is Common. Patella vulgata and Chthamalus stellatus are Common on the tops of boulders in midshore areas, whilst Gibbula umbilicalis and Monodonta lineata are Frequent, particularly amongst boulders. Actinia equina is Common. Mytilus edulis is sometimes present. Littorina mariae and L. obtusata are Common to Abundant amongst the dense fucoids. Nucella lapillus is Frequent. Other littorinid molluscs are generally present only on the bedrock near the top of the shore and include Littorina neglecta, L. neritoides, L. nigrolineata and L. saxatilis.

7. Bedrock and boulder shores on enclosed coasts where fetch does not exceed few hundred metres except within a narrow angle ('Very sheltered' shores) (sites 22, 23, 30 and 31).

Examples of these shores occur in the protected channels between islands and most likely in St. Mary's harbour. Apart from the shores surveyed during the present work, Forman's Island and the surrounding rocks and islands appear from photographs to include particularly good examples of this shore type. The bedrock of the upper shore usually gives way to boulders and the boulders to sand and pebbles near the bottom of the shore.

Boulders on the lower shore are coated by sand, bound in place by Audouinella sp. with some encrusting calcareous algae but usually no Mesophyllum lichenoides present. Encrusting algae are overgrown by patches of Chondrus crispus, Gigartina stellata and Laurencia pinnatifida with Palmaria palmata and a wide variety of other algae present. Corallina officinalis occurs under fucoids. Brown algae present on the lower shore include Laminaria saccharina and Bifurcaria bifurcata with some Cystoseira sp. present, but L. digitata absent. Himanthalia elongata is Abundant on most shores.

The distribution of fucoid algae is similar to that described in the previous shore type with Fucus serratus, F. vesiculosus, Ascophyllum nodosum, F. spiralis and Pelvetia canaliculata all present in large amounts on the appropriate subzones. However, the subzones may be very narrow and the species mixed at some sites. Lichina pygmaea is present on the middle shore and Verrucaria maura forms a narrow band at the top of the shore,above which a wide variety of lichens is present.

Boulders on the lower shore are generally bedded in sand so that underboulder commmunities there are not rich. Boulders on gravel on the lower shore often support rich communities. However, sheltered-shore species occur on the sides of boulders, especially sponges and tunicates. Patella vulgata, Gibbula cineraria, G. umbilicalis, Monodonta lineata and Littorina nigrolineata are Occasional. Chthamalus stellatus is Rare or absent and Chthamalus montagui has a very patchy distribution with occasional groups on the upper shore only. Littorina saxatilis is Frequent in the splash zone and L. obtusata is Abundant amongst fucoids. Nucella lapillus is Rare. Large numbers of Spirorbis spirorbis occur on fucoids. Carcinus maenas is particularly conspicuous amongst boulders on the middle and lower shore.

3.3. Distribution and extent of different shore types

The approximate distribution and extent of the different rocky shore types recorded in the Isles of Scilly has been plotted onto copies of the 1:25,000 Ordnance Survey map and presented separately to NCC. Appendix 9 shows the distribution and extent of the shore types listed below, plotted onto small-scale maps. The approximate length of coastline occupied by each of the rocky shore types mapped is given below.

Shore type 1a	5.4 km
Shore type 1b	5.5 km
Shore type 2	12.6 km
Shore type 3	9.0 km
Shore type 4	13.5 km
Shore types 5a and 5b	21.5 km
Shore type 6	17.1 km
Shore type 7	12.5 km

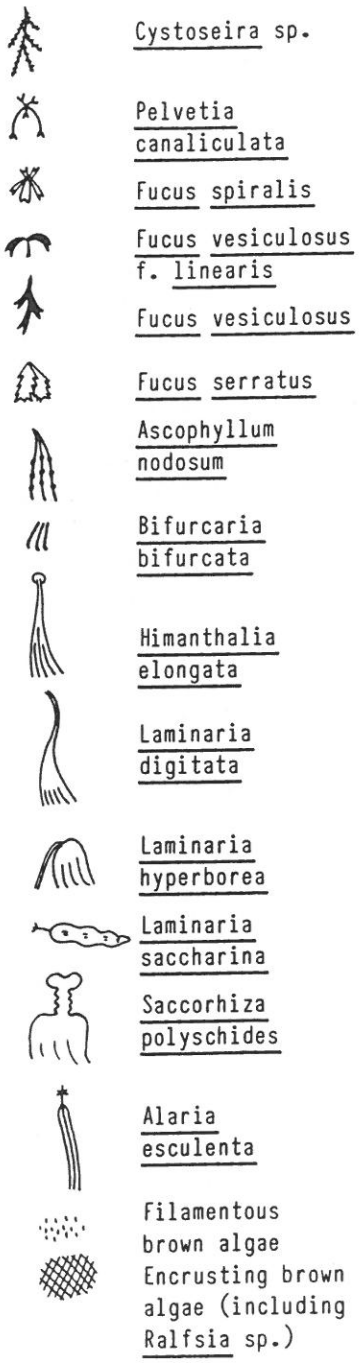
The maps and these figures should be considered as a basis for further studies aimed at obtaining a more accurate classification and mapping. It has not been possible to show intermediate shore types or areas of transition from one shore type to another.

Photographs taken at a few locations by other workers suggest the presence of a further shore type where stones and small boulders are dominated by green algae.

Figs. 2-6

These figures illustrate the main elements of the communities present on different shore types. The key below identifies the symbols used for each species. Both the drawings and the symbols are based on those used in Lewis (1964) with additional symbols, some from other reports to NCC. In Figs. 3, 5 and 6, animal species are shown separately.

ALGAE-BROWN



Cystoseira sp.

Pelvetia canaliculata

Fucus spiralis

Fucus vesiculosus f. linearis

Fucus vesiculosus

Fucus serratus

Ascophyllum nodosum

Bifurcaria bifurcata

Himanthalia elongata

Laminaria digitata

Laminaria hyperborea

Laminaria saccharina

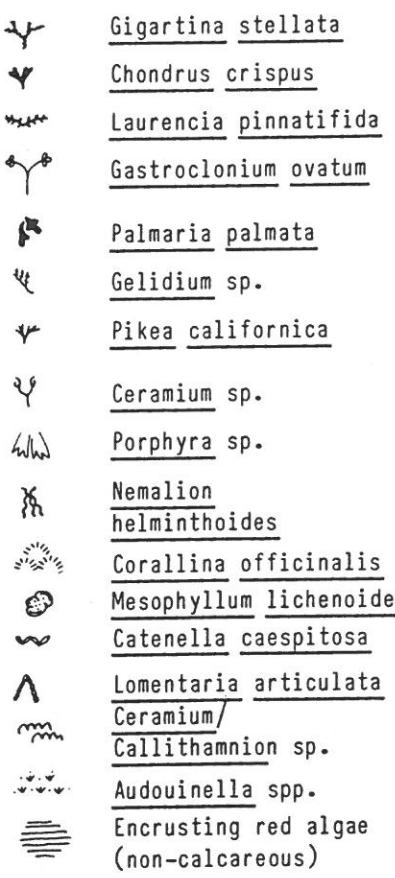
Saccorhiza polyschides

Alaria esculenta

Filamentous brown algae

Encrusting brown algae (including Ralfsia sp.)

ALGAE-RED



Gigartina stellata

Chondrus crispus

Laurencia pinnatifida

Gastroclonium ovatum

Palmaria palmata

Gelidium sp.

Pikea californica

Ceramium sp.

Porphyra sp.

Nemalion helminthoides

Corallina officinalis

Mesophyllum lichenoides

Catenella caespitosa

Lomentaria articulata

Ceramium/ Callithamnion sp.

Audouinella spp.

Encrusting red algae (non-calcareous)

Encrusting calcareous red algae

ALGAE-GREEN

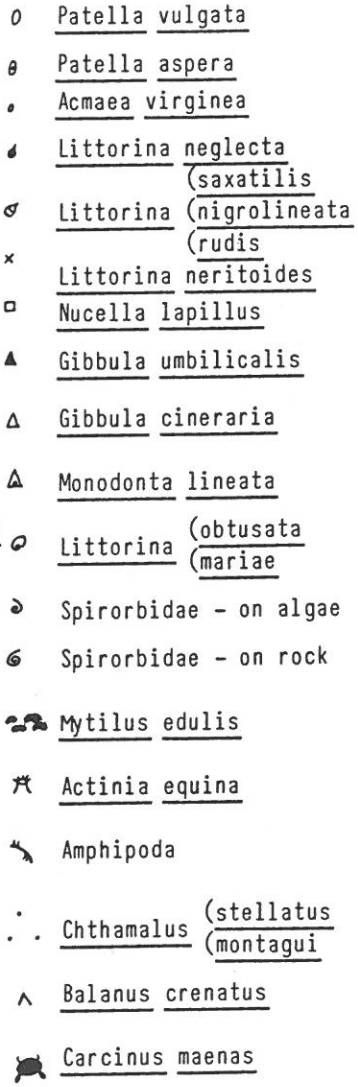
Enteromorpha sp.

LICHENS

Verrucaria maura

Lichina pygmaea

ANIMALS



Patella vulgata

Patella aspera

Acmaea virginea

Littorina neglecta (saxatilis

Littorina (nigrolineata (rudis

Littorina neritoides

Nucella lapillus

Gibbula umbilicalis

Gibbula cineraria

Monodonta lineata

Littorina (obtusata (mariae

Spirorbidae - on algae

Spirorbidae - on rock

Mytilus edulis

Actinia equina

Amphipoda

Chthamalus (stellatus (montagui

Balanus crenatus

Carcinus maenas

Fig. 2. Distribution of species on Super-exposed (type 1a) and Extremely exposed (type 1b) shores. Based on records from Sites 34 and 39.

Fig. 3. Distribution of species on Very exposed (type 2) shores. Based on records for Site 4. Records of algae and animals are shown separately.

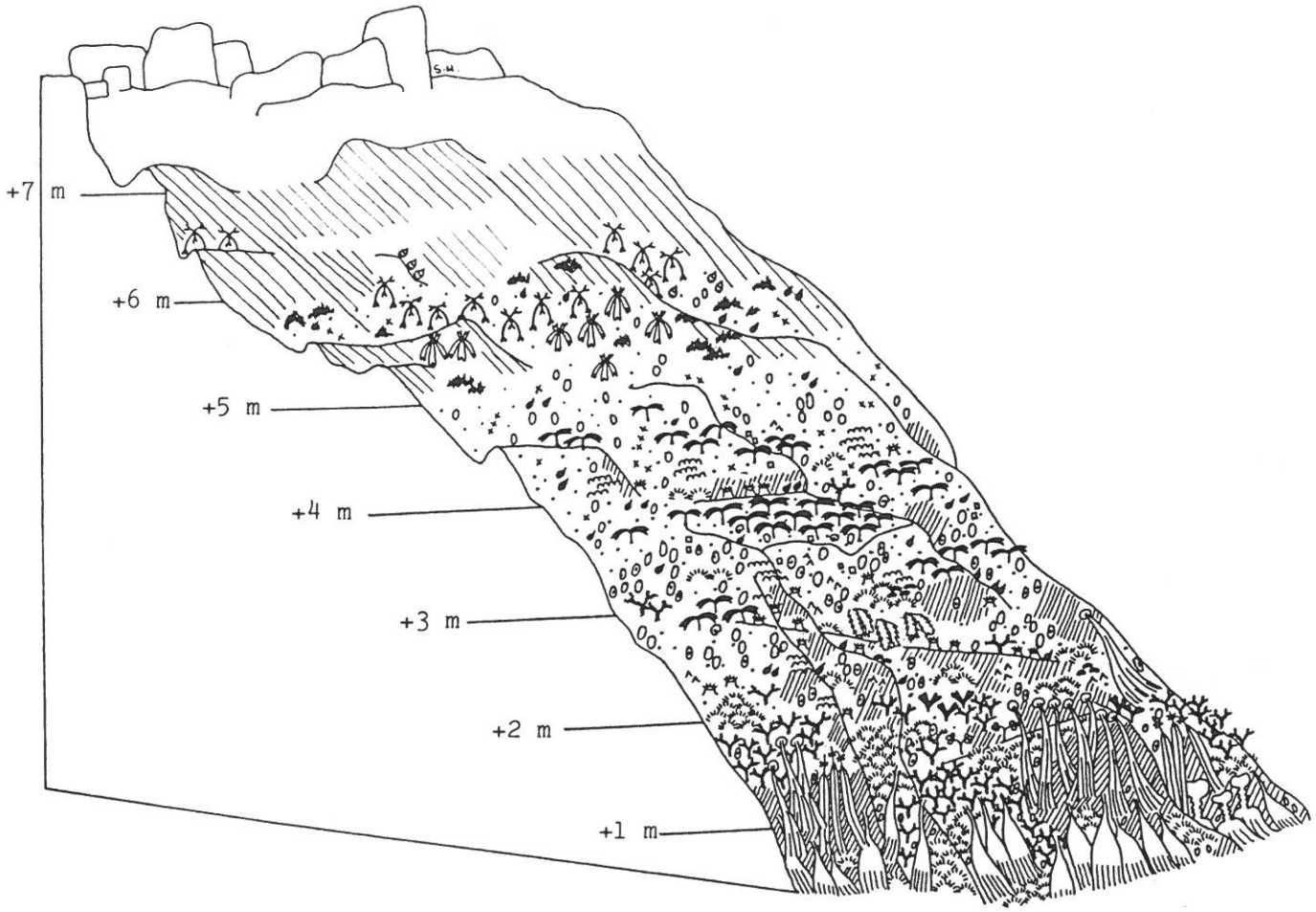


Fig. 4. Distribution of species on Semi-exposed (type 4) shores. Based on records from Site 20.

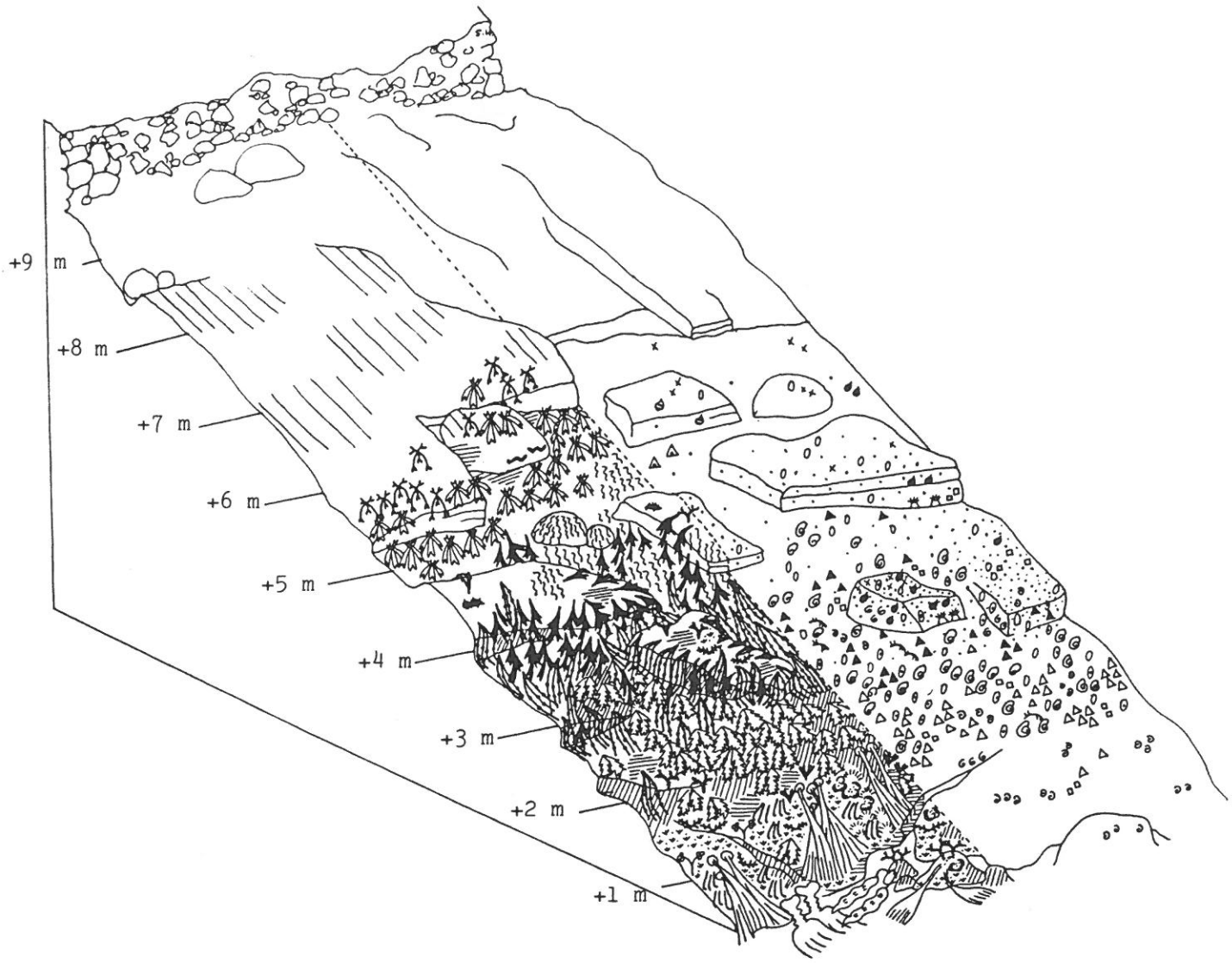


Fig. 5. Distribution of species on a Sheltered (type 6) shore. Based on records from Site 15. Records of algae and animals are shown separately.

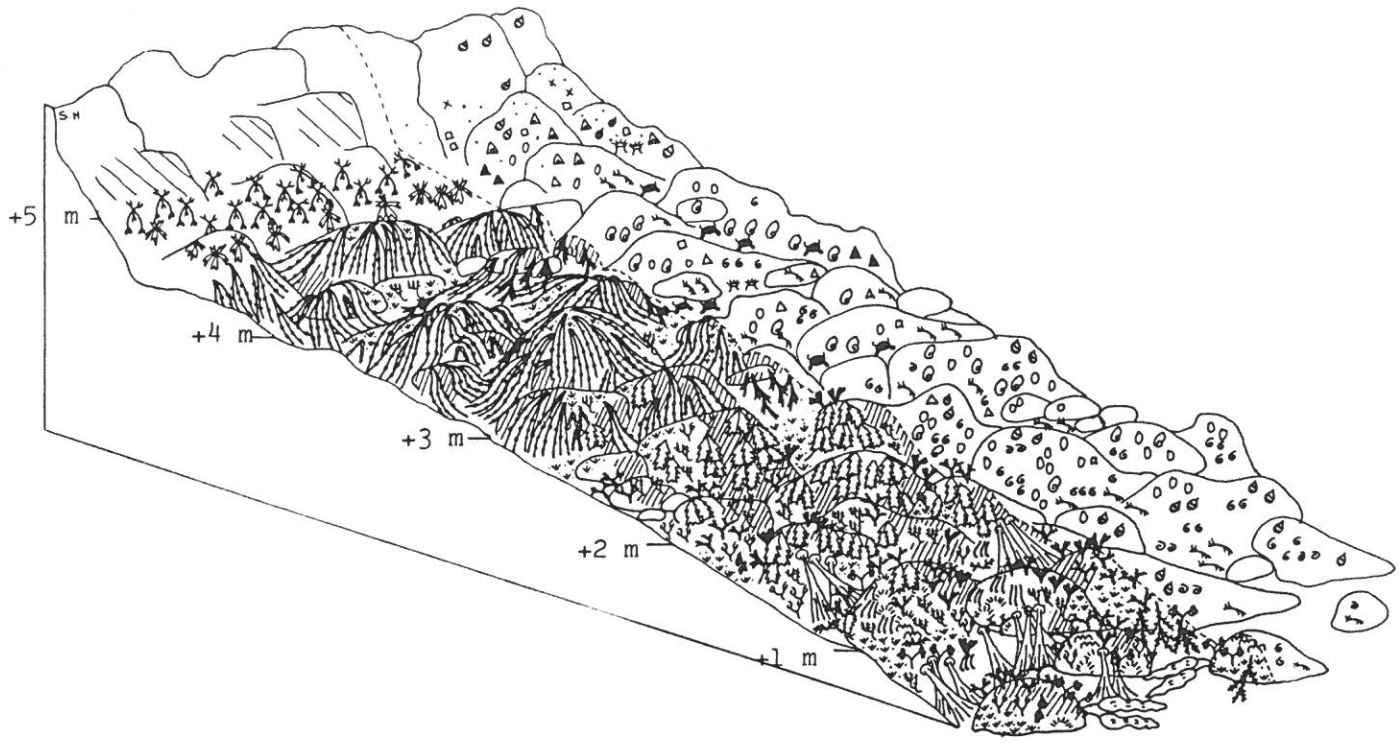


Fig. 6. Distribution of species on a Very sheltered (type 7) shore. Based on records from Site 23. Records of algae and animals are shown separately.

3.4. Description of underboulder communities

Boulders which were small enough to be turned were encountered on shore types 5a and 5b ('Fairly sheltered'), 6 ('Sheltered') and 7 ('Very sheltered'). Records of rich communities on the undersides of boulders were made at sites 1, 5, 7, 8, 15, 17, 18, 19, 23, 24, 26, 28, 29, 30 and 31. Turnable boulders were usually a feature of the lower shore and few records were made of animals present under boulders for midshore or higher areas. Boulders in a rockpool at +3.5 m at site 19 held a similar fauna to lower-shore boulders. The species encountered under lower-shore boulders were similar from site to site and Table 2 lists the species present on some of the shores. A total of 86 taxa were recorded in the searches under boulders on the lower shore and in the pool at site 19 and the communities present were considered very rich. Boulders on 'Very sheltered' shores included less sponges, anthozoans and echinoderms and more ascidians than at more exposed shores.

At site 24 (Carn Near, Tresco) boulders, mostly bedded in sand, were surveyed on the upper midshore (UMS), midshore (MS) and lower midshore (LMS). The communities present under these boulders were distinctly different to those described for lower-shore boulders at other sites and included the following species:

Porifera indet.	MS. Little.
*Laomedea flexuosa	MS, LMS. Common.
Actinia equina	UMS.
Bunodactis verrucosa	UMS, MS, LMS. Single records.
*?Tubulanus annulatus	LMS. One.
Oligochaeta indet.	MS, LMS. In sand.
Cirratulidae indet.	MS, LMS. In sand.
*Anurida maritima	US, MS.
*Sphaeroma serratum	UMS.
Eulimnogammarus obtusatus	UMS, MS, LMS. Abundant.
Carcinus maenas (juv.)	UMS, MS, LMS.
Porcellana platycheles	LMS.
*Monodonta lineata	MS. Several including young individuals.
Gibbula cineraria	MS, LMS. Many.
Gibbula umbilicalis	UMS, MS.
*Littorina nigrolineata	UMS, MS. Common UMS.
*Littorina saxatilis	MS.
Encrusting Bryozoa indet.	LMS.
Umbonula littoralis	LMS.

* = not recorded from under boulders elsewhere.

TABLE 2

Species recorded from the undersides of boulders on the lower shore and the pool at +3.5 m at site 19. The abundance of species recorded at sites 1, 7, 8, 15, 17 and 29 is given as examples of the underboulder community. The meaning of each abundance notation is similar to that given in Appendix 2 but there was no defined scale for recording underboulder communities. A = Abundant, C = Common, F = Frequent, O = Occasional, R = Rare, P = Present, no record of abundance.

	1. Porth Cressa, St. Mary's	7. Stony Porth, Bryher	8. Great Porth, Bryher	15. English Island Point, St. Martin's	17. Pernagie, St. Martin's	29. Great Rag Ledge, Samson
PORIFERA						
Leucosolenia botryoides	-	-	-	-	R	-
Leuconia nivea	P	-	-	-	-	-
Halichondria panicea	-	-	O	-	O	F
Hymeniacidon perleve	-	-	-	-	O	F
Microciona atrasanguinea	R	-	-	-	R	-
Myxilla incrustans	R	F	O	-	F	-
Dysidea fragilis	R	-	-	-	O	-
Porifera indet. (yellow encr.)	F	-	-	O	F	-
Porifera indet. (orange encr.)	F	-	-	-	-	-
Porifera indet. (blue encr.)	-	-	-	-	-	O
Porifera indet. (white encr.)	C	-	-	-	F	-
HYDROZOA						
Dynamena pumila	R	-	-	F	-	F
ANTHOZOA						
Actinia equina	O	-	-	-	-	-
Anemonia viridis	-	F	-	-	-	-
Urticina felina	R	O/R	-	R	R	-
Bunodactis verrucosa	-	O/R	-	-	-	-
Anthopleura ballii	-	-	F	-	R	O
Sagartia elegans	O	-	-	-	-	-
Actinothoe sphyrodeta	O	-	-	-	-	-
POLYCHAETA						
Lepidonotus clava	R	-	-	-	-	-
Hermione hystrix	-	O/R	-	-	-	-
Harmothoe extenuata	-	-	O	-	-	-
Polynoidae indet.	O	F	P	-	F	-
Eulalia viridis	R	-	-	-	-	-
?Nereis pelagica	O	-	-	-	O	F
Cirratulidae indet.	-	C	F	-	-	-
Sabellaria spinulosa	-	-	-	R	-	-
Hydroides norvegica	-	-	-	R	-	-
Pomatoceros triqueter	R	-	-	R	O	O
Filograna implexa	-	-	-	-	R	-
Spirorbinidae indet.	-	-	-	A	C	C
CIRRIPEDIA						
Verruca stroemia	-	-	-	-	R	-
ISOPODA						
Idotea neglecta	-	O/R	P	-	-	-
Cymodoce truncata	-	-	-	A	-	-
Dynamene bidentata	P	-	C	-	-	O
Sphaeromatidae indet.	-	-	-	-	P	-
AMPHIPODA						
Amphipoda indet.	O	C	O	P	O	-
Eulimnogammarus obtusatus	-	-	-	P	-	-

	1. Porth Cressa, St. Mary's	7. Stony Porth, Bryher	8. Great Porth, Bryher	15. English Island Point, St. Martin's	17. Pernagie, St. Martin's	29. Great Rag Ledge, Samson
DECAPODA						
Porcellana platycheles	O	C	F	F	F	-
Pisidia longicornis	-	-	O	C	O	-
Anapagurus hyndmanni	-	C	-	-	-	-
Carcinus maenas	-	-	-	-	-	-
Liocarcinus puber	-	O/R	R	-	R	-
Cancer pagurus	O	-	R	O	O	-
Xantho incisus	-	O/R	O	-	O	-
Pilumnus hirtellus	R	-	-	-	-	-
Galathea squamifera	O	C	O	C	O	O
PYCNOGONIDA						
Nymphon rubrum	-	O/R	-	-	-	-
MOLLUSCA						
Calliostoma zizyphinum	R	O/R	O	F	O	O
Gibbula cineraria	P	C	F	C	A	O
Nassarius incrassatus	-	-	O	O	O	-
Trivia monacha	-	-	-	R	R	F
Rostanga rubra	-	-	-	R	-	-
Aeolidea papillosa	-	-	-	R	-	-
Archidoris pseudoargus	-	-	-	R	-	-
Hiatella arctica	-	-	-	R	-	-
Modiolus modiolus (juv.)	O	-	-	O	O	-
BRYOZOA						
Umbonula littoralis	-	-	-	F	-	-
Turbicellepora magnicostata*	F	-	-	C	C/F	-
Bryozoa (encr.) indet.	-	-	-	A+	-	-
ECHINODERMATA						
Antedon bifida	-	O/R	R	-	O	-
Luidea ciliaris	-	-	-	R	R	-
Asterina gibbosa	O	C	P/F	-	O	-
Asterias rubens	-	-	-	R	-	-
Ophiothrix fragilis	O	C	-	F	O	-
Amphipholis squamata	O	-	-	-	R	-
Psammechinus miliaris	-	-	-	O	R	-
ASCIDIACEA						
Sidnyum turbinatum	-	-	-	P	-	-
Morchellium argus	-	-	-	P	O	-
Didemnidae indet.	R/O	-	-	C	O	-
Dendrodoa grossularia	O	-	R	-	-	P
Botryllus schlosseri	O/R	-	-	F	P	-
PISCES						
Nerophis lumbriciformis	-	-	-	-	R	-

SPECIES RECORDED UNDER LOWER-SHORE BOULDERS ONLY AT OTHER SITES

?Haliclona sp., Alentia gelatineum, Lepidonotus squamatus, Berthella plumula, Chlamys distorta/varia, Ocenebra erinacea, Nucella lapillus, Gibbula umbilicalis, Polyplacophora indet., Aplidium proliferum, Pholis gunnellus.

*includes records of 'Cellepora pumicosa', specimens of which were later found to be T. magnicostata. + included Schizomavella linearis and Escharoides coccineus in samples.

3.5. Boulder caves

On several of the exposed or semi-exposed shores, very large boulders (several metres across) on the shore formed caves with one large boulder supported on others. The fauna present in these caves was very distinctive and examples are given below.

Lower-shore caves at Droppy Nose Point and Porth Hellick

These two caves held a reduced Dendrodoa-Clathrina community normally characteristic of wave surge gullies. The following description is of the cave at Droppy Nose Point. The ceiling was dominated by Dendrodoa grossularia with Clathrina coriacea and Actinia equina also present and particularly conspicuous. Walls of the wave were dominted near the ceiling by Balanus perforatus with large patches of Halichondria panicea and of the sabellid worm Amphiglena mediterranea present. Cryptosula pallasiana, Microciona atrosanguinea and Dynamena pumila were also present. On the lower walls, Scypha compressa, Myxilla incrustans, Tubularia indivisa, Corynactis viridis, Gibbula cineraria and Didemnidae were present. In the pool and on the rock forming the floor of the cave Sagartia elegans vars. nivea and venusta, Urticina felina, Corynactis viridis and Calliostoma zizyphinum were present. The cave at Porth Hellick (21) included some other species usually found in wave surge gullies: Pachymatisma johnstonia and Actinothoe sphyrodeta. The cave at +3.2 m at North Tresco (4) held a reduced community of this type, probably due to its midshore position, but it is notable that A. mediterranea was also present there.

3.6. Rockpools

Rockpools were present on most shores but were generally small in extent and shallow on exposed coasts (shore types 1, 2 and 3) with few distinctive differences to the open shore, and did not occur amongst the boulders which occupied much of the intertidal on shore types 6 and 7. Species recorded in rockpools are listed in Table 3. The large pool at +3.5 m at site 19 (Pernagie Point) is not included in Table 3 because records of animal species were made mainly from under boulders in the pool and are not therefore comparable with other pools. However, algal communities in the pool were rich and were similar to those of other pools with the notable presence of Frequent Cystoseira tamariscifolia.

The diversity of algae was very high in the rockpools studied with species characteristic of rockpools, species also present on the lower shore, species predominantly found in the sublittoral and species also found on the open shore at similar levels. Some species of algae were dominant in many of the pools with encrusting calcareous algae almost always covering the rock surface, Corallina officinalis generally dominant in pools below mid-tide level, Mesophyllum lichenoides often present in large amounts, and the large brown algae Bifurcaria bifurcata and Himanthalia elongata almost filling some pools. Cystoseira tamariscifolia was a particularly conspicuous brown alga, colonising pools at sites 12 and 19.

Only a small variety of animal species was recorded in pools and generally in small amounts. The most conspicuous animal species especially found in rockpools were the sea anemones including Anemonia viridis, Cereus pedunculatus, Corynactis viridis and Sagartia elegans. Several species of Polychaeta, Crustacea and Prosobranchia were also recorded in net sweeps of the algal turf. The brittle stars Amphipholis squamata and Ophiothrix fragilis (juveniles) were often present. The opisthobranch Runcina coronata was recorded in midtide-level pools at two sites, Castle Vean (13) and Darrity's Hole (20), and is an interesting feature of these sites. The Darrity's Hole rockpool included a population in 1969-70 (own observations). Fish were remarkably sparse in rockpools, possibly in part due to the time of year.

TABLE 3

Species recorded from rockpools. Abundance notations are given for most records and the meaning of each notation is similar to that given in Appendix 2 but there was no defined scale for recording rockpool species. E = Extremely Abundant, S = Superabundant, A = Abundant, C = Common, F = Frequent, O = Occasional, R = Rare, P = Present, no record of abundance. * = species predominantly found in rockpools, x = species also present on the lower shore, + = species predominantly found in the sublittoral, o = species also found on the open shore at similar levels.

Site number	3	3	3	7	12	13	20	20	20
Height on shore	1.7m	2.7m	3.4m	c3.5m	7m	c3.2m	c4.5m	c3.5m	c2m
Surface area (approx.)	1-2m²	1-2m²	1-2m²	4m²	20m²	18m²	4-5m²	1-5m²	1m²
Depth (maximum)	<50cm	<50cm	<50cm	<70cm	1.5m	-	15cm	50cm	20cm
ALGAE									
RHODOPHYTA									
Gelidium latifolium*x	-	-	-	R	F	O	O	O	O
Gelidium pusillum o	P	P	-	F	F	O	-	-	-
Calliblepharis jubata*	P	P	-	-	-	O	-	-	-
Cystoclonium purpureum x	-	-	-	R	-	-	-	-	-
Gymnogongrus crenulatus +	-	-	-	-	-	-	-	O	-
Chondrus crispus o x	P	P	P	F	-	O	-	-	O
Gigartina acicularis x	-	-	-	F	-	-	-	-	-
Gigartina stellata x	P	P	-	R	-	-	-	O	-
Corallina officinalis *xo	E	E	E	C	O	F	A	A	A
Mesophyllum lichenoides *+	P	P	-	C	-	-	C	-	-
Encr. calcareous algae *x+	E	E	E	S	C	C	E	E	C
Dumontia incrassata *+	P	P	-	O	-	O	-	-	-
Palmaria palmata x+o	P	P	-	O	-	-	-	-	-
Chylocladia verticillata*	-	-	-	R	-	-	-	-	-
Gastroclonium ovatum *x	P	P	P	-	-	F	O	O	O
Lomentaria articulata x	P	-	-	-	-	F	-	-	O
Lomentaria clavellosa +	P	-	-	-	-	-	-	-	O
Callithamnion ?tetragonum *+x	-	-	-	-	-	O	-	-	-
Callithamnion sp.	-	-	-	-	-	-	-	-	O
Ceramium rubrum *x	-	P	-	F	-	F	O	F	-
Ceramium ciliatum	-	-	-	-	-	R	-	-	-
Griffithsia flosculosa *+	P	-	-	-	-	O	-	-	F
Halurus equisetifolius *+	-	-	-	-	-	-	-	-	O
Apoglossum ruscifolium +	P	-	-	-	-	-	-	-	-
Hypoglossum woodardii *+	-	P	-	-	-	-	-	-	-
Membranoptera alata *+	P	P	-	-	-	-	-	-	F
Brongniartella byssoides	-	-	-	-	-	O	-	-	-
Cryptopleura ramosa	P	-	-	-	-	O	-	-	O
Laurencia hybrida o x	-	P	-	F	F	O	-	-	-
Laurencia pinnatifida ox	P	P	-	F	F	O	O	-	-
Polysiphonia brodiaei *xo	P	P	P	-	-	-	C	C	R
Polysiphonia urceolata *+x	-	-	-	O	-	-	O	-	-
Polysiphonia sp.	-	-	-	-	O	-	-	-	-
Pterosiphonia ?complanata +x	-	-	-	-	A	-	-	-	-
Plumaria elegans x	-	-	-	-	-	O	-	-	O
PHAEOPHYTA									
Encr. red/brown algae *o	-	P	-	O	-	-	-	-	-
Filamentous brown algae *o	P	-	-	-	-	-	O	-	O
Scytosiphon lomentaria *o	-	-	P	-	-	-	F	C	-
Litosiphon agg.	-	-	-	-	O	-	-	-	-
Colpomenia peregrina *x	-	-	-	-	F	O	-	-	-
Laminaria digitata x	P	-	-	-	-	F	O	O	C
Laminaria ochroleuca +	-	-	-	-	-	R	-	-	-
Laminaria saccahrina +x	P	-	-	-	-	-	-	-	-
Alaria esculenta x	P	-	-	-	-	-	-	-	O
Dictyota dichotoma *+	-	-	-	-	-	-	-	-	R
Fucus spiralis o	-	-	-	-	R	-	-	-	-
Fucus serratus o	P	-	-	-	-	-	O	-	-
Himanthalia elongata xo	E	+	-	O	-	-	-	-	C
Bifurcaria bifurcata *xo	P	P	-	A	-	-	-	C	-
Cystoseira tamariscifolia *?x	-	-	-	-	A	-	-	-	-
Cystoseira ?myriophylloides x	P	-	-	-	-	-	-	-	-
CHLOROPHYTA									
Enteromorpha sp.* o	P	P	P	A	C	F	O	F	-
Ulva sp.* o	P	P	P	O	O	F	C	F	F
Chaetomorpha ?gelagonium x	-	-	-	-	F	-	-	-	-
Cladophora sp.* o	-	-	-	-	-	-	-	-	O
Cladophora serincea* o	P	P	-	C	-	-	-	-	-
Codium fragile tomentosoides*	-	-	-	R	-	-	O	-	-
Codium vermilaris*	P	P	P	F	-	-	-	-	O
Bryopsis hypnoides*	-	-	-	-	-	-	O	-	-
Bryopsis ?plumosa*	-	-	-	-	-	-	-	-	O

Site number	3	3	3	7	12	13	20	20	20
Height on shore	1.7m	2.7m	3.4m	c3.5m	7m	c3.2m	c4.5m	c3.5m	c2m
Suface area (approx.)	1-2m²	1-2m²	1-2m²	4m²	20m²	18m²	4-5m²	1-5m²	1m²
Depth (maximum)	<50cm	<50cm	<50cm	<70cm	1.5m	-	15cm	50cm	20cm
ANIMALS									
PORIFERA									
Scypha compressa *x	O	-	-	-	-	-	-	-	-
Halichondria panicea x	-	-	-	-	-	-	-	-	R
Hymeniacidon perleve x	F	P	O	-	-	P	R	O	O
Myxilla incrustans x	-	-	-	-	-	-	-	-	O
COELENTERATA									
Haliclystus auricula*	R	-	-	-	-	-	-	-	-
Sagartia elegans *o	-	O	-	-	-	-	-	-	F
Actinia equina o	F	O	O	R	-	-	A	-	O
Anemonia viridis*	O	O	O	O	-	R	-	-	-
Urticina felina	-	R	-	-	-	-	-	-	-
Cereus pedunculatus*	-	-	O	-	-	P	F	F	-
Corynactis viridis x	-	-	-	-	-	-	O	-	F
POLYCHAETA									
Nereidae indet.?	-	-	-	-	-	P	-	-	-
Polydora sp.*	-	-	-	-	-	-	-	P	-
Terebellidae indet.?	-	-	-	F	-	-	-	-	-
Spirorbinidae indet.*	-	-	-	-	P	-	O	O	-
CRUSTACEA									
Ostracoda indet.?	-	-	-	-	-	P	-	-	-
Dynamene bidentata?	R	R	-	-	-	P	-	-	-
Idotea sp. o	R	R	-	O	-	-	-	-	-
Stenothoe monoculoides*	-	-	-	-	P	P	-	-	-
Apherusa cirrus +	-	-	-	-	P	-	-	-	-
Apherusa jurigei +	-	-	-	-	P	-	-	-	-
Hyale pontica +	-	R	-	-	-	-	-	-	-
Hyale stebbingi o	-	-	-	-	-	P			
Amphipoda indet.?	-	-	-	O	-	-	-	-	-
Paguridae indet.?	-	R	-	-	-	-	-	-	-
MOLLUSCA									
Patella sp. o	-	-	C	F	O	O	S	S	O
Monodonta lineata o	-	O	-	O	-	-	-	-	-
Gibbula cineraria xo	R	-	-	-	-	O	-	-	-
Gibbula umbilicalis o	-	-	-	C	-	-	-	-	-
Lacuna sp. +	R	-	-	-	-	-	-	-	-
Littorina nigrolineata o	-	-	-	F	-	-	-	-	-
Littorina obtusata o	P	-	-	O	-	-	-	-	-
Skeneopsis planorbis*	-	-	-	-	A	P	-	-	-
Rissoa parva	-	-	-	-	-	P	-	-	-
Rissoella diaphana *+	-	-	-	-	-	P	-	-	-
Risoella opalina *+	-	-	-	-	-	P	-	-	-
Rissoidae indet.*+	-	-	-	-	-	P	-	-	-
Nucella lapillus o	-	R	-	O	-	-	-	R	R
Runcina coronata*	-	-	-	-	-	A	-	-	-
Mytilus edulis o	-	-	F	-	-	-	-	-	-
ECHINODERMATA									
Ophiothrix fragilis (juv.)*+	-	-	-	O	-	-	-	-	-
Amphipholis squamata* +	-	-	-	-	-	P	-	-	-
PISCES									
Gobiidae indet.* ?	-	R	-	-	-	-	-	-	-
Nerophis ophidion ?	-	R	-	-	-	-	-	-	-

Pools were present on the floors of the boulder caves described at Droppy Nose Point (6) and Porth Hellick (21). These pools had the appearance of being very scoured and were dominated by a thin sheet of encrusting calcareous algae with Corynactis viridis, Sagartia elegans and Urticina felina present.

3.7. Shell shape of Nucella lapillus and wave exposure

Crothers (1982 and previous papers) has found a linear relationship between shell shape of the dogwhelk Nucella lapillus as measured by the ratio of shell length divided by aperture length (L/Ap) and the exposure grade of shores as estimated using Ballantine (1961) and similar scales. During the July survey, samples of Nucella were collected form eight of the sites by Mark Wilson and dispatched to John Crothers for measurement. The prediction of exposure grade from dogwhelk shell shape and the estimate of exposure grade based on the communities present is compared in Table 4. The predicted exposure grades using the two methods show close agreement although those based on shell shape suggest slightly more exposed conditions than the grades based on communities present. At White Island (East) (site 36) shell shape suggested an exposure grade of 2.0 ('Very exposed') whilst the community present suggested a grade 4 ('Semi-exposed') site. Here, the sample was taken from the entrance to a wave surge gully and this might be important. No dogwhelks were found at shore types 1a and 1b but were present at The Brow (Hellweathers) (site 41) which was rated as between grades 1 and 2 on the basis of communities present. However, the shell shape suggested a grade 1a ('Super-exposed') site.

Previous records of shell shape of dogwhelks in the Isles of Scilly have been made by John Crothers and these are included in Appendix 9.

TABLE 4

Site name	Site number	Exposure grade expected according to Nucella shell shape: Length/ Aperture measurement	Exposure grade expected according to Nucella shell shape: Expected exposure grade	Exposure grade assessed by communities present
Rosevear (East)	35	1.31	2.7	3
White Island (East)	36	1.29	2.0	4
White Island (West)	37	1.30	2.3	3
White Island (West (boulders)	38	1.37	4.5	5
Seal Rock (East)	40	1.26	1.3	2
The Brow (Hellweathers)	41	1.21	0	1b-2
Tean Plat Point, St. Agnes*	42	1.31	2.6	3
Menawethan+	43/44	1.35	3.7	4

*collected from nearby slightly more sheltered area.
+site on Menawethan not recorded, but both were assessed as grade 4.

4. DISCUSSION

4.1. Comparison of rocky shore communities and species present in the Isles of Scilly with other areas of south-west Britain

4.1.1. Introduction. The detailed descriptions of shore communities made during the current study provide a good basis for comparison with thoroughly described shores elsewhere. Also, topographical features of the coastline are important and some comparison can be undertaken on the basis of coastal features. However, a comparison of the communities present on the shores of the Isles of Scilly with those of other areas relies more on a search of published literature and on some discussion with other workers than any personal knowledge of shore communities elsewhere other than Pembrokeshire. The report of the SMBA/MBA Intertidal Survey Unit (Powell et al., 1978) provides an overview of shores in Devon and Cornwall but the Isles of Scilly were not visited during that survey.

4.1.2. Aspect and island configuration: the exposure of sites to wave action. The Isles of Scilly are the furthest south-west of any group of rocks or islands in Britain. As such, they are exposed to the most severe wave action from wind-driven waves and swell and the communities present are characteristic of more exposed conditions than the most exposed described by Ballantine (1961) for Pembrokeshire. Powell et al. (1978) suggest that "the most exposed rocky shores [in the Isles of Scilly] have fauna and flora that is typical of south-west England and very similar to the Land's End area." Despite this statement, the 'Super-exposed' communities present in the Isles of Scilly must be considered a special feature of the area.

Within a few kilometres of these 'Super-exposed' sites and a few hundred yards of slightly less-exposed sites are areas of rocky shore very sheltered from wave action and colonised by communities which, although not characteristic of the extreme shelter described by Ballantine (1961), still rate as 'Very sheltered'. More sheltered rocky shore communities, particularly on bedrock, most likely occur in the upper reaches of the several rias present in south-west Britain.

4.1.3. Geology and shore topography. The block-like structure of the granite bedrock gives a distinctive stepped appearance to many of the shores with some shallow open crevices but few surfaces eroded to form large or deep pools. These types of shores are present along an extensive part of the south-west of Cornwall west of Penzance and on parts of the north coast of Cornwall and at Lundy. The open nature of the few crevices and the non-friable nature of the rock leads to the presence of poorly developed crevice faunas compared with some other areas of south-west Britain. Rich rockpool habitats are a feature of several of the mainland shores described by Powell et al.(1978), but are difficult to find in the Isles of Scilly, and greater ranges of species with more extensive and/or deep rockpool habitats are present elsewhere in south-west Britain.

The boulder shores formed by the erosion of the granite rock (and, in places, old field walls) provide habitats for a very wide variety of species and the underboulder fauna present at some sites in the Isles of Scilly is considered outstanding. These especially-rich areas are at locations where there is some degree of local shelter including areas of the Bryher-Tresco channel.

4.1.4. Effects of climate and geographical location on the communities present. The rocky shore communities present in the Isles of Scilly are distinctly southern in character and include the following features:

1. The presence of large amounts of Asparagopsis armata (particularly during the summer) on the lower shore at sheltered sites. [This is an important species which has become established on the southern coast of England only.]
2. The presence of large amounts of Mesophyllum lichenoides on the lower shore at sheltered sites.
3. The presence of large amounts of Bifurcaria bifurcata on the lower shore and in pools at exposed and sheltered sites.
4. The presence of Cystoseira nodicaulis and C. tamariscifolia on the lower shore at very sheltered sites.
5. The high abundance of Laminaria ochroleuca on lower-shore rocks at semi-exposed and sheltered sites.
6. The much-wider distribution of Lichina pygmaea over the exposure grades.
7. The presence of Anthopleura ballii on the shore at sheltered sites.
8. The presence of Bunodactis verrucosa.
9. The presence of large numbers of Monodonta lineata on some sheltered shores.
10. The presence of large numbers of Balanus perforatus at some sites.
11. The presence of Tubicellepora magnicostata on lower-shore boulders.
12. The absence of Balanus balanoides and the high abundance of Chthamalus montagui and C. stellatus.

The large amounts of Himanthalia elongata present on many semi-exposed and sheltered shores is notable although Lewis (1964) records this species as being found all around the British Isles and does not include it in the species which are predominantly southern. The size of Himanthalia elongata plants is also exceptional, some having been measured to 10 m in length (R. Mitchell, pers. comm.). The absence of records of the Australasian barnacle Elminius modestus is notable since this species has spread all around the British Isles since the first records were made in 1947. The northern barnacle Semibalanus balanoides is sparsely distributed in West Cornwall but is present in Brittany. We did not record S. balanoides although it has been found as scattered individuals at Great Britain Rock in 1980 and at some other locations in subsequent years. Its very low abundance in the Isles of Scilly is most likely due partly to climatic factors and partly the poor larval dispersal from mainland stocks.

Many species generally common or widely distributed in south-west Britain are absent or present in low amounts in the Isles of Scilly. Crisp and Southward (1958) noted the absence of Patella depressa and Semibalanus balanoides and the extreme rarity of Littorina littorea and Mytilus edulis. Indeed, the low numbers of M. edulis were noted by the Rev. George Woodley (1822) and of molluscs in general by J. Victor Carus (quoted in 1850) according to Harvey (1969). Harvey (1969) notes that Polyplacophora ae sparse on all Scilly shores. Smith and Gault (1983) found, amongst the intertidal molluscs "rather less than anticipated - particularly regarding the Polyplacophora, Opisthobranchia and southern species." The latter authors suggest that, with regard to rocky shores, sand scouring and choking, together with the lack of carbonate (particularly the low abundance of calcareous algae in rockpools), may account for the lowered mollusc populations. In addition to supporting the published observations, we were surprised to find so few Littorina neritoides, Littorina obtusata/mariae, Idotea spp. and encrusting gelatinous Bryozoa in many apparently suitable habitats. The absences from the expected flora and fauna of the archipelago appear to be mainly animals and the only conspicuous algae we might have expected to find but did not was Jania rubens and this might be a reflection of the very small amount of Cladostephus spongiosus,

its usual host, present. It is also important to note that we found that Mytilus edulis was present in large amounts on the most wave-exposed shores. Also, the statement by Powell et al. (1978), which wrongly quotes Southward (1976) that Chthamalus montagui is absent in the Isles of Scilly, is incorrect.

The presence of those southern species which do occur in abundance in the Isles of Scilly is doubtless due in part to the mild maritime climate. Also, the proximity of the islands to Brittany as a possible source of larvae and spores of southern species is of possible importance. However, whilst southern species of algae thrive and immigrant species of algae find their way easily to the archipelago, many animals obviously do not establish themselves well in the islands, and the absence of the immigrant barnacle Elminius modestus is particularly notable. The presence of sand on the lower shore suggested as an adverse influence on mollusc populations by Smith and Gault (1983) may be important to molluscs on sandy shores although the suggestion that calcareous algae are of low abundance, thus leading to a lack of carbonate, is not supported by our results. It seems likely that the most important factor preventing the spread of some animal species to the Isles of Scilly or at least restricting their abundance, is the direction of residual water currents. These approach the Isles of Scilly from the open Atlantic, remote from sources of larvae of coastal species, and carry away larvae produced in the archipelago. It may be that species with a short larval life are particularly affected since some water masses from coastal areas to the south and east may eventually reach the Isles of Scilly. However, no clear conclusion can at present be reached about the distributional factors affecting the recruitment of species to the Isles of Scilly.

4.2. Assessment of scientific interest and nature conservation importance of rocky shores in the Isles of Scilly

4.2.1. Introduction. The following information is presented according to the structure given in the Nature Conservancy Council 'Handbook for the Preparation of Management Plans' (1st edition, February 1983) and in the same format as the management plans for the proposed marine nature reserves at Lundy (Hiscock, 1983) and Skomer (Hiscock and Bunker, 1983). The assessment takes account of the information given in Harvey (1969) and Smith and Gault (1983) on sites of particularly high scientific interest, but includes only species encountered during our surveys in the listing of species of high scientific interest. Only rocky shore habitats, communities and species are assessed here.

4.2.2. Evaluation. The criteria used here to assess the conservation value of rocky shores around the Isles of Scilly are applied in the sense of the NCC 'Handbook for the Preparation of Management Plans' and based on those outlined by Ratcliffe (1971) for terrestrial areas.

Size. The c. 97 km of rocky coastline in the Isles of Scilly provides a very extensive length of shore with a wide range of habitats and communities present. This long shoreline ensures that most habitats/communities are represented in several locations and over a considerable length of shore.

Diversity. The diversity of habitats, communities and species along the coastline is very high. Open-shore communities range from those exposed to exceptionally strong wave action to those very sheltered from wave action and thus include virtually the whole range of community types likely to be encountered on shores in Britain. Other habitats are present incuding rockpools, boulder caves and boulders which are colonised by distinctive communities. The diversity of species present in rocky shore habitats is variable with underboulder communities

being very rich but with unexceptional communities in other habitats such as rockpools and several species widespread on the mainland being rare or absent on the open shore. Thus, two features with especially diverse communities are of particular scientific interest: the wide range of open-shore communities and the rich underboulder communities.

Naturalness. Almost all of the rocky shore communities encountered in the Isles of Scilly are natural communities, influenced little by the activities of man. However the immigrant algae Asparagopsis armata and Pikea californica are often abundant species on wave-sheltered and wave-exposed shores respectively. These species are now a permanent feature of the Isles of Scilly. A few man-made habitats exist including harbour walls and shipways but occupy only a small part of the coast. The field walls which now extend across the intertidal flats provide an interesting habitat colonised by a rich variety of species.

Rarity. Tables 6 and 7 show the rarely encountered communities and species present in the Isles of Scilly. Many southern species are present in large amounts and must be considered a particularly important feature of the communities present in the Isles of Scilly.

Fragility (vulnerability). Most rocky shore communities, particularly those of wave-exposed coasts, are highly resilient to the impact of disturbance including oil pollution. However, the sheltered-shore communities present amongst the inner islands in the Isles of Scilly must be seen as susceptible to damage including long-term damage from such activities/incidents as seaweed cutting, harbour or jetty construction and oil pollution. Fortunately, these activities/incidents have not occurred or have been very restricted in occurrence. A major impact on some shore communities might come from educational activities where disturbance to habitat (mainly boulder-turning) and collecting could affect some of the most scientifically interesting sites. The settlement of immigrant species most likely does not displace established species but enriches the native flora. However, care should be taken to avoid introductions and in dealing with any attempt to eradicate new immigrants.

Typicalness. Some of the major features of rocky shore communities in the Isles of Scilly are broadly similar to those of the mainland. However, the influence of the mild climate which results in the high abundance of some southern species, and the geographical isolation of the islands which results in the absence or very low abundance of some usually common species, makes many of the rocky shore communities present in the Isles of Scilly rather untypical of those present in other parts of the British Isles. the untypical nature of these shores should not detract from the scientific interest of the habitats and communities which rests mainly with the wide range of exposure to wave action of habitats at the south-western extremity of the British Isles, and the presence, sometimes in large amounts, of some southern species.

Recorded history. Some observations of the marine communities and species present in the Isles of Scilly were made in the 19th century and remain useful today for comparative purposes. However, most recent work has been undertaken in the past 20 years and has resulted in the publication of species lists for algae and several of the main animal groups. A considerable amount of unpublished information has been amassed by staff of Exeter University during field trips. The detailed and systematic surveys described in this report are the first known to have been published. The documentation which now exists provides a good basis for the assessment of present habitats and communities and of any future gross change.

Position in an ecological/geographical unit. Many of the terrestrial parts of the Isles of Scilly are of high scientific interest and the development of conservation measures on land can be carried out in close association with those of marine areas. Many rocky shores are adjacent to areas of intertidal sediments including the low-tide flats which are of very high scientific interest.

Potential value. There are no parts of the rocky shore area in the Isles of Scilly where potential for any rehabilitation or re-creation of habitats exists.

Intrinsic appeal. The Isles of Scilly are a very popular holiday retreat for many people with an interest in or appreciation of wild scenery and the plants and animals which live there. A major part of the island economy is directed at catering for this interest and the islanders also have a special regard for wildlife. Many of the areas of shore described in this report have, apart from their biological interest, a scenic appeal which must be included in any assessment of their value to man.

Research and educational value. The isolation of the Isles of Scilly from the mainland and the consequent expense of travel to the islands together with the untypical nature of many of the rocky shore communities mitigates against their having a very high research or educational value in general terms. However, the peculiar communities present there, together with the presence of exceptionally exposed communities and very rich underboulder communities, makes the area of some specialist interest. The sheltered nature of much of the archipelago enables the continuation of fieldwork even in the strongest of winds whilst the ease of access to most of the shores is also important. For the general public or for the student obtaining a first grasp of the principles of rocky shore ecology, the islands offer a very wide range of shore types in which the basic principles of rocky shore ecology can be observed without being confused by the slightly unusual features which an experienced eye might observe. In particular, there is considerable potential for the development of interpretative facilities associated with the high natural history appeal of the islands to a large number of visitors. Clearly, such development will have to be carried out with care to avoid disturbance of vulnerable habitats but could provide a means of informing the interested public and explaining the importance of conservation.

4.2.3. Identification/confirmation of important features. Features of the rocky shores of the Isles of Scilly are evaluated here in terms of their International, National, Regional or Local importance. Table 5 lists general features, Table 6 lists all of the main open-shore types and subsidiary habitats, and Table 7 lists species which are considered of scientific interest in their presence on the Isles of Scilly.

The rating of importance is made broadly according the following definitions.

International. Communities which are outstandingly good examples of their type in the north-east Atlantic. Communities recorded at only a very few locations in the north-east Atlantic.

Species which are recorded at only a few locations in the north-east Atlantic. Species recorded in higher abundance in the Isles of Scilly than anywhere else in the north-east Atlantic or where the Scillies archipelago is one of only a very few locations where large quantities are recorded.

National. Communities which are outstandingly good examples of their type in Britain. Communities recorded at only a very few locations in Britain. Both of these definitions refer to communities which are or are likely to be widely occurring in other parts of North-west Europe.

Species which are recorded at only a few locations in Britain but are more widespread in other parts of the North-east Atlantic. Species recorded in higher abundance in the Isles of Scilly than anywhere else in Britain or where the Scillies archipelago is one of only a very few locations where large quantities are recorded in Britain. This rating is also used for species which are or are probably widely distributed in south-west Britain but where the Isles of Scilly populations provide particularly good and well-documented examples of the species.

Regional. Communities which are present elsewhere in Britain but which are outstandingly good examples of their type in south-west Britain or are as good examples as similar communities present elsewhere in Britain. Communities recorded at only a few locations in south-west Britain.

Species which are unrecorded or recorded at only a few locations in south-west Britain but are widespread in other parts of Britain. Species recorded in higher abundance in the isles of Scilly than anywhere else in south-west Britain or where the Scillies archipelago is one of only a very few locations where large quantities are recorded in south-west Britain.

Local. Communities which are widespread in south-west Britain with as good or better examples at several other locations. [The selection only of species which are of higher than Local importance precludes the use of this category in the species lists.]

TABLE 5

Evaluation of general features of rocky shores in the Isles of Scilly.

Feature	Notes	Suggested Importance
Variety of rocky shore communities in the area.	The c. 97 km of rocky shore present in the Scillies archipelago includes areas exposed to the most severe wave action of south-west facing coasts through to shores very sheltered from wave action in the channels between islands. The most exposed shores have communities which indicate more severe wave action than the most exposed shores described in the classic study by Ballantine (1961). The sheltered shores are not the most sheltered to occur on the coast of Britain but are found within a few hundreds of metres of very exposed sites. It is the wide range of communities characteristic of different exposures to wave action which make the shores of very high interest.	National
Variety of topographical features and habitats in the area.	The shore types generally follow a pattern of topographical features related to wave exposure, with the ubiquitous granite rock helping to lead to similar shore types in similar situations of wave exposure. Some areas of cliff provide a distinctly different shore type to the usual broken slope in similar conditions of exposure. The broken nature of rocks and the presence of boulders on less-exposed shores often leads to the presence of rich underboulder communities.	Local
Variety of species in the area.	Although most of the key rocky shore species are present in the Isles of Scilly, many expected species are absent or present in low abundance, most likely as a result of isolation of the archipelago from mainland sources of larvae. Also, the variety of species in many of the cryptic or minor taxa is low. These absences or low abundances are partly compensated for as a result of the wide variety of rocky shore habitats present in the Isles of Scilly and the presence of rich underboulder communities, thus giving the area the importance indicated.	Regional
Presence of particular biogeographical groups of species.	Many of the species present on the shore are southern or Mediterranean-Atlantic species. These species occur rarely elsewhere in Britain but some are widespread and common in the Isles of Scilly.	National
Presence of rare species.	There are several rocky shore species recorded only in the Isles of Scilly in the British Isles or which are particularly abundant there. Most of these are southern species requiring a mild climate and some most likely benefit from some of the unusual habitats found amongst the archipelago.	National
Presence or rare/unusual communities.	The exceptionally exposed communities and the very sheltered boulder communities are considered unusual.	National
Geographical location	The Isles of Scilly are Britain's most south-westerly archipelago and from this position arise many of the influences which shape the communities present. This feature is of high importance.	Regional/National

TABLE 6

Evaluation of rocky shore types and identification of shores of high conservation interest. The comments made by Harvey (1969) and Smith and Gault (1983) are taken account of in this evaluation.

Shore type	Notes	Suggested Importance
1a. West-facing, steeply sloping bedrock shores exposed to the full force of prevailing wind-driven waves and swell. ('Super-exposed' shores.)	These shores represent the ultimate exposure of sites in south-west Britain to wave action. The communities present have a restricted variety of species with some plants and animals usually considered characteristic of exposed shores rare or absent. This type of shore is restricted to the offshore rocks and islands to the west of the archipelago.	National
1b. West- and north-facing steeply sloping bedrock shores exposed to very strong wave action ('Extremely exposed' shores.)	The shores are similar to open-coast areas of many parts of south-west Britain where very strong wave action occurs. In the Isles of Scilly, they are present on the north- and west-facing shores of the outer islands.	Local
2. Rock slopes on wave-exposed coasts ('Very exposed' shores.)	These shores are similar to open-coast areas of many parts of south-west Britain where strong wave action occurs. In the Isles of Scilly, they are present in local shelter on the outer rocks and islands.	Local
3. Rock slopes on the seaward-facing shores of the outer islands but sheltered by aspect or offshore rocks ('Exposed' shores.)	(As shore type 2.)	Local
4. Rock slopes on east-facing or locally sheltered shores of the outer islands ('Semi-exposed' shores.) (Including notes on rockpools.)	These shores are similar to open-coast areas with some degree of local shelter or an eastern aspect in many parts of south-west Britain. In the Isles of Scilly, they occur over an extensive length of the coastline and include shores with the most extensive and richest rockpool communities, with sites at Plumb Island, Pernagie Point, St. Martin's and Castle Vean (St. Agnes) particularly notable and some less-rich rockpool sites at Morning Point and Darrity's Hole (Gap Point), St. Mary's. The presence of the best examples of rockpools on this type of shore increases their importance from local to regional.	Regional
5a and b. Bedrock and large boulder slopes near to the open coast but within bays ('Fairly sheltered' shores.)	It seems likely that this type of shore is widespread along sheltered parts of the coast of Cornwall although some of the shore species normally characteristic of this type of shore are absent or present in low abundance in the Isles of Scilly.	Local

Species - Animals	Notes	Suggested Importance
6. Bedrock and boulder slopes extending to sand and sheltered from strong wave action. ('Sheltered' shores.) (Including notes on underboulder communities.)	These shores are possibly similar to some of the areas at the entrance to the wave-sheltered rias of the south coasts of Cornwall and Devon. In the Isles of Scilly, they are particularly rich in species (although some species common on the mainland are absent or present in low abundance) and the underboulder communities which were found were very rich on many of the shores, particularly at Great Porth, Bryher; English Island Point, St. Martin's; Pernagie, St. Martin's; and the area between Periglis Cove and Carnew Point, St. Agnes, which Harvey (1969) assesses as being very rich. The open-shore communities are possibly of only local importance but the very rich underboulder communities make these shores of higher importance.	Regional/ National
7. Bedrock and boulder slopes on enclosed coasts where fetch does not exceed a few hundred metres ('Very sheltered' shores.)	These shores, which are mostly adjacent to the extensive low-tide flats amongst the central islands or in almost-completely enclosed bays include lower-shore communities of considerable richness most likely not found elsewhere in south-west Britain. The midshore and upper-shore communities are typical of very wave-sheltered conditions, although similar communities doubtless exist in the South Cornwall and South Devon rias. The area of the Bryher-Tresco channel and rocks in the area of St. Martin's Flats and Forman's Island are noted here as particularly good examples of this type of habitat.	National

TABLE 7

Species of high scientific and conservation interest recorded during rocky shore surveys. Only species recorded by FSC and NCC staff during the March/April and July survey are included here.

Species - Algae	Notes	Suggested Importance
Asparagopsis armata (gametophyte stage)	The gametophyte stage of this immigrant species is found in abundance only on the southern shores of Cornwall and Devon. In the Isles of Scilly, the species is widespread in shelteredareas and often present in large amounts.	Regional/ National
Gigartina aicularis	This south-western species was frequent on many of the sheltered shores. Its northern recorded limit of distribution is in Pembrokeshire.	Regional
Pikea californica	Records from the Isles of Scilly are the first for the North-East Atlantic of this species, previously reported from the lower intertidal and subtidal in California and possibly Japan (Abbott and Hollenberg, 1976). The species was recorded from many of the exposed sites surveyed, often in large amounts. It was collected in the Isles of Scilly in 1967 but not identified as this species (C.M. Maggs, pers. comm.).	International
Mesophyllum lichenoides	A southern species present in particularly large amounts in the Isles of Scilly.	Regional
Laminaria ochroleuca	This southern species forms a high proportion of the extreme lower-shore kelp population and is present even at exposed sites. It appears that *L. ochroleuca* is particularly abundant in the Isles of Scilly although quite widespread in south-west Britain.	Regional
Cystoseira tamariscifolia, *C. myriophylloides*, *C. nodicaulis*	*Cystoseira* species are predominantly south-western in distribution and the occurrence of these species on the lower shore and in rockpools at many sheltered sites is a distinctly southern characteristic.	Regional

Species - Animals	Notes	Suggested Importance
Anthopleura ballii	A south-western species of uncommon occurrence which was recorded on several of the shores.	Regional/ National
Dynamene bidentata, *Cymodoce truncata*, *Sphaeroma serratum*	These sphaeromatid isopods, although widely distributed, were present in large numbers in some habitats on the Isles of Scilly and, as a group, are therefore of some interest.	Regional
Runcina coronata	Although no special mention is made of the frequency of occurrence of this species in Thompson and Brown (1976), it appears to have a very sporadic occurrence in the British Isles. The presence of large numbers in some coralline rockpools in the Isles of Scilly is therefore of note.	Regional

Species - Animals (cont.)	Notes	Suggested Importance
Turbicellepora magnicostata	This species is only recorded in the Isles of Scilly in the British Isles by Hayward and Ryland (1979) who note, as found in the present survey, that it constitutes a common, and obvious, member of the rocky shore community.	National
Antedon bifida	Although a common species on subtidal rocks, the presence of this species on the shore at several sites is unusual.	Regional
Asterina gibbosa	Although a frequent inhabitant of rocky shores, the abundance and widespread distribution of this species on fairly sheltered and sheltered shores is noteworthy.	Regional
Sidnyum elegans, Morchellium argus, Aplidium spp., Polyclinum aurantium	These polyclinid tunicates, although widespread lower-shore and subtidal species, were particularly abundant on lower-shore boulders at sheltered sites.	Regional

5. RECOMMENDATIONS FOR FUTURE WORK

Following this detailed survey of conspicuous species present on rocky shores and the definition of shore types, there is a basis by which to undertake rapid surveys by boat or on foot to provide accurate maps of the location and extent of different shore types and to ensure that all of the main habitats and communities have been included in the assessment of Isles of Scilly shores. It is recommended that this type of survey be undertaken.

Several individual biologists or groups of biologists have now undertaken shore surveys in the Isles of Scilly although the extent to which their work has been reported has varied widely. A collation of available information on the shores of the Isles of Scilly and publication in one scientific report or paper is clearly desirable. It is recommended that such a collation of data is undertaken by an experienced biologist.

The assessment of scientific interest of shores and species included in this report is mainly restricted to the rocky shores described by FSC and NCC staff. In order to obtain an assessment of the shores surveyed by other workers, their views on the conservation importance of shore types, sites and species with which they are familiar should be sought. It is recommended that biologists with experience of Isles of Scilly shores should be asked to either identify all the areas and species they feel are of Regional, National or International importance (according to defined criteria) or to apply these criteria to all of the areas/sites they have surveyed in the past. Also, a search of the literature should be carried out to ensure the listing of all species of high scientific interest.

In this report, limited use has been made of detailed data. There is scope for the further comparison of sites and description of shore types, possibly in a clearer format, using the raw data available. In particular, a tabulation of abundance data on open-shore species in the main shore types could be useful. It is recommended that the raw data be consulted in preparing material for any future summaries or publications on the rocky shore ecology of the Isles of Scilly.

Many sections of the NCC rocky shore recording sheet were found difficult to apply for the sort of survey work being carried out. Also, the use of the recording sheets to separate sites of similar character was very difficult and assessment of a biologically defined exposure grade was used rather than the sheets. There were no sections on the recording sheet for much potentially useful information. It is recommended that the categories included on the sheet should be thoroughly reviewed and a new sheet developed.

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Appendix 1

N.C.C. ROCKY SHORE RECORDING SHEET

LOCALITY	ABSTRACT	GRID REFERENCE	LATITUDE	LONGITUDE

SECTOR	SEA AREA	DATE OF VISIT	TIDAL LEVEL	RECORDER

COASTAL SITUATION:			INTERTIDAL EXTENT: (m)		
Open coast			SUBTIDAL EXTENT: (m)		
Sheltered coast			HABITAT EXTENT: (m)		
Large bay (>2km across)			OFFSHORE FEATURES:		
Small bay			Islands		
Island			Reefs		
Island attached at L.W.			Breakwater		
Sea loch			Banks		
Marine inlet			COASTAL HEIGHT:		
Narrows			High		
Rapids			Moderate		
Estuary			Low		
SHORE TYPE:	dom	2°	COASTAL BACKING:		
Vertical rock			Sand dunes		
Steep rock (>30° slope)			Low cliff		
Rock ridges			Moderate cliff		
Rock platform			High cliff		
Rock outcrop			Machair		
Fissured rock			Marsh		
Irregular rock			Grassland		
Large gully			Peat		
Large boulders (>1024mm)			Valley		
Medium boulders (512-1024mm)			Freshwater		
Small boulders (256-511mm)			Trees		
Stones (64-255mm, angular)			other		
Shingle (64-255mm, rounded)			ASPECT & PREVAILING WIND:	asp.	wind
Pebbles (5-63mm, rounded)			North		
Gravel (2-4mm)			North East		
Sand (<2mm)			East		
Lagoon, lower shore			South East		
Pools			South		
Shingle ridge at HWS			South West		
Man-made			West		
ROCK TYPE:			North West		
BIOTA:			EXPOSURE:		
Ascophyllum			Very exposed		
Mackaii			Exposed		
Fucoids			Moderate		
Fucobalanus			Sheltered		
Fucopatella			Very sheltered		
Fucomytilus			TIME OF E.L.W.S.T.		
Chlorpatella			SPRING TIDE RANGE (max, m,);		
Chlorophyce.			NEAP TIDE RANGE (min.m.):		
Rhodomytilus			ANNUAL RAINFALL (mm):		
Rhodobalanus			CURRENT STRENGTH (max speed knots):		
Rhodopatella			Strong		
Balanomytil.			Moderate		
Barnacles			Weak		
Molluscs			SALINITY:		
COVER:			High (>36‰)		
Blanket			Normal		
Most			Low (<30‰ throughout shore)		
Half			Stream flowing onto shore		
Patchy			DISTANCE FROM NEAREST TOWN:(km)		
Sparse			SHORE USAGE:		
SLOPE:			Re creation		
Vertical			Angling		
Steep (>30°)			Shellfish collection		
Moderate			Seaweed harvesting		
Flat (<5°)			Monitoring		
			other		

Appendix 2

Abundance scales for rocky shore species.

1. Live barnacles (except B. perforatus)
(record adults, spat, cyprides sep'tly)
Littorina neritoides
Littorina neglecta
Ex 500 or more per $0.01m^2$-+5/cm^2
S 300-499 per $0.01m^2$ 3-4/cm^2
A 100-299 per $0.01m^2$ 1-2/cm^2
C 10- 99 per $0.01m^2$
F 1- 9 per $0.01m^2$
O 1- 99 per m^2
R Less than 1 per m^2

2. Balanus perforatus
Ex 300 or more per $0.01m^2$
S 100-299 per $0.01m^2$
A 10- 99 per $0.01m^2$
C 1- 9 per $0.01m^2$
F 1- 9 per $0.1m^2$
O 1- 9 per m^2
R Less than 1 per m^2

3. Patella spp. 10mm+
Littorina littorea (juvs. & adults)
Littorina 'littoralis' (adults)
Nucella lapillus (juvs. <3mm)
Ex 20 or more per $0.1m^2$
S 10-19 per $0.1m^2$
A 5- 9 per $0.1m^2$
C 1- 4 per $0.1m^2$
F 5- 9 per m^2
O 1- 4 per m^2
R Less than 1 per m^2

4. Littorina 'saxatilis'
Patella smaller than 10mm
Anurida maritima
Hyale nilssoni & other amphipods
Littorina 'littoralis' juvs.
Ex 50 or more per $0.1m^2$
S 20-49 per $0.1m^2$
A 10-19 per $0.1m^2$
C 5- 9 per $0.1m^2$
F 1- 4 per $0.1m^2$
O 1- 9 per m^2
R Less than 1 per m^2

5. Nucella lapillus (>3mm)
Gibbula spp.
Monodonta lineata
Actinea equina
Idotea spp.
Carcinus (juvs. & recent sett.)
Ligia oceanica
Ex 10 or more per $0.1m^2$
S 5-9 per $0.1m^2$
A 1-4 per $0.1m^2$
C 5-9 per m^2, locally sometimes more
F 1-4 per m^2, locally sometimes more
O Less than $1/m^2$, loc. sometimes more
R Always less than 1 per m^2

6. Mytilus edulis
Ex 80% or more cover
S 50-79% cover
A 20-49% cover
C 5-19% cover
F Small patches <5%, 10+ sm. inds. per $0.1m^2$, 1 or more lg. per $0.1m^2$
O 1-9 sm. per $0.1m^2$, 1-9 lg. per m^2. No patches except small in crevices
R Less than 1 per m^2

7. Pomatoceros triqueter
A 50 or more tubes per $0.01m^2$
C 1-49 tubes per $0.01m^2$
F 1- 9 tubes per $0.1m^2$
O 1- 9 tubes per m^2
R Less than 1 tube per m^2

8. Spirorbis spp.
A 5 or more/cm^2 on approp. substrata. More than $100/0.01m^2$ generally
C Patches of 5 or more per cm^2. 1-100 per $0.01m^2$ generally
F Widely scattered small groups. 1-9 per $0.1m^2$ generally
O Widely scattered small groups. Less than 1 per $0.1m^2$ generally
R Less than 1 per m^2

9. Sponges
Hydroids
Bryozoa
A Present on 20% or more of suitable surf.
C Present on 5-19% of suitable surfaces
F Scattered patches, less than 5% cover
O Small patch or single sprig in $0.1m^2$
R Less than one patch over strip, one small patch or sprig per $0.1m^2$

10. Flowering plants, lichens & lithothamnia
Ex More than 80% cover
S 50-79% cover
A 20-49% cover
C 1-19% cover
F Large scattered patches
O Widely scattered patches, all small
R Only 1 or 2 patches

11. Algae
Ex More than 90% cover
S 60-89% cover
A 30-59% cover
C 5-29% cover
F Less than 5% cover, zone still apparent
O Scattered plants, zone indistinct
R Only 1 or 2 plants

Other plant species
Record as % cover or approx. average nos. within 0.01, 0.1 or $1m^2$

APPENDIX 3

Checklist of algae, lichens and animals used in March/April survey.

ALGAE

CHLOROPHYTA
Enteromorpha spp.
Monostroma spp.
Ulva spp.
Cladophora spp.
Bryopsis spp.

PHAEOPHYTA
Alaria esculenta
Laminaria digitata
L. saccharina
Saccorhiza polyschides
Himanthalia elongata
Fucus serratus
F. vesiculosus
f.v. f. linearis
F. spiralis
Ascophyllum nodosum
Pelvetia canaliculata
Filamentous brown algae

RHODOPHYTA
Encrusting reds/browns
'lithothamnion'
Corallina spp.
Gigartina stellata
Chondrus crispus
Laurencia pinnatifida
L. hybrida
Lomentaria articulata
Palmaria palmata
Porphyra spp.
Gelidium pusillum
Catenella repens
Plocamium cartilagineum
Membranoptera alata
Antithamnion plumula
Callithamnion/Ceramium spp.

LICHENS

Lecanora atra
Anaptychia fusca
Other grey lichens
Ochrolechia parella
Ramalina sp.
Xanthoria parietina
Caloplaca thallincola
Caloplaca spp.
Verrucaria maura
V. mucosa
Lichina confinis
L. pygmaea

ANIMALS

Halichondria panicea
Orange sponges
Dynamena pumila
Obelia sp.
Laomedia flexuosa
Actinia equina
Anemonia viridis
Bunodactis verrucosa
Cereus pedunculatus
Eulalia viridis
Pomatoceros triqueter
Spirorbis on fucoids
Gigartina/Chondria
Corallina
'lithothamnion'
rock
Patella spp.
Gibbula umbilicalis
G. cineraria
Monodonta lineata
Calliostoma zizyphinum
Littorina 'neglecta'
L. saxatilis
L. littorea
L. littoralis
L. neritoides
Nucella lapillus
Mytilus edulis
Chitons
Acmaea virginea
Patina pellucida
Balanus perforatus
B. crenatus
B. balanoides
Elminius modestus
Chthamalus stellatus
C. montagui
Carcinus maenas
Cancer pagurus
Anurida maritima
Isopoda indet.
Amphipoda indet.
Alcyonium sp.
Membranipora membranacea
Electra pilosa
Flustrellidra hispida
Umbonula littoralis
Botryllus schlosseri
Botrylloides leachi

Appendix 4

Checklist of algae and lichens used in the July survey.

SCILLY ISLES ROCKY SHORE SURVEY

ALGAE AND LICHENS

SITE NAME: GRID REFERENCE:

DATE: NAME OF RECORDER:

Checklist species

RHODOPHYTA	PHAEOPHYTA
Audouinella sp.	Laminaria digitata
Gelidium latifolium	Laminaria hyperborea
Gelidium pusillum	Laminaria saccharina
Asparagopsis armata	Saccorhiza polyschides
Catenella caespitosa	Alaria esculenta
Calliblepharis jubata	Cladostephus spongiosus
Plocamium cartilagineum	Ascophyllum nodosum
Ahnfeltia plicata	Fucus serratus
Gymnogongrus crenulatus	Fucus spiralis
Chondrus crispus	Fucus vesiculosus
Gigartina acicularis	Pelvetia canaliculata
Gigartina stellata	Himanthalia elongata
Corallina officinalis	Bifurcaria bifurcata
Encrusting calcareous algae	Encrusting brown algae
Mesophyllum lichenoides	Filamentous brown algae
Dumontia incrassata	
Callophyllis laciniata	CHLOROPHYTA
Hildenbrandia sp.	Enteromorpha spp.
Palmaria palmata	Ulva spp.
Chylocladia verticillata	Chaetomorpha linum
Gastroclonium ovatum	Chaetomorpha melagonium
Lomentaria articulata	Cladophora spp.
Lomentaria clavellosa	Codium spp.
Callithamnion spp.	
Ceramium rubrum	LICHENS
Ceramium shuttleworthianum	Caloplaca marina
Griffithsia flosculosa	Caloplaca thallincola
Halurus equisetifolius	Grey lichens
Plumaria elegans	Lichina pygmaea
Acrosorium reptans	Verrucaria maura
Cryptopleura ramosa	Verrucaria mucosa
Hypoglossum woodwardii	Xanthoria parietina
Membranoptera alata	
Heterosiphonia plumosa	**Additional species**
Laurencia hybrida	
Laurencia pinnatifida	
Polysiphonia brodiaei	
Polysiphonia lanosa	
Polysiphonia nigrescens	
Polysiphonia urceolata	
Encrusting dark red algae	
Scytosiphon lomentaria	

Appendix 5

Checklist of animals used in the July survey.

SCILLY ISLES ROCKY SHORE SURVEY

ANIMALS

SITE NAME: GRID REFERENCE:

DATE: NAME OF RECORDER:

Checklist species

PORIFERA
Hymeniacidon perleve
Myxilla sp.
Halichondria panicea

COELENTERATA-HYDROZOA
Actinia equina
Anemonia viridis
Urticina felina
Corynactis viridis

ANNELIDA
Pomatoceros triqueter
Spirorbinidae - on rock
- on fucoids
- on Gigartina/Chondrus
- on 'lithothamnia'

CRUSTACEA-CIRRIPEDIA
Chthamalus stellatus
Chthamalus montagui
Balanus perforatus

CRUSTACEA-ISOPODA
Idotea sp(p).

CRUSTACEA-AMPHIPODA
Amphiphoda indet.

CRUSTACEA-DECAPODA
Galathea squamifera
Porcellana platycheles
Cancer pagurus
Carcinus maenas

MOLLUSCA
Patella vulgata
Patella aspera
Acmaea virginea
Calliostoma zizyphinum
Gibbula umbilicalis
Gibbula cineraria
Monodonta lineata
Littorina 'saxatilis'
Littorinia neritoides
Littorinia mariae
Littorina obtusata
Littorina nigrolineata
Littorina neglecta
Nucella lapillus
Mytilus edulis

BRYOZOA
Electra pilosa
Umbonula littoralis

ECHINODERMATA
Asterina gibbosa

ASCIDIACEA
Didemnidae indet.
Polyclinidae indet.
Dendrodoa grossularia

Additional species

Appendix 6

Descriptions of all shores surveyed by FSC and NCC staff. These notes are mostly those made during field survey work and do not include detailed lists of species. All sites are described from the upper to the lower shore. During the July survey, an abbreviated method of reporting was adopted for sites 33 to 45.

MARCH/APRIL SURVEY

1. Porth Cressa (east shore), St. Mary's (SV 906 099).

General description of shore

The area surveyed was an extensive and gradually sloping boulder shore facing to the west. The slope started on the upper shore at about 25° extending about 25 m west, then levelling off to a slope of about 5° and extending approximately 100 m horizontally to low tide. Many of the boulders were large (c. 3 m in diameter). Between these boulders, rocks of various sizes were present with gravel and sand at their bases, particularly towards the lower littoral.

The stability of both large and small boulders was suggested by the presence of fucoids, barnacles and limpets. These communities, together with the position of the Pelvetia canaliculata zone at only +4.9 m relative to chart datum, the geographical position of the shore and the gradual slope suggest that the site was sheltered from strong wave action.

The shore topography was extremely uneven and the boulder substratum presented a wide variety of habitats. Major physical habitats with distinctly different communities were as follows: on top of boulders, between boulders, under overhangs, under boulders, in pools, in sand in pools. The dense seaweed towards the lower littoral provided habitats for several organisms, particularly epiphytic species.

Description of communities present

Supralittoral rocks were colonised by a zone of Ramalina sp. with various crustose grey lichen species. This zone extended over about 4 m vertically and downwards to a height of 6.5 m above chart datum over a c. 10 m length of shore. Below the Ramalina zone there was a narrow (c. 70 cm vertically) zone mainly of Caloplaca marina with patches of Xanthoria parietina and Lichina confinis over a c. 5 m length of shore. A black Verrucaria maura-dominated zone extended from about +5.9 m to +4 m relative to chart datum and over about a 5 m length of shore.

On top of boulders in the upper littoral (starting at +4.9 m) the algae Pelvetia canaliculata, Fucus spiralis, Catenella caespitosa, the limpet Patella vulgata and the barnacle Chthamalus montagui were present. Between boulders at this level were plants of Fucus serratus, plus many Littorina saxatilis and L. nigrolineata. Other conspicuous animals included Monodonta lineata, Gibbula umbilicalis, Nucella lapillus and Actinia equina. Verrucaria mucosa was conspicuous on the eastern side of boulders. This species extended well into the more gradually sloping middle shore.

In the middle shore (+3.0 m) Lichina pygmaea occurred chiefly on west faces.

On top of boulders the dominant species were P. vulgata, C. montagui, Chthamalus stellatus with patches of Fucus vesiculosus and Laurencia pinnatifida. Between boulders were F. vesiculosus plus patches of F. serratus and a variety of foliose red algae and corallines. Littorina obtusata and Gibbula umbilicalis were also conspicuous here.

Extensive shallow pools lined with sand were present in the lower littoral. These pools were rich in algae. Conspicuous species included Bifurcaria bifurcata, Laminaria digitata, L. saccharina, Chondrus crispus and Corallina sp(p).

Algal cover incresed towards the lower shore. At +1.6 m the dominant alga was F. serratus, with large amounts of Himanthalia elongata, L. digitata, B. bifurcata and various red algal species. In many areas, the rock bore large patches of the 'sand-binding' alga Audouinella sp(p). P. vulgata was present and the dominant barnacle was C. stellatus on top of boulders. A few Balanus perforatus were noted between boulders.

At the bottom of the shore +0.7 m, 90% of the rock bore dense foliose algal cover over the encrusting calcareous algae. Patches of Mesophyllum lichenoides were observed amongst other encrusting algae. The bases of the boulders were surrounded by coarse sand, with occasional specimens of Urticina felina visible. Other animals on the lower shore included C. stellatus, Gibbula cineraria and Spirorbidae indet. Sponges occurred under overhangs and boulders.

The shore corresponded most closely to a Fairly sheltered or Sheltered (Ballantine, 1961) shore.

2. Dutchman's Carn, St. Mary's (SV 909 095).

General description of shore

The area surveyed was a steeply sloping north-west facing shore mostly of unbroken rock but with some platforms and a few small pools. The rock slope terminated near to low water. To the south was a boulder platform of very large boulders (2 m+) with smaller boulders in between. The splash zone and above was characterised by extensive patches of Ramalina with some patches of Caloplaca. The black lichen zone extended to about 9.2 m above chart datum and Littorina neritoides was present to at least +8.1 m. Patella vulgata and Chthamalus montagui extended up to 6.1 m above chart datum. The major part of the shore from +5.7 to +1.6 m was limpet/barnacle-dominated, with dense Pelvetia canaliculata on the part of the shore nearest land at +5.8 m. Lichina spp. was present in patches at and below the Pelvetia belt and fucoid algae were present as sparse clumps at +3.8 to +2.7 m. Below +2.7 m, large patches of rock were dominated by Laurencia pinnatifida, with Gelidium sp., Gigartina stellatus, Corallina sp., Chondrus crispus, Himanthalia elongata and Fucus serratus. This community extended down to the lower shore with encrusting calcareous algae becoming dominant below +1.5 m. Laminaria digitata was present at +1.3 m and dense at +1 m. The boulder area was largely of bare granite with sparse barnacles and a low density of large limpets together with patches of F. serratus and L. digitata.

The shore corresponded most closely to an Exposed/Semi-exposed (Ballantine, 1961) shore.

3. Morning Point (rockpools), St. Mary's (SV 901 098).

General description of shore

The area on which rockpools were surveyed was a gradually sloping, broken, south-facing shore with an extensive area of large and small boulders. Bedrock was very bare in appearance with a high density of limpets and generally sparse barnacles. Boulders held a similar biota but with some patches of green filamentous algae. On the lower shore, patches dominated by Laurencia pinnatifida with some Fucus serratus and Himanthalia elongata were present. The largest pool present was

filled with Laminaria drift and was not studied. Other rockpools were about 1 to 2 m^2 in area and maximum of 50 cm deep. Four pools/groups of pools were surveyed at:

1.7 m above chart datum - pool 1
2.1 m above chart datum - pool 2
2.7 m above chart datum - pools 3
3.4 m above chart datum - pool 4

(Heights calculated from time at which pools were reached by the tide.)

The pools were dominated by algae but with only a small variety of both algae and animals present. Pools 3 were about 15 m east of a sewage outfall and sewage debris was present on the shore. The rockpools were dominated by Corallina officinalis with H. elongata and Bifurcaria bifurcata present. The lowest pool held Laminaria digitata and Alaria esculenta, and limpets did not extend into the pool. Pool 4 was dominated by encrusting calcareous algae with only a c. 20% cover of C. officinalis; Enteromorpha sp. and Scytosiphon lomentaria were present on limpets.

A rapid search was made further west looking for more pools when the tide was at about midtide level. Some pools were present and were broadly similar, though some a little deeper and with more B. bifurcata generally present.

The shore corresponded most closely to a Semi-exposed (Ballantine, 1961) shore.

4. North Tresco (SV 883 167).

General description of shore

The area studied was a north-facing, gently sloping shore of very broken bedrock with a strip of very large boulders from the upper shore to low water level. The shore was sheltered from the full force of wave action at low water level by offshore reefs and boulders.

A black lichen zone extended on vertical and upward-facing rock up to 10.2 m above chart datum, with a very broken cover of black lichens on upward-facing surfaces above 10.2 m, though with continuous black lichens on vertical surfaces. Pelvetia canaliculata was present at up to 8.7 m above chart datum with the main belt (on sheltered areas of broken rock) at +7.6 m to +7.0 m. Small patches of Lichina pygmaea were present (<5% cover) at +7.6 to +6.0 m and Porphyra sp. was present at +7.0 m to +5.4 m. Barnacles and limpets extended up to +6.5 m but the main zone was below +6.0 m. Most of the shore was characterised by a patchy cover of Fucus vesiculosus var. linearis on limpet/barnacle-dominated rock with large numbers of Actinia eqina present. F. vesiculosus var. linearis extended from +5.3 m to +2.2 m, A. equina from +4.0 m to the lower shore, and Nucella lapillus from +4.0 m to the lower shore. Corallina officinalis occurred on open rock surfaces from about +3.7 m to the lower shore. On the lower shore below +2.6 m, there was a patchy cover of C. officinalis with Himanthalia elongata, sparse F. vesiculosus and some Chondrus crispus and Gigartina stellata on lithothamnia-dominated (70-80% cover below +2 m) rock. Laminaria digitata was present up to +2.2 m and was common below +1 m. Some Alaria esculenta was present near to low water (+0.5 m) and Laminaria hyperborea was showing.

Several small rockpools were present on the shore. At +9.8 m to 7.6 m, rockpools were dominated by Enteromorpha sp. Midshore pools were dominated by lithothamnia with large Patella present. Some pools on the upper shore (+3.7 m) were lined with C. officinalis with L. digitata present. Lower shore pools were dominated by C. officinalis.

A cave formed by very large boulders on the midshore at c. +3.2 m held a very dense population of Balanus perforatus with two large patches of Dendrodoa grossularia. A high density of both red and green A. equina was present and encrusting Bryozoa and Spirorbinidae dominated some areas of rock, and dense patches of the sabellid worm Amphiglena mediterranea were present.

On the lower shore at sea level (+0.5 m), overhangs in dark places held a fauna characterised by Corynactis viridis, Tubularia indivisa and with some Scypha compressa present.

The shore communities corresponded most closely to a 'Very exposed' (Ballantine, 1961) shore.

5. West of Merchant's Point, Tresco (SV 892 161).

General description of shore

The shore studied was a north-facing, broken rock slope down to about +3.3 m, continuing as large and small boulders to the lower shore. Offshore reefs were present, giving shelter from northerly winds.

The upper shore was dominated by a limpet/barnacle community with Pelvetia canaliculata and Porphyra sp. present at around +6.6 m. Lower shore areas, mostly boulders, were dominated by Fucus serratus, Laurencia pinnatifida, Gigartina spp. and Chondrus crispus. It is notable that, although there was a high cover of algae, very few Littorina obtusata or L. mariae were present. The lower shore below about +1.6 m was largely covered in Himanthalia elongata, Bifurcaria bifurcata, Gigartina spp., all on an overall cover of encrusting calcareous algae. At low water (+0.6 m), Laminaria saccharina and L. digitata were present. Gibbula cineraria was a conspicuous element of the lower shore fauna.

Lower shore boulders had a rich underfauna including Spirorbinidae (dominant) Cellepora pumicosa*, G. cineraria, encrusting sponges and several species of Crustacea. Overhangs on the lower shore had several unusual species including Dendrodoa grossularia, Corynactis viridis, Tubularia indivisa, Calliostoma zizyphinum and Polyclinidae.

Rockpools present on the shore were dominated by B. bifurcata or by lithothamnia and Patella.

The shore was notable for the rich underboulder fauna present and the extensive area of B. bifurcata on open rock.

This shore had a peculiar mixture of exposed and sheltered coast species possibly resulting from the offshore reefs providing shelter for the lower shore when the tide is out, leading to the high abundance of Laminaria saccharina and Gibbula cineraria.

The shore corresponded most closely to a 'Fairly sheltered' community according to Ballantine (1961), although upper shore areas had a more exposed appearance.

6. Droppy Nose Point, Bryher (SV 872 143).

General description of shore

The shore surveyed ran south-west from the pinnacle of rock with a characteristic nose-like summit. Rock from the summit to the upper shore region over a distance of about 15 m was vertical and was followed by a more gradual slope (about 30°) to the lower shore where the steepness increased to about 45°. The topography of the shore was uneven with flat granite rock being dissected by shallow and

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*Records of Cellepora pumicosa made in the field were later found to be Turbicellepora magnicostata in samples.

deep crevices. The middle shore region was split in two by a 4 m deep surge gully, described later. Rockpools were present.

The supralittoral extended from about 18 m to 5 m above chart datum and was divided into three distinct subzones: A Ramalina sp. subzone about 1.5 m in extent; an orange lichen subzone about 1.5 m in extent; and a Verrucaria maura subzone about 10 m in extent. Littorina neritoides was also present.

Upper shore rocks from about +5 to +3 m were steeply sloping and characterised by many small patches of Lichina pygmaea and small scattered clumps of Pelvetia canaliculata.

The midlittoral region extended 1 m vertically and 10 m horizontally, from 2.1 m to 3.2 m above chart datum. This region bore a dense covering of Fucus vesiculosus var. linearis (about 80% cover) and was divided almost equally into two subzones: a) characterised by dense Chthamalus stellatus, few limpets and small patches of L. pygmaea. Nucella lapillus and Actinia equina occurred frequently in crevices; and b) characterised by patches of Corallina officinalis (particularly in crevices) together with scattered 'buttons' of Himanthalia elongata. Large limpets, Patella vulgata, bore a variety of foliose algae, particularly Enteromorpha sp(p)., Palmaria palmata and Ceramium sp(p). C. stellatus was dense and N. lapillus present, but less numerous than in subzone a.

The lower littoral extended from 2 m above chart datum downwards. The region was divided into two distinct subzones and sloped at about 45° in a series of steps to low water (+0.6 m). The rock here was colonised by many long plants of H. elongata, scattered F. vesiculosus var. linearis and many patches of foliose red algae. These red algae included C. officinalis, Gigartina stellata, P. palmata and Laurencia pinnatifida.

Below this, the lower shore was characterised by Laminaria species, including L. digitata, L. hyperborea and L. ochroleuca. Animal species included Actinia equina, Balanus perforatus, Acmaea virginia, Patella aspera and Scypha compressa. The horizontal extent of the lower littoral was about 7 m.

This shore corresponded most closely to an 'Exposed' or 'Very exposed' shore according to Ballantine (1961).

Description of surge gully

The long surge gully which dissected the middle littoral was 1 m wide and 4 m deep in places and pools occurred at its base. At the western end the gully was covered by two large boulders.

The gully walls bore numerous red and green A. equina, N. lapillus, Balanus perforatus and Patella sp(p). The rock was covered by thick encrusting calcareous algae and several foliose red algae, particularly Lomentaria articulata, Laurencia pinnatifida and Plumaria elegans.

A pool shaded from direct sunlight was present under the large boulders. In this pool were large Urticina felina, Corynactis viridis and Sagartia elegans, the hydroid Tubularia indivisa and the sponges Halichondria panicea and Microciona atrosanguinea.

Underneath the boulders the rock had a dense covering of the sea squirt Dendrodoa grossularia and the sponge Clathrina coriacea.

7. Stony Porth, Bryher (SV 872 142).

General description of shore

This was a gently sloping boulder shore c. 200 m east of Droppy Nose Point within Stony Porth and clearly much more sheltered than Droppy Nose Point. Only the lower shore and a large rockpool on the upper shore were surveyed.

The small cliff at the top of the shore was dominated by lichens with Pelvetia canaliculata at the base, followed by Fucus spiralis. The gradual slope of boulders with some rock outcrops was dominated by Fucus vesiculosus with other brown algae and Laminaria spp. present over the lower shore. Underboulder communities included a wide variety of species including the following species rarely encountered elsewhere: Bunodactis verrucosa, Anapagurus hyndmani, Antedon bifida and Asteria gibbosa.

The pool was about 4 m^2 by up to 70 cm deep with ridges running across. The walls were characterised by dense Bifurcaria bifurcata over a cover of encrusting calcareous algae, Mesophyllum lichenoides and Corallina officinalis. Enteromorpha sp(p). was dominant on small boulders in the pool. Twenty-four species of algae and sparse populations of 12 species of animals were recorded.

This shore was most likely nearest to a 'Fairly sheltered' (Ballantine, 1961) shore.

8. Great Porth (Old Kelp Pit), Bryher (SV 874 144).

General description of shore

The shore studied was north-facing in a sheltered cove. The slope of the shore was about 45° in the supralittoral, extending over the main part of the littoral zone at about 10° and levelling to about 5° in the lower littoral. The substratum was of widely separated boulders with smaller rocks and stones scattered over the beach. Coarse sand and gravel were present between rock, becoming increasingly extensive towards the lower littoral. The large angular boulders and the smaller boulders and stones produced a very broken topography with habitats present including the tops of rocks, under rocks, under weed, on weed (epiphytes) and in sand. The various substrata present appeared fairly stable.

The supralittoral extended from about 9.0 m to 5.2 m above chart datum and included two main subzones: the upper one dominated by Ramalina sp. at +9.0 to +6.5 m, and the lower one by Verrucaria maura with orange lichens present, extending down to about +5.2 m. Approximately an 8 m length of shore was occupied by Pelvetia canaliculata at +5.7 to +4.3 m and included V. maura, Catenella caespitosa, Enteromorpha sp. and large numbers of Littorina saxatilis and L. nigrolineata. At about +4.3 to +4 m and over approximately 5 m of shore, Fucus spiralis was dominant and C. caespitosa, Monodonta lineata and Chthamalus montagui were also conspicuous.

The midlittoral from +3.8 to +2.1 m was dominated by Ascophyllum nodosum and Fucus vesiculosus, extending over about 20 m of shore. The epiphytic alga Polysiphonia lanosa was conspicuous on A. nodosum. The density of barnacles was low and a low density of large Patella vulgata was present. The seaweed canopy sheltered large numbers of gastropods: Littorina obtusata, Gibbula umbilicalis and Monodonta lineata. Species occurring under stones included cirratulid worms, spirorbinid worms and amphipods.

Two main subzones were conspicuous on the lower littoral. The upper area was dominated by Fucus serratus and the lower by Bifurcaria bifurcata with Himanthalia elongata towards the lowest shore. The F. serratus subzone extended from about +2.1 to +1.6 m and associated species included Audouinella sp., Gigartina stellata,

Ahnfeltia plicata, encrusting calcareous algae, the squat lobster Galathea squamifera, Gibbula cineraria, Asterina gibbosa and amphipods.

On the lower shore from +1.6 to +1 m where B. bifurcata formed a dense cover on rock, there was a wide variety of algal species including Audouinella sp(p)., Gelidium pusillum, Polyides rotundus, lithothamnia, Mesophyllum lichenoides and Colpomenia peregrina. This area extended over about a 5 m band of shore. From +1 m to low water level at +0.7 m, a similar community was present but with a richer algal component including H. elongata, Cystoseira nodicaulis and C. tamariscifolia. Several animal species were present amongst algae and under stones including polynoid and cirratulid worms, Rissoa sp., Sphaeromatidae and a variety of sponges.

The shore was closest to a 'Sheltered' or 'Very sheltered' (Ballantine, 1961) community.

9. Barrel of Butter, St. Agnes (SV 872 089).

General description of shore

The site surveyed was a north-facing, steeply sloping broken bedrock shore with some small rockpools and dominated by limpets and barnacles with sparse fucoids. Black lichens, Littorina neritoides and L. saxatilis extended to the top of the pinnacle at c. +9 m. Limpets and barnacles extended up to +7.5 m on the open shore with Patella vulgata in crevices to +8.0 m. The upper shore was characterised (apart from limpets and barnacles) by patches of Porphyra. The main area of littoral had very dense Chthamalus stellatus (little C. montagui) and widely scattered fucoids. Below +2.5 m, widely scattered clumps of Gigartina stellata and Himanthalia elongata were present. Alaria esculenta and Laminaria digitata were present below +2 m. A patch of Bifurcaria bifurcata was present on open rock to the north.

On the lowest part of the shore, vertical surfaces and overhanging rock were colonised by patches of sponges, Sagartia elegans in damp places, and patches of Umbonula littoralis.

The shore was considered 'Very exposed' (Ballantine, 1961).

10. South of Little Smith Brow, St. Agnes (SV 873 089).

General description of shore

(This shore was surveyed after failing to gain access to the offshore reef where rich communities with many Lusitanian algae had been reported).

This was a north-facing shore composed of very large (>2 m across) and large (>50 cm across) boulders with very few turnable boulders present to investigate underboulder fauna. Only the lower shore and midshore areas were studied.

Extensive areas of the lower shore boulders were covered by Laminaria digitata over a coating of encrusting calcareous algae, with a few limpets present. Chondrus crispus, Gigartina stellata and Corallina officinalis were common. Open shore communities included very few animal species but Gibbula cineraria were present amongst the boulders with some Sagartia elegans and Urticina felina (in sandy patches) between boulders. One Echinus esculentus was found. Overhanging surfaces of large boulders held patches of Crisiidae and Scrupocellaria sp., Sertularia sp. Didemnum sp., Umbonula littoralis, Corynactis viridis and several species of encrusting sponges.

Undersides of boulders were generally dominated by Spirorbinidae with patches of sponges (20 to 40% cover) and encrusting Bryozoa (<10% cover) and several solitary mobile species.

No attempt was made to assess the exposure grade of this shore.

11. Tins Walbert, St. Agnes (SV 872 087).

General description of shore

This was a rapid survey of extensive areas of lower shore and midshore areas made en route from Barrel of Butter back to the main island. On the steeply sloping west-facing broken bedrock to the north, lower shore communities were similar to those described at site 9 and no extensive overhanging surfaces or gully systems were found. Some pools were present dominated by Corallina officinalis with Bifurcaria bifurcata present.

The boulder shore was mainly of large boulders with a few rock outcrops and no turnable boulders which were not highly abraded were found. The boulders were generally barnacle/limpet-dominated with sparse clumps of fucoids. The lower shore areas were characterised by Corallina officinalis with clumps of Laurencia pinnatifida, Gigartina stellata, Himanthalia elongata, and with Alaria esculenta and Laminaria digitata on the lowest shore. Some Fucus serratus and Chondrus crispus were present in the lee of large boulders. Some Codium was present on open rock and in pools.

Overhangs were very similar to other exposed coasts with patches of erect Bryozoa and encrusting Bryozoa, encrusting sponges, groups of Corynactis sp. and Sagartia elegans, and single records of Tubularia indivisa and Calliostoma zizyphinum.

Many Gibbula cineraria were present under boulders and one Galathea sp. was found.

One extremely large boulder midshore was supported on other boulders to form an extensive downfacing surface with dense Balanus perforatus present.

Cobbles and mobile boulders were colonised by green and red algae.

The shore was considered nearest to an 'Exposed' (Ballantine, 1961) shore although local shelter by large boulders allowed some species characteristic if more sheltered conditions to survive.

12 and 13. Castle Vean/Little Castle Vean rockpools, St. Agnes (SV 877 077).

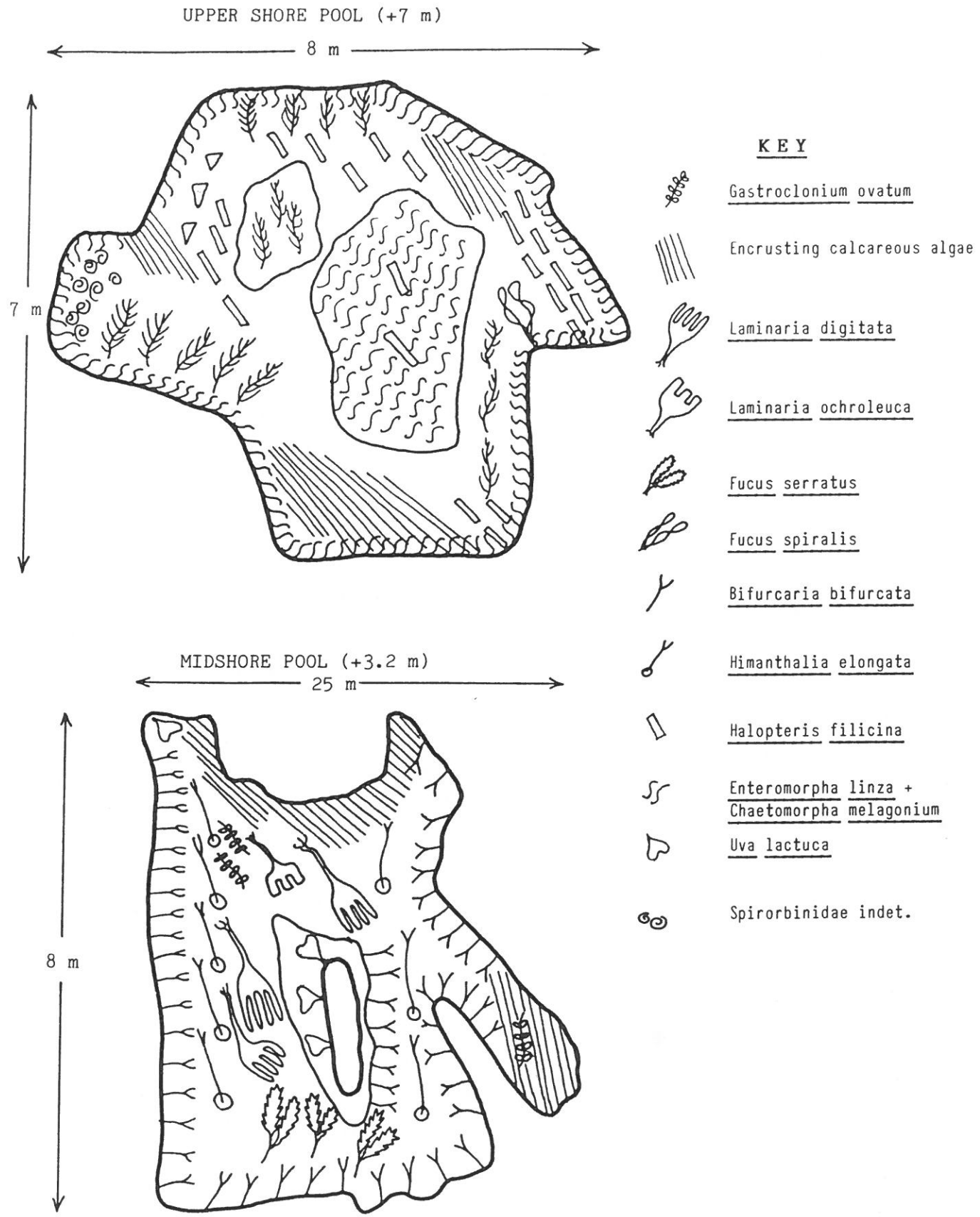
General description of shore

Two large rockpools were surveyed and detailed species lists obtained. The dimensions of each pool an distributions of large conspicuous species are shown in Appendix Fig. 1. The upper pool was at 7 m above chart datum and the midshore pool at 3.2 m above chart datum.

14. Castle Vean, St. Agnes (SV 877 077).

General description of shore

This shore faced south-west and was located between two large rocky outcrops, Castle Vean and Castle Brose. The supralittoral was a steep (45-90^{o}) backing cliff. The shore was principally granite bedrock, sloping mainly at about 5 to 10^{o} and extending over a length of about 65 m from the upper shore to low water.



Appendix Fig. 1. Plan view of rockpools at Castle Vean, St. Agnes.

Occasional large boulders and many small boulders covered much of the upper shore. Many large and smallrockpools were present on both upper shore and midshore areas. Distinctive habitats present included level bedrock, crevices, large and small rockpools and algae (particularly on the lower shore).

The following areas characterised by distinctive communities were observed:

1. Supralittoral bedrock divided into three subzones:
   a) Ramalina-dominated rock from the top of the cliff at c. +15 m to +6.5 m.
   b) Caloplaca marina-dominated rock at +6.5 to +5.5 m extending over a c. 4 m length of shore.
   c) Verrucaria maura-dominated rock at +5.5 to +5.0 m extending over a c. 3 m length of shore.
2. Upper shore areas from +5.0 to +3.7 m extending over a c. 10 m length of shore, characterised by Pelvetia canaliculata, Fucus spiralis and Porphyra sp. on large boulders and bedrock. Many small boulders scattered over the shore were covered in Enteromorpha sp. Littorina neritoides and L. neglecta were present in crevices. Chthamalus montagui and Patella vulgata were sparse on large boulders and bedrock.
3. Midshore areas from +3.7 m to +1.5 m and over a c. 45 m length of shore were separated into two main areas:
   a) An upper area characterised by sparse Fucus vesiculosus var. linearis and by patches of Lichina pygmaea. Much of the rock here was colonised by C. montagui, C. stellatus and P. vulgata, with Nucella lapillus and Actinia equina also conspicuous.
   b) A lower area characterised by patchy F. vesiculosus var. linearis with occasional Himanthalia elongata and Fucus serratus. Other algae which were present in large amounts included Laurencia pinnatifida, L. hybrida, Gelidium sp(p). and Ulva lactuca.
4. Lower shore areas below +1.5 m included two distinctive communities:
   a) An upper area at +1.5 to +0.7 m which extended over a c. 5 m length of shore and which was dominated by Gigartina stellata and H. elongata. Other conspicuous algae were lithothamnion and Saccorhiza polyschides. Animal species present included Patella aspera, P. vulgata, Gibbula cineraria, N. lapillus and Corynactis viridis (present in crevices).
   b) A lower area at +0.7 m to low water level at +0.4 m over about a 5 m length of shore characterised by dense Laminaria digitata and (most commonly) L. hyperborea. The rock below was covered by a thick crust of lithothamnion with G. stellata and H. elongata buttons present. There were several conspicuous lower shore animal species present including various sponges, C. viridis and didemnid tunicates.

The communities corresponded most closely to 'Semi-exposed' or 'Fairly sheltered' Ballantine (1961) shores.

15. English Island Point, St. Martin's (SV 938 152).

General description of shore

The area surveyed was a south - south-east facing, gradually sloping shore of broken bedrock extending onto sand at ELWST level. Some areas of small boulders and cobbles and some small pools were present. The shore was sheltered to the west by English Island Point.

Flowering plants and Ramalina sp. were present above +8 m, Caloplaca marina above +7 m and Lichina pygmaea was present at +7.5 to +7 m. A belt of dense patchy Pelvetia canaliculata with some Porphyra sp. was present on the upper shore followed by Fucus spiralis and F. vesiculosus on the upper midshore. Dense Ascophyllum nodosum was present midshore and dense Fucus serratus on the lower midshore. The rock below these dense large algae was bare granite with sparse large Patella vulgata present. The tops of blocks and rock pinnacles in the fucoid belt had few fucoids and were dominated by limpets and barnacles. The lower shore ledges were sandy and were dominated by Audouinella sp. with large amounts of Cladophora sp. and Himanthalia elongata, with some Mesophyllum lichenoides present. The heights on the shore at which some of the main species were first observed were:

Littorina neritoides	+7.3 m
Littorina saxatilis	+7.0 m
Chthamalus montagui	+6.1 m
Pelvetia canaliculata	+6.0 m (main belt +5.5. to +5.0 m)
Patella sp(p).	+5.3 m
Ascophyllum nodosum	+3.8 to +2.5 m (main belt +3.8 to +3.0 m)
Fucus serratus (dense)	+2.5 m
Audouinella sp.	+1.3 m

The shore was rich in species including some rare or unusual species, and the sandy rock on the lower shore provided communities only encountered at a few other sites. Few rockpool habitats were present and, although not extensive at the main survey site, underboulder communities were rich. More extensive areas of boulders were found nearby and these are described below.

The shore communities were closest to a 'Sheltered' (Ballantine, 1961) exposure.

Description of the lower shore around English Island Point

There were two main areas of high interest around the Point: the boulder shore of the east side of the Point and the sandy area with Zostera marina on the west side. The boulders were generally about 40 m across and many of them rested on stones or hard sand, enabling the development of a very rich underboulder fauna dominated by Bryozoa and Spirorbinidae but including a wide variety of encrusting sponges, polychaetes, molluscs, crustaceans and echinoderms. Boulders resting on and embedded in sand were of bare granite underneath.

The south side of the island included extensive sand areas at low water level with some rock or stones buried by the sand but attached foliose algae and Laminaria saccharina protruding through the sand. To the south-west of the island, sand extended seawards as a large spit with Zostera marina exposed at up to c. 30 cm above sea level (c. +0.6 m). Several species of algae were present including large amounts of Asparagopsis armata, scattered small numbers of Lanice conchilega, frequent Anemonia sulcata and widely scattered Arenicola casts.

16. South of Popplestone Corner, St. Martin's (SV 940 162).

Description of shore near Popplestone Corner

During reconnaissance, the steeply sloping bedrock shore on the south-western aspect of Popplestone Corner was viewed through binoculars and a brief description was made. Upper shore areas held patches of Lichina pygmaea, Pelvetia canaliculata and Porphyra sp. A 40% cover of fucoid algae was present over most of the shore which was otherwise limpet/barnacle-dominated to the lower shore where encrusting calcareous algae and Corallina officinalis were dominant with Gigartina stellata,

Himanthalia elongata and Bifurcaria bifurcata present. Laminaria digitata was present near to low water level. Upper shore rockpools appeared bare of large algae and with limpets on their sides. Midshore pools had patches of Corallina.

The shore was most likely 'Exposed' (Ballantine, 1961).

Description of boulder shore to the south of Popplestone Corner

This shore was of very large boulders with some smaller boulders between. Small boulders (<50 cm across) on the upper shore were dominated by filamentous green algae or were bare. Large numbers of Littorina saxatilis were present on the upper shore. The large boulders were colonised by small, widely scattered patches of Pelvetia canaliculata on the upper shore except that, in the lee of very large boulders some dense patches were present. A very few single sprigs of Ascophyllum nodosum were present under large boulders. Patches of Porphyra sp. were present at the level usually occupied by P. canaliculata. Most of the boulders had a c. 40% cover of Fucus, mostly F. spiralis, F. vesiculosus var. linearis in the appropriate zones, and a discontinuous cover of limpets and barnacles. Nucella lapillus and Actinia equina were frequent. On the lower midshore, the cover of F. vesiculosus var. linearis was about 90%. Lower shore boulders were dominated by Gigartina stellata, Chondrus crispus and Laurencia pinnatifida with scattered Himanthalia elongata and some Fucus serratus. Vertical slopes of boulders were colonised by a discontinuous cover of Chthamalus sp(p). and by large numbers of Patella sp. Laminaria digitata was present in the sub-littoral fringe.

Shaded vertical and overhanging rock surfaces on the lower shore were colonised by Scypha compressa, encrusting sponges, Spirorbis corallinae, Pomatoceros triqueter, Crisiidae and Umbonula littoralis.

This shore included a peculiar mixture of exposed and sheltered coast species but probably corresponded most closely to a 'Semi-exposed'(Ballantine, 1961) shore.

17. Pernagie, St. Martin's (SV 919 173).

General description of shore

The shore surveyed extended from the inlet between White Island and Pernagie Island southwards to the cliffs called Pernagie. The shore faced north - north-west and the littoral zone extended over about a 200 m length. The supralittoral was composed of large (c. 2 m diameter) boulders between which were small boulders and stones. The supralittoral sloped at about 10-15° from the low grassy cliffs behind. The upper littoral was a bedrock outcrop sloping ca. 25° to 40°. Lower and midlittoral areas sloped at ca. <50° and were of large (>50 cm diameter boulders. Many of these boulders held rich underboulder communities from the mid- to lower shore.

Seven main subzones distinguished by the communities present were recorded.

1. The supralittoral which was divided into:
   a) a belt of Ramalina sp. and grey lichens extending over about a 1 m length of shore above +6.5 m;
   b) a belt characterised by orange lichens extending over about a 10 m length of shore from +6.5 m to +6.0 m.
2. The upper littoral which was divided into:
   a) an area characterised by Pelvetia canaliculata with Verrucaria mucosa abundant and Lichina pygmaea rare, extending over about a 10 m length of shore from +5.0 to +5.0 m;

b) an area characterised by Fucus spiralis where V. maura was present in patches, a few large Patella vulgata and Chthamalus montagui were present, and Monodonta lineata was present in pools.

3. The midlittoral was divided into:
   a) an area of bedrock characterised by Fucus vesiculosus and Ascophyllum nodosum with dense Chthamalus stellatus and Patella vulgata extending over about a 20 m length of shore at +4.5 to +3.5 m. Some pools were present;
   b) an area characterised by Fucus vesiculosus and F. serratus with a wide range of other species on boulders extending over about a 50 m length of shore at +3.5 to +2.3 m. Several subsidiary communities were present including those in small rockpools, on the sides of boulders, under boulders and amongst algae.
4. The lower littoral was divided into:
   a) an area dominated by F. serratus extending over about a 40 m length of shore from +2.3 to +1.5 m. Chthamalus stellatus, C. montagui and Patella vulgata were still present, and conspicuous foliose algae were Plumaria elegans, Laurencia pinnatifida and Lomentaria articulata;
   b) an area of mixed F. serratus and Bifurcaria bifurcata with some Himanthalia elongata, Chondrus crispus and Gigartina stellata extending over about a 15 m length of shore from about +1.5 to +1.3 m. Rocks here were sandy and Audouinella sp. was present:
   c) an area characterised by H. elongata which extended over a c. 10 m length of shore at +1.3 to +0.5 m. Boulders were covered with sand and there was much sand between boulders. Other conspicuous species included Laminaria digitata, L. ochroleuca, L. saccharina, Saccorhiza polyschides, Audouinella sp., Gigartina stellata, Chondrus crispus, Asparagopsis armata and Mesophyllum lichenoides;
   d) an area dominated by laminariales with the species listed in c) above plus Laminaria hyperborea extending over about a 10 m length of shore at +0.5 to +0.3 m. The area was particularly rich in foliose red algae.

The shore communities corresponded very approximately to those of a 'Sheltered' (Ballantine, 1961) shore.

Additional notes on the shore north-west of Plum Island (SV 917 171).

A brief survey was made of the open shore north-west of Plum Island which was found to be similar to site 6 (Droppy Nose Point). The rockpools were similar to those present at site 13 (Castle Vean) but more extensive, and included a variety of different-sized pools at various levels.

18. St. Warna's Cove, St. Agnes (SV 879 079).

General description of shore

The shore was of generally gradually sloping bedrock with small ridges running parallel to the shoreline holding back rockpools at various heights. Some large boulders were scattered over the shore with small boulders and cobbles present in large numbers on the lower shore.

Lichens were abundant in the supralittoral, with Ramalina sp. particularly conspicuous on the vertical granite boulders below the grassland margin. The upper shore fucoid belts (Pelvetia canaliculata, Fucus spiralis and F. vesiculosus were fairly compressed but the F. serratus belt was extensive. On the lower shore

a wide belt of Bifurcaria bifurcata was present with Himanthalia elongata and Laminaria digitata on the lowest shore. A turf of Gigartina stellata, Laurencia pinnatifida and Chondrus crispus was particularly noticeable on the tops of small boulders and rock ridges.

The communities present suggested a 'Fairly Sheltered' or 'Sheltered' (Ballantine, 1961) shore.

19. Pernagie Point (rockpool) (SV 918 171).

General description of shore

The rockpool was at +3.5 m above chart datum, was roughly oval in shape and c. 30 m x 10 m in size. Depths in the pool ranged from 10 to 90 cm and the bed of the pool had a layer of coarse sand. There were many scattered boulders and stones in the pool with Fucus serratus dominant on the tops of stones and boulders just under the water surface. Coralline algae were dominant on the sides of boulders and stones: encrusting calcareous algae, Mesophyllum lichenoides and Corallina officinalis. Other species of algae present were Cladophora sp(p)., Polyides rotundatus, Furcellaria lumbricalis, Cystoclonium purpureum and Ahnfeltia plicata growing through coarse sand. In deeper water, the dominant algae were Laminaria digitata and Himanthalia elongata.

20. Darrity's Hole (Gap Point), St. Mary's (SV 932 113).

General description of shore

The area studied was a north-facing, stepped rock slope with some extensive platforms. Short vertical surfaces and generally broken rock were also present. Several shallow rockpools were present.

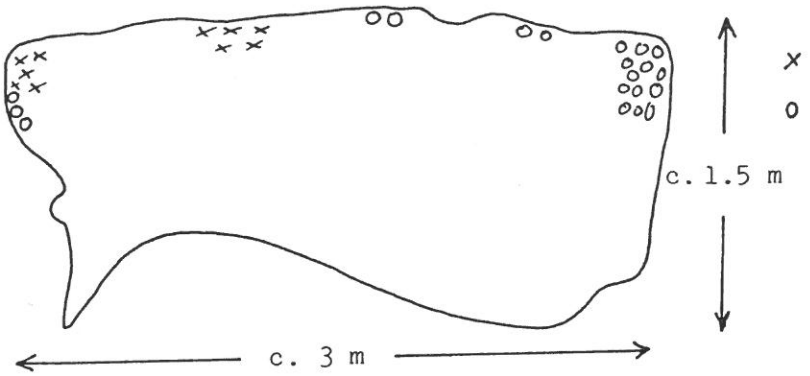
The supralittoral splash zone was dominated by Verrucaria extending up to +9.3 m with small patches of Lichina pygmaea present in the lower part of the belt. Patches of Pelvetia canaliculata were present at +5.5 to +6.0 m with the highest colony at +6.5 m. Recorded heights to which other species occurred were:

Littorina neritoides	+6.7 m
Littorina saxatilis	+6.3 m
Chthamalus montagui	+6.3 m
Patella vulgata	+5.7 m
Alaria esculenta and Laminaria digitata	+1.8 m (main belt +1.2 m)

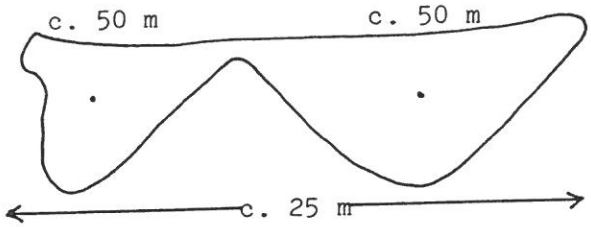
The majority of the shore was dominated by a limpet/barnacle community but with some dense fucoids present on parts of the rock platforms. The lower shore below about +2.0 m was dominated by lithothamnia with small patches of Corallina officinalis and a Gigartina/Chondrus/Laurencia community present. Alaria esculenta and Laminaria digitata were present in large amounts below +1.2 m.

The communities present suggested a 'Semi-exposed' (Ballantine, 1961) shore.

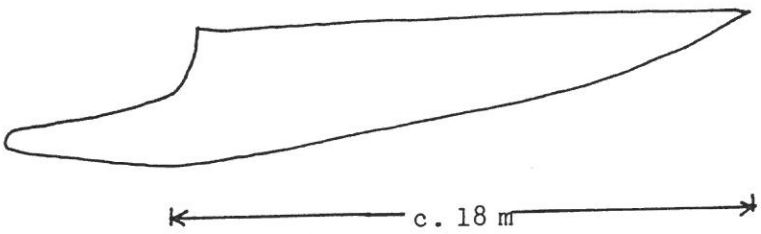
Description of rockpools



Pool 1 was c. 4 m above chart datum and a maximum of 15 cm deep. The pool was situated against a north-facing cliff and was shaded for most of the day. The bottom of the pool was dominated by a 'nodular' encrusting calcareous alga, with patches of Corallina officinalis, large numbers of Patella sp. and Actinia equina. A few foliose algae were atached to the limpets. Groups of Cereus pedunculatus and Corynactis viridis were present at the back of the pool nearest the cliff. Spirorbinidae were occasional and a few tiny spots of Hymeniacidon perleve were present with other encrusting sponges underneath the calcareous algae nodules.



Pool 2 was situated on open rock on the upper midshore and was up to 50 cm deep. The walls of the pool were dominated by nodular calcareous algae, with a c. 30% cover of C. officinalis and with other algae attached to limpets. Patella sp. were present in large numbers; A. equina was frequent and C. pedunculatus was present in the deeper parts of the pool. Small amounts of Spirorbinidae and Hymeniacidon perleve were present and the tentacles of Polydora sp. could be seen protruding form the lithothamnia. The most notable feature of the pool community was the presence of very large numbers of Pelta coronata.



Pool 3 was against a north-facing cliff on a lower midshore rock platform. The pool was notable for the large colonies of C. viridis, the pink Sagartia elegans and the presence of many more algae (and fewer limpets) compared to other pools. Other animal species noted in small amounts included Hymeniacidon perleve, Myxilla sp., Halichondria panicea and Actinia equina.

21. Porth Hellick, St. Mary's (SV 927 104).

Introduction

A rapid survey of four main areas of shore was carried out and an outline description of the communities present in each was made.

Open coast boulder beach on the north side of the bay

The area studied was large and very large boulders dominated on the upper shore by limpets and sparse barnacles. Extensive areas of midshore boulders had a c. 40% cover of fucoids extending down to the lower midshore with patches of Fucus serratus. Lower shore boulders were dominated by Audouinella sp. with Cladophora sp. and patches of the Gigartina stellata/Chondrus crispus/Laurencia pinnatifida community. Himanthalia elongata was present in places with Laminaria digitata and Saccorhiza polyschides present on the lowest shore. The open shore fauna was very sparse on the lower shore, with a few Gibbula cineraria and Scypha compressa present.

The very large boulders formed several 'cave' habitats where they were propped up by other boulders. Here, elements of a surge gully Dendrodoa grossularia/Clathrina coriacea community were present, though scattered amongst several separate underboulder areas. In addition to D. grossularia and C. coriacea, the species present included Pachymatisma johnstonia, Myxilla incrustans, Halichondria panicea, Actinothoe sphyrodeta and Didemnidae. The floors of the 'caves' were greatly scoured with several Urticina felina and some Corynactis viridis present.

A few boulders on the lower shore were turnable and there was a small variety of species present under the boulders dominated by Spirorbinidae with large numbers of G. cineraria.

Boulders on the seaward side of Porth Hellick lagoon

These boulders were of a remarkably similar size of 30 to 40 cm across and many were turnable. The underboulder fauna was similar to that described for the north shore although richer and included several echinoderms and one cup coral, Caryophyllia smithii. However, the range of species encountered was not as great as on some other shores studied.

Bed of outflow channel

The bed of the outflow channel, probably the nearest habitat to a tidal rapids in the Scilly Isles, was dominated by Corallina officinalis, Laminaria digitata, Himathalia elongata and with some Ulva sp. present. No animal or algal communities which had not been encountered elsewhere were observed. The underboulder community within the rapids was similar to that nearby though with more Ophiothrix fragilis, sponges and Verruca stroemia present.

Porth Hellick lagoon

The lagoon was fringed by boulders dominated by encrusting calcareous algae with much Mesophyllum lichenoides also present. C. officinalis and Laminaria saccharina were also present, particularly near to the outflow. Just under the water surface, Calliblepharis jubata was generally dominant on rocks. Most of the boulders were bedded in sand with a poorly-developed underfauna, though with large numbers of Gibbula cineraria around their lower edges.

The bottom of the lagoon was of granite granules in large waves with large numbers (up to 10/m^2) of Gibbula magus present but little else. Increasing numbers of Arenicola marina were present further west.

22. Near Samson Hill, Tresco (SV 882 153).

General description of shore

(Only an outline description of shore communities was made and, due to tape recorder failure, heights of the different communities are not generally available.)

The shore was composed of large boulders with many small boulders, stone and areas of coarse sand between. The supralittoral extended over a c. 10 m length of shore and was backed by a 2-3 m high cliff. The upper 5 m length of shore sloped at c. 30° and was colonised by Ramalina sp(p)., Xanthoria parietina and several unidentified grey lichens. The lower 5 m length of shore at c. 25° was colonised by orange and black lichens including Caloplaca marina, C. thallincola, Lichina confinis and Verrucaria maura.

The upper shore was colonised by Pelvetia canaliculata and V. maura with occasional patches of Enteromorpha sp. over a c. 7 m length of shore sloping at 5-10°. Littorina saxatilis and L. nigrolineata were present under stones. Upper midshore areas were colonised by Fucus spiralis with sparse V. maura and widely separated Ascophyllum nodosum and Catenella caespitosa over a c. 2 m length of shore sloping at 5-10°. Animal species present on the upper midshore included Patella vulgata, Littorina saxatilis (agg.) and Monodonta lineata.

There was a very extensive midshore to lower shore area dominated by A. nodosum with some Fucus vesiculosus present and F. serratus at its lower limit over about a 40 to 50 m length of shore at a slope of c. 5°. It was notable that Polysiphonia lanosa, the usual epiphyte of A. nodosum, was sparse but Ulva lactuca was commonly present. Species occurring on the boulders under the fucoids included Enteromorpha sp(p). and Porphyra sp(p). with lithothamnia and Palmaria palmata in crevices, sparse Patella vulgata, widely scattered barnacles and large numbers of Littorina obtusata and Amphipoda.

The midshore to loweer midshore communities graded into a lower shore community dominated by Fucus serratus and Bifurcaria bifurcata extending over about a 35 m length of shore at +1.8 to +1.3 m. Below this, the community was dominated by B. bifurcata with some F. serratus and Laminaria saccharina. The portion of shore covered by coarse sand and gravel increased near to low water level and boulders were colonised by Ulva lactuca, Codium sp., Dumontia incrassata, Chondrus crispus, Gigartina stellata, Lomentaria articulata, Audouinella sp. and Colpomenia peregrina. Animal species included Calliostoma zizyphinum, Carcinus maenas and, burrowing in the sand, Arenicola marina.

The communities present suggested a 'Sheltered' or 'Very sheltered' (Ballantine, 1961) shore.

23. Hangman Island, Tresco (SV 882 157).

General description of shore

This shore was a south - south-east facing bedrock outcrop with scattered large boulders and some smaller rocks and sand, particularly in the midshore region. Many rockpools and gullies were present midshore. The littoral communities extended over about a 100 m length of shore. The top of the rock outcrop included communities of grey lichens with some flowering plants. From c. +8 m to +5.9 m, an orange lichen belt consisting of a 2 m wide Xanthoria parietina belt and a 1 m wide Caloplaca marina/C. thallincola belt was present. A narrow band of Verrucaria maura occupying a c. 3 m length of shore form +5.9 to +5.6 m extended to a Pelvetia canaliculata/Fucus spiralis community occupying a c. 10 m length of

shore from +5.6 to +4.6 m. This area was also colonised by sparse Patella vulgata and Chthamalus montagui on rock surfacesand by Ulva sp. and Monodonta lineata in rockpools. Dendrodoa grossularia was frequent to common under large boulders.

The midshore area from +4.6 to +1.6 m extending over a c. 30 m length of shore was dominated by Ascophyllum nodosum with some very large and old plants present. The main algal species present were Audouinella sp(p)., Lomentaria articulata, Plumularia elegans, Cladostephus spongiosus and encrusting calcareous algae. The main animal species were Actinia equina, Bunodactis verrucosa, Spirorbinidae, Gibbula cineraria, Patella vulgata and Porcellana platycheles. Dendrodoa grossularia was common under large boulders.

The lower shore was of large (>3 m) boulders with a little sand present, sloping steeply over a length of shore of c. 5 m from +1.6 to +0.6 m. The boulders formed many secondary habitats including vertical surfaces, overhangs and heavily shaded rock. The shore was dominated by Himanthalia elongata with occasional Fucus serratus and other species including Laurencia pinnatifida, Gigartina stellata and, on sandy rocks, Audouinella sp(p). Animal species were very sparse but included the cup coral Caryophyllia smithii.

The shore below +0.6 m was submerged but Laminaria ochroleuca, L. hyperborea, L. digitata and L. saccharina could be seen.

The communities present suggested a 'Very sheltered' (Ballantine, 1961) shore.

24. Carn Near, Tresco (SV 891 133).

General description of shore

The area surveyed was a gentle slope of large and small boulders with some bedrock outcrops backed by heath. A few pools were present. The boulder shore merged into sand at low water level. Supralittoral boulders were colonised by Ramalina and Caloplaca with a powdery cover of black lichens. Patches of Pelvetia canaliculata were present on bedrock and boulders at +5.5 m. The majority of the shore had a patchy cover of fucoid algae with boulders and bedrock colonised by limpets and barnacles. Barnacles were generally sparse except on the tops of rocks. Ascophyllum nodosum and Fucus serratus were dominant (60% cover) over the midshore and down to 2 m above chart datum, below which F. serratus was dominant to the boulders on sand on the lower shore. There were large numbers of topshells and Littorina obtusata/L. mariae present. The boulders on sand were characterised by a mixture of F. serratus, Chondrus crispus, Gigartina stellata, Cladophora rupestris, Audouinella sp(p)., Bifurcaria bifurcata, some Himanthalia elongata and a little Laurencia pinnatifida and Gigartina ascicularis.

The upward limits of selected species were as follows:

Patella vulgata and Chthamalus montagui	+5.6 m
Monodonta lineata	+5.4 m
Nucella lapillus	+4.0 m

Many of the boulders over the shore were turnable and a fairly wide variety of underboulder species were present over most of the shore including large numbers of Eulimnogammarus obtusatus. However, on the lower shore boulders were bedded in sand and the underfauna poor.

The communities present suggested a 'Sheltered' (Ballantine, 1961) shore.

25. Bar Point, St. Mary's (SV 918 129).

General description of shore

This was a north-facing bedrock and boulder shore exposed to considerable wave fetch to the east but sheltered to the north and west by the proximity of other islands. The area surveyed extended approximately 75 m from the supralittoral to the lower littoral and was backed by sand dunes. The rock was sandy in places, especially in the flat areas of midshore, and many pools and crevices were present.

Six subzones were described (no grey lichen zone was present and sand dunes were present at the appropriate level):

1. Orange lichen subzone at +5.8 to +5.3 m above chart datum extending over about a 10 m length of shore.
2. An area of shore characterised by Pelvetia canaliculata and Fucus spiralis from +5.3 to +3.8 m, extending over about a 20 m length of shore. Many pools were present about 1 m wide and 20 cm deep, colonised by Scytosiphon lomentaria and Cladophora spp. Particularly common animals were Actinia equina and Littorina saxatilis.
3. An area of shore with sparse Ascophyllum nodosum and Lichina pygmaea present from +3.8 to +3.3 m, extending over about a 10 m length of shore. Many small pools were again present. Particularly common animals were Actinia equina, Monodonta lineata, Chthamalus montagui and many Littorina neritoides and L. neglecta.
4. An area of shore characterised by Ascophyllum nodosum extending over about a 10 m length of shore which was generally flat and sand-covered in places. Small boulders were present in the sandy areas, covered by Enteromorpha sp(p). with a few large limpets present. Rock without sand had a higher density of limpets and barnacles present. Other conspicuous species included small insects in crevices, Spirorbinidae on encrusting algae and fucoid algae, Gibbula umbilicalis, Nucella lapillus and Littorina obtusata.
5. An area of shore characterised by Fucus serratus from +2.3 to +1.0 m extending over about a 10 m length of shore where sand cover increased towards the lower shore. Red algae were also common in this area and included Audouinella sp(p)., Petrocelis sp(p)., Gigartina stellata, Laurencia pinnatifida and encrusting calcareous algae. Common animals were Patella vulgata and spirorbinid worms.
6. At the bottom of the shore was a Himanthalia elongata/Bifurcaria bifurcata subzone extending from +1.0 m to +0.7 m (low water) and probably a little further over a 4 m length o shore. A large variety of foliose red algae were present and the rock below the erect algae was generally dominated by Audouinella sp(p).

The shore was closest to a 'Sheltered' (Ballantine, 1961) shore.

26. Long Crow, Tresco (SV 890 134).

General description of shore

This site was west of Carn Near (24) and the survey was a brief one undertaken during a walk around Long Crow.

South Island

The shore here was similar to Carn Near with a gentle slope of boulders extending to boulders on sand on the lowest shore. A few pools were present on bedrock. Boulders were bedded in sand and the underfauna was therefore poor. Some pools with sandy bottoms were present. These were about 50 cm deep and a high variety of species was present.

West Point

Coarser sand and more pebbles were present on the lower shore here so that some boulders were resting on pebbles and had a fairly rich underfauna.

North Island

Extensive sandy areas were present on the lower shore with standing water, many pebbles and a few large boulders present. Some parts of old field walls and one square area of stones were present. Boulders were dominated by algae, particularly Fucus serratus, Chondrus crispus and Lomentaria orcadensis. Stones in standing water were colonised by Ulva sp., Laminaria saccharina, some Codium sp. and some Cystoseira sp. Vertical and overhanging surfaces held a fairly rich fauna.

The communities present on rock suggested a 'Sheltered' shore to the south and west and a 'Very sheltered' (Ballantine, 1961) shore to the north.

27. Crow Point, Tresco (SV 892 133).

General description of shore

A brief survey was made of this shore. The shore was of broken bedrock to mid-tide level with a lower shore of boulders/bedrock platform dominated by fucoids. The upper shore was dominated by Patella/barnacles. Little Pelvetia canaliculata was observed on the upper shore but there were large numbers of small Lichina pygmaea patches. Ascophyllum nodosum was present as sparse small plants. The lower shore was characterised by Fucus serratus, Laurencia pinnatifida, Lomentaria orcadensis, some Cladophora sp. and Codium on the lower shore with Himanthalia elongata. Some patches of coarse sand and pebbles were present on the lower shore. Laminaria saccharina was present below sea level. Additional species to those recorded on the lower shore at Carn Near were Calliblepharis jubata, Hypoglossum woodwardii, Furcellaria fastigiata, Colpomenia peregrina, Mesophyllum lichenoides and Palmaria palmata.

Some pools were present on the shore and one was quite large, 30 cm deep and held a good variety of algae similar to those present on the lower shore. Many Gibbula cineraria were present in the pool and Halichondria panicea was present. Stones at the edge of the pool held an underfauna including Asterina gibbosa, Botryllus schlosseri, Polyclinidae, Porcellana platycheles, Didemnidae, Spirorbinidae and one Anemonia sulcata.

The shore was most likely closest to a 'Fairly sheltered' or 'Sheltered' (Ballantine, 1961) shore.

28. East side of Innisidgen, St. Mary's (SV 924 127).

General description of shore

This shore was briefly surveyed. The shore was gently sloping and of bedrock and boulders, showing some unusual features which are emphasised in the description.

The upper shore had the appearance of a very exposed shore being characterised by many small patches of Lichina pygmaea and large patches of Porphyra sp. with little Pelvetia canaliculata present. Midshore regions were colonised by Fucus vesiculosus between boulders and in crevices whilst the tops of boulders and the more open bedrock were dominated by limpets and barnacles with little algal cover except by Laurencia pinnatifida. The lower shore was covered in Fucus serratus with Laminaria digitata common up to c. +2.0 m. Animals present under boulders on the lower shore were similar to those present at site 25 though with much larger numbers of Gibbula cineraria present and large numbers of Idotea sp. Lower shore areas had less sand than at Site 25 and therefore a richer underboulder fauna.

The communities present suggested a 'Semi-exposed' or 'Fairly sheltered' (Ballantine, 1961) shore.

29. Great Rag Ledge, near Samson (SV 884 135).

General description of shore

Only one area was searched here: boulders on granite sand at low water level. Boulders were >2 m to c. 25 cm in diameter and included a wide variety of species.

30. Plumb Island, Tresco (SV 886 148).

General description of shore

The shore of Plumb Island adjacent to the Bryher-Tresco channel was composed of a boulder slope with the largest boulders present at the top of the shore. Towards the lower shore, boulders became scattered and smaller, eventually merging into the area of sand and small stones adjacent to the channel and at the bottom of the Fucus serratus subzone.

There was an uppermost orange lichen zone with Ramalina sp., followed by a belt of Verrucaria maura, a dense band of Pelvetia canaliculata and a narrow overlapping band of Fucus spiralis and Catanella repens. The middle shore was dominated by Ascophyllum nodosum growing on medium-sized boulders and cobbles, and with Audouinella sp. present.

Below, on small boulders, there was a Fucus serratus subzone. On the lowest part of the shore, scattered small boulders were present with a few larger boulders on sand at the edge of the channel. These were colonised by F. serratus, encrusting calcareous algae and Audouinella sp. Bifurcaria bifurcata and filamentous brown algae were present on some unturnable boulders on granite sand.

The communities present suggested a 'Very sheltered' (Ballantine, 1961) shore.

31. Puffin Island, near Samson (SV 883 135).

General description of shore

The north-east facing shore was surveyed. This was a slope of boulders on bedrock leading to large boulders scattered in sand at the lowest level. The supralittoral lichen zone was dominated by Xanthoria parietina with less abundant Caloplaca marina and C. thallincola and Verrucaria maura also present. The algal subzones at the top of the shore were narrow and overlapping with Pelvetia canaliculata followed by Fucus spiralis, followed by mixed Fucus vesiculosus and Ascophyllum nodosum. The extensive A. nodosum zone extended towards the lower shore where Fucus serratus was present with the Ascophyllum followed by a F. serratus subzone on the scattered boulders on sand. The lowest shore was of Himanthalia elongata growing on boulders on sand with a wide variety of other algae present, particularly filamentous brown algae, Audouinella sp(p)., Chondrus crispus, Gigartina sp., Corallina officinalis, Laurencia pinnatifida, Bifurcaria bifurcata and some Cystoseira baccata and C. tamariscifolia.

The communities present suggested a 'Very sheltered' (Ballantine, 1961) shore.

JULY SURVEY

32. Bishop Rock (SV 807 064).

General description of shore

This shore was briefly surveyed when the tide was c. 2 m above chart datum. No measurement of heights were taken. The area of the lighthouse steps and to the west was described.

Shore communities were dominated by Chthamalus montagui in the splash zone, Chthamalus and Patella below and by dense Corallina officinalis from above mid-tide level to the lowest part of the shore surveyed. There were many algae present though only as low-lying patches. No fucoids were recorded. Upper and midshore Chthamalus had a coating of ?Ralfsia sp.* and Porphyra umbilicalis was present. Very large numbers of large Littorina neglecta were present on the upper shore together with ridged and unridged Littorina rudis. Littorina neritoides was searched for but not found. Mid and upper shore communities were characterised by the algae Gigartina stellata, Chondrus crispus, Ceramium rubrum, Gelidium pusillum, Callithamnion ?sepositum, with Enteromorpha sp. present on the tops of limpets. Large Mytilus edulis were common as scattered individuals and clumps. There were many Hyale perieri present amongst the algae and Parajassa pelagica and Idotea pelagica were present in large numbers in samples of algae. Some small pools on a rock platform contained Sagartia elegans and two Actinia equina were found in these pools. Towards the lower shore, communities were dominated by Corallina officinalis. Scattered Alaria esculenta were present. Patella aspera was common and C. montagui abundant with large numbers of L. neglecta present in the dead barnacles. Again, there were large numbers of M. edulis present (several per 0.01 m^2).

The communities present indicated an exposure to wave action greater than the 'Extremely exposed' grade of Ballantine(1961).

*Specimens have been identified as Ralfsia verrucosa by Dr. R. Fletcher.

33. Round Island (SV 901 178)

General description of areas surveyed

Upper splash zone (+9.0 m). This was of boulders. A fine filamentous brown 'felt' covered most of the rock. A few littorinid molluscs were present in sheltered places up to +10 m.

Lower splash zone (+7.0 to +8.0 m). This was of boulders. Barnacles were dominant, covered in extensive patches of brown encrusting algae. Patella vulgata was present (at this level only).

Upper shore +5.5 to 6.0 m). This was a vertical rock surface dominated by barnacles with Patella aspera common* and covered in Enteromorpha sp.

Upper midshore (+4.5 to +5.2 m). Rock surfaces were flat and open with some crevices. Fucus vesiculosus f. linearis was common, Corallina officinalis and barnacles were patchy, and some P. aspera were present. Mytilus edulis was present on bare flat surfaces.

Midshore (+3.0 to +3.5 m). The shore was of broken bedrock and crevices. C. officinalis was dominant with Callithamnion sp. common. Large patches of Chthamalus montagui and some Balanus perforatus were present.

Lower midshore (+2.0 to +2.5 m). Flat and broken rock surfaces including some vertical faces were present. C. officinalis was dominant with Alaria esculenta common. Small patches of C. montagui were present.

Lower shore (+1.0 m). Vertical and horizontal rock surfaces were present with small overhangs. C. officinalis was dominant with B. perforatus and P. aspera present.

The communities present suggested a 'Very exposed' or 'Extremely exposed' (Ballantine, 1961) shore.

34. Rosevear (West) (SV 838 059)

General description of areas surveyed

Rockpool at +9.5 m. Walls of the pool were covered by encrusting calcareous algae with Enteromorpha sp. and Corallina officinalis common. A few Patella aspera were present.

Upper shore (+9.0 to +11.0 m). Vertical rock, some slightly sheltered, was present. The rock was colonised by common Verrucaria maura and Porphyra sp. with frequent Enteromorpha sp. and large numbers of limpets and barnacles.

Lower upper shore (+8.0 to +9.0 m). Steep or vertical rock was present dominated by limpets and barnacles with Nemalion helminthoides and Verrucaria maura common.

Upper midshore (+4.8 to +8.0 m). Steep or vertical rock was present dominated by Chthamalus stellatus with abundant P. aspera and common Littorina neglecta. Porphyra sp. and encrusting brown algae were occasional with encrusting calcareous red algae common.

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*Terms of abundance used for sites 33 to 46 do not necessarily refer to the scale given in Appendix 2. There was some difficulty over the identification of species of Chthamalus at these sites and reference is therefore only usually made to 'Chthamalus' with no specific designation.

Midshore (+3.5 to +4.8 m). Steeply sloping, vertical and horizontal rock was present dominated by encrusting brown algae towards the top of the subzone and by C. officinalis towards the bottom, with a mixture of the two in the middle. Large numbers of C. stellatus and P. aspera were present.

Lower midshore (+1.7 to +3.5 m). Vertical and horizontal surfaces were present dominated by C. officinalis with Callithamnion sp. and encrusting brown algae common. A few barnacles, limpets and Littorina nigrolineata were present.

Lower shore (+0.8 m). Vertical and horizontal surfaces were present dominated by C. officinalis with Alaria esculenta and Bifurcaria bifurcata present. P. aspera was common and a few C. stellatus were present.

The communities present suggest an exposure to wave action greater than the 'Extremely exposed' grade of Ballantine (1961).

35. Rosevear (East) (SV 840 059)

General description of areas surveyed

Upper shore (+4.4 to +6.0 m). The boulders which formed the upper shore were clearly perching places for birds and the tops of boulders were devoid of lichens with accumulated bird lime present. Slightly further down the shore, Verrucaria maura was present on the tops of boulders but mostly in crevices along with large numbers of Littorina nigrolineata.

Upper midshore (+3.7 to +4.4 m). The rounded rocks present here included horizontal surfaces and crevices. Verrucaria maura was common and a few other species of algae were found in crevices. Barnacles were scattered and limpets were found only in sheltered areas.

Midshore (+2.5 to +3.7 m). This area was of broken rock with horizontal and vertical surfaces and crevices present. Rock was dominated by barnacles with common limpets and abundant L. nigrolineata. Fucus vesiculosus f. linearis and Enteromorpha sp. were frequent with some Lichina pygmaea present.

Lower midshore (+1.9 to +2.3 m). Horizontal and vertical surfaces and crevices were present. Barnacles were abundant and limpets common, with Fucus vesiculosus f. linearis the main species of alga present. Spongonemia sp. was present as an epiphyte.

Lower shore (+1.2 m). Broken rock was present dominated by Himanthalia elongata, Laminaria digitata and Saccorhiza polyschides with Ceramium rubrum common. Just above this station, Patella aspera and Chthamalus stellatus were common.

The communities present suggest an 'Exposed' (Ballantine, 1961) shore.

36. White Island (East) (SV 926 172)

General description of areas surveyed

Upper splash zone (+7.8 to +9.5 m). Rock surfaces were colonised by Caloplaca sp(p). and Xanthoria parietina with Ramalina siliquosa near the top of the area.

Lower splash zone (+7.2 to +7.8 m). Broken rock here was dominated by Verrucaria maura with Littorinidae at their upper limit in crevices.

Upper shore (+6.5 to +7.2 m). Broken rock surfaces with steep slopes were present. Rocks were dominated by Pelvetia canaliculata with patchy Chthamalus and some Littorinidae in pools.

Lower upper shore (+5.5 to +6.5 m). Broken rock surfaces and steep slopes were dominated by Fucus spiralis with abundant barnacles present. Large Patella vulgata were present on open rock surfaces and small ones under algae.

Upper midshore (+4.6 to +5.5 m). Steeply sloping rocks were present colonised by Fucus vesiculosus (recorded as F. vesiculosus f. linearis) with abundant barnacles and large limpets present.

Midshore (+3.0 to +4.6 m). Steeply sloping rock characterised by Fucus vesiculosus (f. linearis recorded) and barnacles present with small Patella aspera.

Lower midshore (+0.8 to +2.5 m). These were steeply sloping surfaces dominated by Himanthalia elongata and Gigartina stellata with some Corallina officinalis present.

Lower shore (below +0.8 m). These were steeply sloping rock surfaces dominated by Laminaria digitata and Saccorhiza polyschides with encrusting algae and Chondrus crispus present.

In addition to the open-shore areas surveyed, there were a number of gullies present running across the shore. The best-developed gully, to the south of the bay, receives wave surge from mid-tide level upwards. The bottom of the gully was noted as being free of brown algae with a high cover of barnacles and particularly common Actinia equina around a pool at the top of the gully. Nucella lapillus was particularly common around the gully entrance. A wide variety of red algae was present in the gully pool together with algal detritus.

The communities present on the shore suggested a 'Fairly sheltered' (Ballantine, 1961) shore.

37. White Island (West) (SV 921 177).

General description of areas surveyed

The shore was of bedrock with some extensive upward-facing surfaces present. Heights of the different communities were not recorded.

Upper shore. Horizontal and vertical surfaces were present dominated by Verrucaria maura and Pelvetia canaliculata and sparse barnacles. Enteromorpha sp(p). was noted in pools.

Upper midshore. Horizontal and vertical surfaces were present. Fucus spiralis and Porphyra sp. were characteristic with sparse barnacles present.

Midshore. Rock ridges with horizontal and vertical surfaces were present dominated by Fucus vesiculosus (recorded as F. vesiculosus f. linearis) and Chthamalus sp. dominant. Actinia equina was very common in crevices but absent elsewhere.

Upper lower shore. Rock surfaces were dominated by Chthamalus sp. with a wide variety of red foliose algae present. Spirorbinidae were particularly abundant on rock on the lowest part of the community.

Lower shore. Rock surfaces were dominated by Corallina officinalis and encrusting calcareous algae with Laminaria digitata, Saccorhiza polyschides and Alaria esculenta present.

The communities present suggested an 'Exposed' or 'Semi-exposed' (Ballantine, 1961) shore.

38. White Island (West) (boulder shore) (SV 921 976).

General description of areas surveyed

This shore was located further into the shelter of Porth Morran than the preceding site and was of large boulders from the midshore down. The shore was surveyed rapidly after the tide had started to rise and no levelling was undertaken.

Upper shore. Horizontal and vertical surfaces on bedrock were present. Pelvetia canaliculata was patchy with Chthamalus only abundant in crevices. Littorina rudis was present in crevices and extended to about 1 m above the Pelvetia belt.

Upper midshore. Horizontal and vertical surfaces were present on broken bedrock. Fucus spiralis and Chthamalus were dominant.

Midshore. Large boulders were present with Fucus vesiculosus present in shelter and F. vesiculosus f. linearis recorded as abundant in more exposed areas. Enteromorpha sp(p). was abundant with Chthamalus. Nucella lapillus were common, becoming abundant under boulders. Encrusting sponges were present under large boulders.

Lower midshore. The large boulders included extensive cover of Fucus serratus with Enteromorpha sp(p). common as an epiphyte. Gigartina stellata was abundant with Patella vulgata common and including some large individuals.

Lower shore. Large boulders dominated by Gigartina stellata with some limpets were present.

The communities present suggested a 'Fairly sheltered' (Ballantine, 1961) shore.

39. Maiden Bower (SV 849 145).

General description of areas surveyed

Splash zone. This was of bedrock colonised by Verrucaria maura and with littorinid molluscs present in crevices to the top of the shore at 14 to 15 m. Chthamalus was present to about +13 m.

Upper shore (+9.0 to +11.0 m). This was a large boulder face with some crevices dominated by Verrucaria maura with some bleached Porphyra sp. present. Chthamalus, Littorina rudis and L. neglecta were present in crevices.

Upper midshore (+7.0 t +9.0 m). Steep rock slopes with some deep crevices were present. The rock was dominated by Chthamalus with Porphyra sp. and Lichina pygmaea present. Mytilus edulis, Actinia equina, Corallina officinalis and encrusting calcareous algae were present in crevices.

Midshore (+5.3 to +7.0 m). This was of broken rock with steeply sloping surfaces and deep crevices. Chthamalus was dominant though many were dead and were encrusted with ?Ralfsia sp. Many limpets and some Fucus vesiculosus f. linearis were present. Deep crevices contained large mussels and Laurencia spp.

Lower midshore (+2.0 to +5.0 m). This was a steeply sloping surface dominated by Corallina officinalis with extensive patches of Chthamalus and many red and brown algae present.

Lower shore (+0.6 to +2.0 m). These steeply sloping surfaces were dominated by Corallina officinalis and Alaria esculenta with a wide variety of red algae present. Patella aspera was common and encrusted with calcareous red algae.

The communities present suggested an 'Extremely exposed' (Ballantine, 1961) shore.

40. Seal Rock (SV 855 140).

General description of areas surveyed

This site was a rock slope, broken on the upper shore, on the east side of Seal Rock.

Splash zone (+5.5 to +7.0 m). This part of the shore was of vertical and horizontal surfaces with crevices present dominated by Verrucaria maura with scattered limpets and barnacles present in crevices. Littorinidae extended to +10 m.

Upper shore (+4.0 to +5.5 m). Large broken rocks with crevices were present colonised by scattered Chthamalus and Porphyra sp.

Midshore (+2.1 to +4.0 m). This area was of broken fissured rock dominated by Chthamalus with a distinct belt of scattered Fucus vesiculosus f. linearis.

Lower midshore (+1.3 to +2.1 m). The horizontal creviced rock here was dominated by Chthamalus with Patella aspera. Enteromorpha sp(p) was common on the shells of limpets.

Lower shore (+0.7 to +1.3 m). Large boulders and flat surfaces were present dominated by Corallina officinalis with a variety of red algae, Himanthalia elongata and Alaria esculenta.

Sublittoral fringe (+0.7 m and below). The vertical and overhanging rock here was characterised by Laminaria digitata with Saccorhiza polyschides and Chondrus crispus present.

The communities present suggested a 'Very exposed' (Ballantine, 1961) shore.

41. The Brow (Hellweathers) (SV 864 075).

General description of areas surveyed

Splash zone (+8.3 to c. +13 m). This area was of broken bedrock with vertical surfaces and crevices present. Rock was dominated by Verrucaria maura with Littorina nigrolineata and L. neritoides present. Towards the top of the pinnacle, Xanthoria parietina was present with L. nigrolineata occurring to within 0.5 m of the top of the pinnacle.

Upper shore (+7.0 to +8.3 m). This area was of broken rock with vertical surfaces, gullies and crevices present. The rock was colonised by V. maura with common bleached Porphyra sp. and barnacles and limpets present in shelter.

Upper midshore (+5.5 to +7.0 m). Broken rock with crevices and gullies in this area were dominated by Chthamalus stellatus with Porphyra sp. present and, in the gullies, Nucella lapillus and Actinia equina were abundant.

Midshore (+3.3 to +5.5 m). Horizontal surfaces with deep gullies were present here dominated by barnacles with some Fucus vesiculosus f. linearis present (a higher density was recorded in shelter). The gullies were colonised by large numbers of the exposed-shore form of Nucella lapillus and by large numbers of Actinia equina with some Balanus perforatus present.

Lower midshore (+2.0 to +3.8 m). Horizontal and vertical surfaces with pools were present. Rocks were dominated by Chthamalus and Corallina officinalis with Patella aspera abundant, particularly at the bottom of the belt and often with Enteromorpha sp(p). on the shells. Actinia equina were particularly common and were present on exposed rocks.

Lower shore (+2.0 m and below). Horizontal and vertical surfaces at this level were dominated by C. officinalis, encrusting calcareous algae and other red algae with Laminaria digitata and Alaria esculenta abundant.

The communities present suggested an 'Extremely exposed' to 'Very exposed' (Ballantine, 1961) shore.

42. Tean Plat Point, St. Agnes (SV 887 075)

General description of areas surveyed

Splash zone (+9.0 to +12.0 m). This was the Caloplaca to Ramalina siliquosa zone.

Upper shore/splash zone (+6.0 to +8.5 m). This area of shore was dominated by Verrucaria maura with Pelvetia canaliculata confined to crevices except in locally sheltered areas. Enteromorpha sp. was present in pools together with Littorina nigrolineata. Littorinid molluscs extended to +8.0 m.

Lower upper shore (+5.5 to +6.0 m). This area was of broken rock ledges dominated by Chthamalus with Porphyra present.

Upper midshore (+3.6 to +5.5 m). Broken rock ledges with gullies, crevices and boulders were present. Rocks were dominated by Chthamalus with Fucus vesiculosus and Lichina pygmaea present.

Midshore (+1.5 to +3.6 m). This area was a broken boulder shore with horizontal and vertical surfaces present. The shore was dominated by Chthamalus with Fucus vesiculosus f. linearis present in places. Actinia equina and Balanus perforatus were present in crevices.

Lower midshore (+1.2 to +1.5 m). Rounded rock surfaces were present with small gullies and crevices dominated by Corallina officinalis with Patella aspera present.

Lower shore (+0.7 to +1.2 m). This was a vertical rock surface dominated by C. officinalis with many red algae and large amounts of Laminaria digitata and some Himanthalia elongata.

The communities present suggested an 'Exposed' (Ballantine, 1961) shore.

43. Menawethan (North) (SV 954 136).

General description of areas surveyed

Upper splash zone (+8.0 m and above). The shore here was of rounded rocks with crevices and was colonised by Caloplaca marina, Xanthoria parietina and Ramalina siliquosa with some short filamentous green algae present.

Splash zone (+6.5 to +8.0 m). Steeply sloping rock was present with some vertical surfaces dominated by Verrucaria maura with some Caloplaca marina and Littorina neritoides extending to the top of the belt.

Upper shore (+5.8 to +6.5 m). This was of broken rock colonised by Pelvetia canaliculata and Fucus spiralis.

Midshore (+3.5 to +5.8 m). This was of broken rock with pools and crevices dominated on the open shore by Chthamalus with Fucus vesiculosus, Patella vulgata and Nucella lapillus abundant and a wide variety of red algae present.

Lower midshore (+2.0 to +3.5 m). Rock surfaces here were irregular with pools and crevices dominated by Corallina officinalis and Chthamalus with Himanthalia elongata present.

Lower shore (+2.0 m and below). This was steeply sloping rock with abundant encrusting calcareous algae, Laminaria digitata, Alaria esculenta and Patella aspera present.

The communities present suggested a 'Semi-exposed' (Ballantine, 1961) shore.

44. Menawethan (South)(SV 955 137).

General description of areas surveyed

(Heights of the different survey areas were not recorded here.)

Splash zone. The rock here was dominated by lichens, Verrucaria maura, Caloplaca marina, Xanthoria parietina and Ramalina siliquosa.

Upper shore. This area was of steep rock surfaces with crevices. Chthamalus was dominant with Porphyra sp(p). present.

Upper midshore. The steep rock surfaces were dominated by Chthamalus with Lichina pygmaea and some Fucus vesiculosus* present.

Midshore. There were steep rock surfaces, gullies and crevices present. The shore was dominated by Chthamalus with Fucus vesiculosus* present. The gullies were colonised by, in particular, red algae, Actinia equina and Nucella lapillus.

Lower midshore. The rounded rocks present here were dominated by Chthamalus with Fucus vesiculosus* and Porphyra sp. present.

Lower shore. Steeply sloping rock surfaces here were colonised by Himanthalia elongata, Saccorhiza polyschides and Laminaria digitata.

The communities present suggested a 'Semi-exposed' (Ballantine, 1961) shore.

45. Hanjague (SV 958 151).

General description of areas surveyed

Descriptions of these east-facing vertical rock faces were briefly carried out from a small inflatable.

Upper shore. Verrucaria maura and Porphyra sp. were present.

Midshore. Chthamalus encrusted with ?Ralfsia sp. were present. Corallina officinalis and ?Bifurcaria bifurcata were occasional.

Lower midshore. This area was dominated by C. officinalis, encrusting calcareous algae and with foliose red algae present.

Lower shore. Rock was dominated by C. officinalis and encrusting calcareous algae with abundant Alaria esculenta and frequent to common foliose red algae. Patella aspera was abundant. Laminaria digitata was present just below the water surface.

The communities present suggested an 'Exposed' (Ballantine, 1961) shore although the biology of the shore was influenced by the vertical rock which led to the presence of communities of a more exposed-coast characteristic than would occur on a sloping shore.

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*recorded as F. vesiculosus f. linearis.

46. Shipman Head (SV 87 165).

General description of areas surveyed

A very brief survey of this north-west facing vertical rock surface was carried out when the tide was 1.6 m above chart datum.

The upper shore included a band of Verrucaria maura with Lichina pygmaea and Porphyra sp. leading down to a belt of widely scattered Fucus vesiculosus f. linearis.

Midshore areas were dominated by Chthamalus sp(p). with abundant Patella aspera, frequent Actinia equina and widely scattered Mytilus edulis (small) and Littorinidae. The lower-shore zone was dominated by lithothamnia with common Corallina officinalis, Alaria esculenta common to +2.2 m and frequent Balanus perforatus. Several foliose red algae were recorded on the lower shore including Pikea californica. No Laminaria digitata could be seen below sea level.

Near to this site, one area of vertical rock was inspected where a dense 'carpet-like' patch of seaweed was present at just above mid-tide level. This patch was of a mixture of Chondrus crispus and Gigartina stellata.

The communities present at this site suggested an 'Extremely exposed' (Ballantine, 1961) shore.

APPENDIX 7

Annotated list of taxa observed and sampled.

The nomenclature of the algae is according to Irvine (1983), Dixon and Irvine (1977) and Parke and Dixon (1976) with the exception of species marked with an asterisk, which are additions to the British flora since those publications.

The nomenclature of lichen taxa (recorded only in littoral surveys) is according to Dobson (1979).

The nomenclature of the animal taxa is according to the most recent publications on each of the main groups, or to the Plymouth Marine Fauna for groups with no recent revision of nomenclature.

References to exposure grades and abundance notations, where starting with a capital letter, refer to scales shown in the appendices or described in the text.

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ALGAE

(Nomenclature according to Parke and Dixon, 1976. * = not in Parke and Dixon, 1976.)

RHODOPHYTA

Audouinella sp.: (1,5, 8, 11, 15, 16, 18, 21, 22, 23, 24, 25, 26, 30, 31). Occasional to Abundant from lower shore to midshore stations at wave-sheltered sites with sand near to rocks. Up to Extremely abundant, forming a turf binding sand where rocks were adjacent to sand. Present in sandy pools.

Pterocladia capillacea: (21). Present in Porth Hellick lagoon in July.

Gelidium latifolium: (5, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 25, 31, 32, 43). Occasional or Frequent from the lower shore to midshore at sites Sheltered from very strong wave action. Also recorded from the upper shore at Bishop Rock (32). Present in pools.

Gelidium pusillum: (1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 22, 23, 24, 25, 26, 30, 31, 33, 34, 35, 36, 37, 38, 40, 41, 42, 43, 44). Occasional or Frequent from the lower shore to the midshore and sometimes higher. Rare or Absent on Super-exposed shores.

Nemalion helminthoides: (32, 34, 40, 41, 42, 43). Occasional or Frequent on the lower midshore and upper shore at wave-exposed sites.

Asparagopsis armata: (15, 21, 24, 26, 30, 31). Occasional or Frequent on the lower shore at sites Sheltered or Very sheltered from wave action. Usually in sandy areas and often amongst Zostera.

Asparagopsis armata (tetrasporangial - 'Falkenbergia' phase): (18, 21, 26). Rare or Occasional on the lower shore.

Bonnemaisonia hamifera: (15, 21). Present on the lower shore at English Island Point (15) and in the lagoon at Porth Hellick in July.

Bonnemaisonia hamifera (tetrasporangial - 'Trailliella' stage): (20). Occasional on the lower midshore.

Furcellaria fastigiata: (21). Present in the lagoon at Porth Hellick.

Furcellaria lumbricalis: (17, 19, 26, 27, 31). Occasional or Frequent on the lower shore on rocks adjacent to and sometimes partly covered in sand.

Polyides rotundus: (1, 15, 18, 21, 24, 25). Occasional or Frequent on the lower shore and lower midshore on rocks near to sand and in pools including the lagoon at Porth Hellick (21).

Catenella caespitosa: (1, 15, 16, 22, 24, 25, 30, 33, 37, 40, 41). Occasional or Frequent at stations from the midshore to the upper shore at a discontinous series of sites from Very exposed to Very sheltered shores.

Calliblepharis ciliata: (5). Occasional on the lower shore.

Calliblepharis jubata: (3, 13, 14, 15, 17, 18, 19, 21, 23, 25, 27, 30, 31). Occasional on the lower shore and in pools at sites sheltered from wave action.

Cystoclonium purpureum: (?1, 26, 30). Possibly this species Common in pools at Porth Cressa (1). Otherwise, Occasional on the lower shore and lower midshore.

Rhodophyllis divaricata: (21). Present in Porth Hellick lagoon in July.

Plocamium cartilagineum: (1, 4, 9, 15, 18, 20, 30, 33, 39, 41). Occasional or Frequent on the lower shore.

Gracilaria verrucosa: (1, 15, 21, 25, 26). Rare or Occasional, mainly recorded in pools but also on sandy rock on the lower shore. Present at wave-sheltered sites.

Ahnfeltia plicata: (8, 15, 17, 18, 19, 21, 22, 23, 24, 25, 30, 31). Occasional or Frequent at stations from the lower shore to midshore and in pools. Usually present in or near sand.

Gymnogongrus crenulatus: (5, 15, 16, 17, 20, 21, 24, 26, 30, 31). Occasional or Frequent on the lower shore and in pools at sites Sheltered from strong wave action.

Phyllophora crispa: (18). Rare.

?Phyllophora sicula: (5). Occasional on the lower shore.

?Phyllophora traillia: (5). Occasional on the lower midshore.

Chondrus crispus: (1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 30, 31, 32, 33, 34, 35, 36, 37, 39, 40, 42, 43). Occasional to Common from the lower shore to midshore and sometimes higher at almost all sites. Also present in pools.

Gigartina acicularis: (1, 2, 7, 8, 15, 21, 22, 23, 24, 25, 26, 30, 31). Occasional or Frequent on the lower shore at wave-sheltered sites.

Gigartina pistillata: (5). Occasional on the lower shore.

Gigartina stellata: (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 15, 16, 17, 19, 20, 21, 22, 23, 24, 25, 2, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 46). Occasional to Abundant from the lower shore to midshore and sometimes higher. Present in pools.

Petrocelis sp.: (1, 6, 8, 14, 17, 18, 22, 23, 25, 30). Occasional to Common at stations from the lower shore to midshore mainly at sites Sheltered from strong wave action.

Corallina officinalis: (1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21, 22, 23, 24, 25, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46). Occasional to Frequent on wave-sheltered shores to Abundant to Extremely abundant (dominant) at wave-exposed sites. Present from the lower shore to midshore to higher levels and at wave-exposed sites. Frequent to Common in pools.

Encrusting calcareous red algae ('lithothamnia'): (1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46). Common to Extremely abundant on the lower shore and lower midshore with a patchy cover on the midshore. Less abundant at wave-sheltered sites and overgrown by Corallina at wave-exposed sites. Present and often dominant in pools.

Mesophyllum lichenoides: (1, 3, 5, 6, 8, 14, 15, 17, 18, 19, 20, 21, 23, 24, 25, 31). Occasional to Common on the lower shore at Semi-exposed to Very sheltered sites. Present in rockpools.

Dumontia incrassata: (1, 3, 7, 8, 13, 14, 17, 21, 22, 25, 26, 30, 31). Occasional or Frequent on the lower shore and lower midshore at sheltered sites. Present on pebbles on sediment on the lower shore at Very sheltered sites. Present in rockpools at more exposed sites.

*Pikea californica: (33, 34, 36, 39, 41, 46). Occasional or Frequent on the lower shore at Super-exposed to Very exposed sites.

Callophyllis lacineata: (5, 14, 17, 19, 20, 22, 23, 25, 30, 31). Occasional or Frequent on the lower shore at Semi-exposed to Very sheltered sites. Recorded from the rockpool at +3.5 m at Site 19.

Hildenbrandia sp(p).: (1, 6, 7, 8, 18, 19, 21, 22, 25). Occasional to locally Common on the lower shore, in shaded places between boulders and in rockpools at Exposed to Sheltered sites.

Palmaria palmata: (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 15, 16, 17, 20, 21, 23, 25, 27, 30, 31, 33, 35, 36, 37, 38, 29, 40, 41, 42, 43, 44). Occasional to Common on rock on the lower shore and up to the midshore at some sites at Very exposed to Sheltered sites but rarely recorded at more and less exposed sites. Also recorded in rockpools and epiphytic on Laminaria hyperborea.

Chylocladia squamosa: (23). Occasional on the lower shore.

Chylocladia verticillata: (8, 15, 21, 22, 23, 24, 26, 30, 31). Rare or Occasional on the lower shore at Sheltered and Very sheltered sites. Present in the lagoon at Porth Hellick (21).

Gastroclonium ovatum: (1, 2, 3, 4, 5, 6, 9, 13, 14, 15, 16, 17, 18, 19, 20, 22, 23, 24, 25, 26, 30, 31, 33, 34, 35, 36, 37, 38, 39). Occasional to Common on the lower shore and sometimes the lower midshore at Super-exposed to Very sheltered sites.

Lomentaria articulata: (1, 2, 4, 5, 6, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 20, 21, 22, 23, 24, 25, 26, 30, 31, 33, 34, 36, 37, 38, 39, 41, 42, 43, 44, 46). Occasional to Frequent from the mid- to lower shore and recorded at almost all sites. Extending to the upper shore at sites Exposed to very strong wave action. Often recorded from pools.

Lomentaria clavellosa: (3, 6, 9, 15, 20, 26, 30, 31, 33, 37, 39, 40, 46). Rare or Occasional on the lower shore and lower midshore at Exposed to Sheltered sites. Often present in pools.

Callithamnion ?sepositum: (32). Collected from the upper shore.

Callithamnion ?tetricum: (14, 21, 31). Rare or Occasional.

Callithamnion sp.: (1, 4, 5, 6, 8, 9, 13, 14, 15, 17, 18, 22, 23, 24, 25, 30, 33, 34, 36, 37, 38, 39, 40, 41, 42, 43). Usually Occasional or Frequent and recorded at stations from the lower shore to the upper midshore but usually at only one station at each site. Most widespread over the shore at wave-exposed sites. Often recorded in pools.

Ceramium rubrum complex (including records of Ceramium sp.): (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 14, 15, 18, 20, 21, 22, 24, 25, 30, 31, 32, 33, 34, 35, 36, 37, 38, 40, 41, 42, 43, 44). Occasional or sometimes Frequent at lower shore to upper midshore stations though often with a discontinuous distribution over the shore. Recorded especially from crevices and pools, often on the upper shore. Sometimes epiphytic on brown algae. Recorded colonising pebbles in sediment at Very sheltered sites.

Ceramium shuttleworthianum: (2, 20, 46). Occasional in a pool at Site 2. Occasional or Common on the lower midshore at Site 20 and present on the lower shore at Site 46.

Griffithsia corallinoides: (23, 30, 31). Rare or Occasional on the lower shore at Very sheltered sites.

Griffithsia flosculosa: (3, 5, 8, 13, 15, 17, 18, 20, 22, 23, 25). Occasional or sometimes Frequent on the lower shore at Semi-exposed to Very sheltered sites.

Halurus equisetifolius: (2, 11, 14, 17, 20). Occasional on the lower shore and in a rockpool at Site 20.

Plumaria elegans: (1, 2, 5, 6, 10, 14, 15, 16, 17, 18, 19, 20, 21, 23, 25, 30, 31). Occasional or Frequent from the lower shore to midshore at Exposed to Very sheltered sites. Recorded as Abundant on the lower shore at Porth Cressa (1).

Spermothamnion sp.: (31). Rare.

Spondylothamnion multifidum: (36). Frequent in a midshore pool.

Acrosorium reptans: (11, 16, 20). Occasional on the lower shore.

Apoglossum ruscifolium: (3, 14, 15, 21). Occasional on the lower shore and in pools.

Cryptopleura ramosa: (1, 2, 5, 8, 9, 10, 13, 15, 17, 18, 20, 21, 22, 24, 25, 30, 31). Occasional or Frequent on the lower shore and sometimes lower midshore at Exposed to Very sheltered sites. Also recorded in pools and in the lagoon at Porth Hellick (21).

Hypoglossum woodwardii: (3, 10, 17, 20, 23, 27). Occasional on the lower shore at Sites 17, 23 and 27. Otherwise present in pools and the lagoon at Porth Hellick (21).

Membranoptera alata: (1, 2, 3, 4, 5, 10, 14, 15, 18, 20, 21, 23, 25, 31, 33). Rare or Occasional on the lower shore and sometimes higher. Often recorded in pools and as an epiphyte on brown algae.

Phycodrys rubens: (22). Rare on the lower shore.

?Dasya corymbifera: (9). Occasional on the lower midshore.

Heterosiphonia plumosa: (2, 5, 8, 10, 13, 14, 15, 17, 18, 21, 31). Rare or Occasional on the lower shore and in rockpools at Semi-exposed to Very sheltered sites.

Brongniartella byssoides: (13). Occasional in a rockpool.

Chondria dasyphylla: (22, 26). Rare and Occasional respectively on the lower shore.

Laurencia hybrida: (1, 2, 3, 5, 7, 8, 10, 12, 13, 14, 18, 19, 22, 25, 30, 31, 33, 36, 38, 39). Occasional or Frequent over a wide wave-exposure range but with a sporadic occurrence. Present at stations on the lower midshore and midshore with some records from the lower shore and in crevices from the upper midshore. Often present in pools.

Laurencia pinnatifida: (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 24, 25, 26, 30, 31, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44). Occasional to Common at most sites on the lower shore and lower midshore with many records also from the midshore. Sometimes present in crevices higher up. Often recorded in pools. Large plants on pebbles in sediment at Very sheltered sites.

Polysiphonia brodiaei: (3, 4, 9, 20, 30, 36, 40). Occasional or Frequent at stations on the lower shore to midshore mainly at Very exposed and Exposed sites. Present in pools.

Polysiphonia lanosa: (?1, 8, 14, 15, 17, 21, 22, 24, 25, 30, 31, 38). Occasional or Frequent on Ascophyllum nodosum and other fucoids usually at about midshore level.

Polysiphonia macrocarpa: (33). Occasional on the upper shore.

Polysiphonia nigrescens: (1, 2, 6, 11, 21, 22, 25, 26). Occasional or Frequent, usually noted as present in pools.

Polysiphonia urceolata: (2, 3, 4, 7, 9, 12, 14, 15, 18, 20, 24). Occasional or Frequent on the lower shore at sites Exposed to fairly strong wave action. Present in pools.

Polysiphonia sp(p).: (5, 8, 33, 35, 36, 41, 42, 43, 44). Occasional or Frequent in the lower shore and lower midshore (records mostly from the July survey when identification to species was not undertaken).

Pterosiphonia complanata: (4, 12, 15, 18, 34). Present on various parts of the shore at wave-exposed and sheltered sites. Recorded as Abundant in the rockpool at Site 12.

Pterosiphonia thuyoides: (24, 40). Occasional on the lower midshore and midshore.

Rhodomela sp.: (22). Rare on the lower shore.

Rhodophyta indet. (dark red encrusting): (9, 15, 16, 24, 26, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43). Occasional to Common from the lower shore to crevices on the upper shore, particularly at wave-exposed sites. Also present in pools.

Erythrotrichia boyana: (32). Large amounts attached to Corallina officinalis collected at Bishop Rock.

Porphyra purpurea: (1, 4, 6, 8, 9, 14, 15, 18, 22, 24, 25, 26, 31). (Almost all records in the March/April survey.) Occasional or Frequent, sometimes Common, at stations from the lower shore to upper shore but with a sporadic distribution. Present on wave-exposed and sheltered shores.

Porphyra umbilicalis: (4, 9, 32). (Records from the July survey are included under 'Porphyra sp(p).'.) Occasional or Frequent on the upper shore.

Porphyra sp(p).: (5, 14, 16, 30, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 44, 45, 46). Distribution as for P. purpurea.

BACILLARIOPHYCEAE

Bacillariophyceae indet.: (19). Frequent in a pool at +3.5 m.

PHAEOPHYTA

Ectocarpus agg.: (1, 2, 10, 20, 21, 24, 28). Occasional or Frequent on the lower shore. Present in Porth Hellick lagoon (21).

Spongonema tomentosum: (33, 35, 36, 37, 38, 40, 41, 42, 43, 44). Occasional to Frequent on the lower midshore and midshore and often noted as epiphytic on Fucus.

Ralfsia verrucosa: (32). Patches on the mid- to upper shore and splash zone over barnacles at Bishop Rock. (Identified from specimens collected at this site by R.L. Fletcher but probably widespread at wave-exposed sites.)

Elachista fucicola: (37, 38, 40, 41, 42, 43, 44). Occasional or Frequent on the lower shore and sometimes on the lower midshore and midshore.

Elachista scutulata: (1, 2, 4). Occasional. Recorded as epiphytic on Himanthalia elongata in a pool at Site 1.

Leathesia difformis: (21). Recorded in Porth Hellick lagoon in July.

Litosiphon agg.: (12). Occasional in a pool.

Colpomenia peregrina: (8, 12, 13, 15, 18, 19, 21, 22, 23, 26, 27, 30, 31). Occasional or Frrequent in rockpools and on the lower shore at Sheltered sites. Present in the Zostera bed at English Island Point (15).

?Petalonia sp.: (9, 34, 39, 42). Occasional on the lower shore and lower midshore at sites exposed to very strong wave action. Occasional in pools at Site 9.

Scytosiphon lomentaria: (2, 3, 5, 8, 9, 14, 16, 18, 20, 22, 24, 26, 30, 31, 33, 34, 36, 37, 40, 41, 42, 43, 44). Occasional or Frequent at stations from the lower shore to midshore and in rockpools and crevices at higher levels. On pebbles in sediments at Very sheltered sites. Recorded from the most exposed to the most sheltered sites.

Desmarestia aculeata: (14). Rare on the lower shore.

Laminaria digitata: (1, 2, 3, 6, 8, 9, 10, 11, 13, 14, 16, 17, 18, 19, 20, 21, 23, 30, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45). Occasional to Superabundant on the lower shore at all but the most exposed and the most sheltered sites. Present in rockpools including high on the shore and at +9.5 m at Site 34 (Rosevear West, a Super-exposed site).

Chorda filum: (21). Recorded in Porth Hellick lagoon in July.

Laminaria hyperborea: (1, 4, 6, 9, 10, 11, 14, 17, 21, 23). The L. hyperborea forest was only observed on the lowest tides near to chart datum level.

Laminaria ochroleuca: (6, 10, 13, 17, 18, 23). Present in the Laminaria hyperborea forest at Exposed to Very sheltered sites. Recorded from the rockpool at Site 13.

Laminaria saccharina: (1, 2, 3, 8, 15, 17, 18, 21, 23, 24, 26, 30, 31). Mostly recorded from rockpools. Rare to Frequent on the lower shore at Very sheltered sites often attached to pebbles in sediment. Abundant in the outflow channel at Porth Hellick (21).

Saccorhiza polyschides: (5, 6, 10, 14, 15, 18, 21, 35, 36,37, 40, 41, 44). Rare to Common on the lower shore at Exposed to Fairly sheltered sites.

Alaria esculenta: (3, 4, 9, 10, 11, 20, 33, 34, 37, 39, 41, 42, 43, 45, 46). Occasional to Common on the lower shore at sites Super-exposed to Semi-exposed to wave action. Extending to the lower midshore at very steeply sloping sites. Present in a pool at +9.5 m at Site 34.

Cladostephus spongiosus: (8, 17, 18, 22, 23, 31). Occasional or Frequent on the lower shore at Fairly sheltered to Very sheltered sites, often noted as near to sand.

Cladostephus verticillatus: (21). Recorded in the lagoon in July.

Asperococcus fistulosus: (36). Frequent in a midshore pool.

Asperococcus turneri: (21). Recorded in Porth Hellick lagoon in July.

Dictyota dichotoma: (8, 20, 31, 36). Present in pools.

Ascophyllum nodosum: (8, 15, 16, 17, 21, 22, 23, 24, 30, 31). Frequent to Superabundant on Sheltered and Very sheltered shores at about mid-tide level. Present only in the lagoon at Porth Hellick (21). Occasional stunted plants in the shelter of very large boulders on the upper shore at the Semi-exposed Site 16.

Fucus serratus: (1, 2, 3, 5, 6, 8, 10, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 26, 30, 31, 37, 38, 43). Occasional to Abundant on the lower shore to midshore at sites Semi-exposed to Very sheltered from wave action. Superabundant on gently sloping rock at some Sheltered and Very sheltered sites. Also present in rockpools.

Fucus spiralis: (1, 5, 8, 12, 14, 15, 16, 17, 18, 20, 22, 23, 24, 36, 37, 38, 43). Occasional to Superabundant on the upper midshore and upper shore at sites Semi-exposed to Very sheltered from wave action.

Fucus vesiculosus: (1, 2, 4, 6, 8, 9, 10, 14, 15, 16, 17, 18, 20, 21, 22, 24, 30, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 46). Frequent to Superabundant from the lower midshore to the upper shore. The bladderless form (f. linearis) occurs on Super-exposed to Semi-exposed shores and the form with bladders on Fairly sheltered to Very sheltered shores. May be absent on Super-exposed shores. f. linearis has short fronds and a short, erect, thick stipe on the most exposed shores, giving it the appearance of a stunted palm tree. On Exposed and Semi-exposed shores, large plants similar to the bladdered form which have long fronds and lie over the shore occur.

Pelvetia canaliculata: (1, 2, 4, 5, 6, 8, 14, 15, 16, 17, 18, 20, 22, 23, 24, 36, 37, 38, 42, 43, 44). Frequent to Common on the upper shore at Exposed to Very sheltered sites but only forming a distinct belt on Fairly to Very sheltered sites. May be present in local shelter at Very exposed sites.

Himanthalia elongata: (1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 14, 15, 17, 18, 19, 20, 21, 23, 24, 26, 31, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44). Frequent to Abundant on the lower shore and lower midshore on all but the most exposed shores. Present in pools.

Bifurcaria bifurcata: (1, 3, 4, 5, 7, 8, 9, 14, 15, 17, 18, 19, 21, 22, 23, 24, 26, 30, 31, 34, 36, 37, 45). Occasional to Superabundant on shores Super-exposed to Very sheltered but with a discontinuous distribution. Mostly recorded from wave-sheltered sites. Usually on rock platforms or gently sloping rock. Often dominant in pools.

Cystoseira myriophylloides: (3). Present in a lower-shore pool.

Cystoseira nodicaulis: (8, 15, 21, 26). Rare or Occasional on the lower shore at Sheltered or Very sheltered sites and in the lagoon at Porth Hellick (21).

Cystoseira tamariscifolia: (8, 13, 19, 26, 30, 31). Abundant and Frequent in pools at Sites 13 and 19 respectively. Occasional on the lower shore often attached to pebbles in sediments at Sites 8, 26, 30 and 31.

Phaeophyta indet. (brown encrusting): (1, 2, 3, 4, 5, 9, 10, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44). Records of this taxon appear incomplete. Records are of Occasional to Common crusts from the lower shore to the upper midshore. Records in the splash zone at exposed sites are most likely of Ralfsia verrucosa.

Phaeophyta indet. (brown filamentous): (3, 4, 5, 8, 9, 14, 15, 16, 19, 20, 21, 22, 23, 24, 26, 30, 31, 33, 34, 36, 37, 38, 40, 41, 42). Occasional or Frequent at widely different sites and from the lower shore to the upper shore. Often noted as epiphytic on brown algae. Present in several pools.

CHLOROPHYTA

Enteromorpha compressa: (10). Occasional on the lower shore and lower midshore.

Enteromorpha intestinalis: (3, 4, 5, 10, 21). Differentiated from 'Enteromorpha spp.' at these sites but probably widely distributed.

Enteromorpha prolifera: (5). Present in an upper-shore pool.

Enteromorpha spp.: (1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44). Occasional to Frequent on most shores at stations from the lower shore to the upper shore. Present mostly on limpets on wave-exposed shores. Often present in large amounts in pools including splash zone pools. Common on Abundant on some Sheltered and Very sheltered shores, often colonising stones on sediment.

Ulva spp.: (1, 2, 3, 4, 5, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 30, 31, 35, 36, 37, 39, 40). Occasional or Frequent at stations on the open shore mainly on the lower to midshore but sometimes higher. Often present in pools and Common on small pebbles in sediment at some sheltered locations.

Chaetomorpha linum: (2, 4, 8). Occasional to Common in pools and in a sheltered crevice on the lower shore at Site 4.

Chaetomorpha melagonium: (9, 12, 15). Occasional or Frequent in pools.

Chaetomorpha tortuosa: (2, 20, 22). Occasional in pools.

Chaetomorpha sp.: (11, 22). Frequent and Occasional on the lower midshore and lower shore respectively.

Cladophora spp.: (1, 2, 3, 4, 5, 7, 8, 9, 10, 14, 15, 16, 17, 18, 20, 21, 22, 23, 24, 25, 26, 31, 35, 36, 37, 38, 40, 41, 42, 43, 44). Occasional or Frequent, sometimes Common, from the lower shore to the midshore of Exposed to Very exposed shores. Present at higher levels usually in pools. Recorded in most pools described. Recorded as C. rupestris in Porth Hellick lagoon (21).

Bryopsis hypnoides: (20). Occasional in a pool.

Bryopsis plumosa: (9, 20). Occasional in pools.

Codium fragile: (7, 19, 30). Rare to Frequent. Noted as usually found on small pebbles on sediment at Site 30.

Codium vermilaria: (1, 7, 31). Occasional or Frequent.

Codium spp.: (2, 3, 5, 6, 8, 10, 11, 14, 15, 17, 19, 20, 21, 22, 24, 25, 26, 36, 40, 41). These records, to genus only, together with those identified to species above, record Occasional and sometimes Frequent occurrence at lower shore to midshore stations on the open shore and presence in pools at sites Sheltered from strong wave action.

Chlorophyta indet. (green filamentous): (1, 8). Frequent on the midshore at Porth Cressa (1). Common on the lower shore and in pools on the upper midshore at Great Porth (8).

LICHENS

(At many sites, particularly wave-exposed areas, rock did not extend to a sufficient height for populations of splash-zone lichens to develop. Thus, distributional data may be misleading particularly for species apparently not present at wave-exposed sites.)

Anaptychia fusca: (2, 5, 15). Frequent to Abundant in the splash zone.

Caloplaca marina: (1, 2, 5, 6, 8, 14, 15, 17, 20, 22, 24, 25, 31). Occasional to Extremely abundant on the upper shore and splash zone where suitable rock surfaces were present.

Caloplaca thallincola: (1, 6, 8, 22, 25, 31). Occasional to Common in the splash zone at sites Fairly sheltered to Very sheltered from wave action.

Caloplaca spp. (all records made of Caloplaca during the July survey were to genus only): (36, 42, 43, 44). Frequent to Common in the splash zone at sites sheltered from very strong wave action. Frequent to Common at +7.2 to +7.8 m and Abundant at +7.8 to +9.5 m (end of survey belt) at Site 36.

Lecanora sp(p).: (2, 5, 15, 24). Occasional to Common high in the splash zone at sites Sheltered from very strong wave action.

Lichenidae indet. ('grey lichens' - most likely Lecanora sp(p).): (1, 6, 8, 14, 17, 22, 25). Occasional to Superabundant in the splash zone of sites Sheltered from very strong wave action.

Lichina confinis: (1, 2, 5, 8, 15, 18, 20, 24). Occasional to Common on the upper shore and in the splash zone at sites Sheltered from very strong wave action.

Lichina pygmaea: (1, 2, 4, 5, 6, 8, 9, 14, 15, 16, 17, 18, 20, 22, 24, 25, 31, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44). Occasional or Frequent on the upper midshore and upper shore and in the splash zone at sites exposed to very strong wave action. Sometimes recorded at midshore level. Not recorded or only recorded in crevices at the most exposed sites and only small amounts present or not recorded at Sheltered and Very sheltered sites.

Ochrolechia parella: (2, 15, 18). Frequent or Common in the splash zone.

Ramalina sp(p).: (1, 2, 4, 5, 6, 8, 14, 15, 24, 36, 43, 44). Occasional to Superabundant high in the splash zone at sites Sheltered from very strong wave action. Recorded at +7.8 to +9.5 m (top of survey belt) at Site 36.

Verrucaria maura: (1, 2, 5, 8, 9, 14, 15, 16, 17, 18, 20, 22, 23, 24, 25, 30, 31, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45). Occasional to Superabundant from the upper midshore to the splash zone. Sometimes present in small amounts midshore. Restricted distribution and abundance at sites Exposed to very strong wave action were restricted to the upper shore and splash zone, and at sites Very sheltered from wave action were extending only to the upper shore.

Verrucaria mucosa: (1, 2, 4, 5, 6, 8, 16, 20,,23, 24, 25). Occasional to Frequent, sometimes Common, at midshore to upper-shore stations at sites Sheltered from strong wave action.

Xanthoria parietina: (1, 2, 5, 8, 11, 14, 15, 23, 24, 25, 31, 36, 43, 44). Occasional to Common mainly in the splash zone but also recorded from the upper shore. Present at sites Sheltered from strong wave action. Recorded as Occasional at +7.2 to +7.8 m and Common at +7.8 to +9.5 m (top of survey belt) at Site 36.

ANIMALS

PORIFERA: CALCAREA

Leucosolenia botryoides: (8, 17). Rare.

Clathrina coriacea: (6, 21). Present under very large boulders supported by other boulders to form caves at low-water level.

Scypha compressa: (3, 4, 6, 9, 15, 16, 21, 23, 25, 31). Present on the lower shore at Exposed and Sheltered sites usually under overhangs or in boulder caves.

Leuconia sp.: (1, 4, 8). Rare or Occasional on the lower shore.

PORIFERA: DEMOSPONGIARIA

Pachymatisma johnstonia: (21). Colonies present in the darkest areas of a cave formed by one very large boulder supported by other boulders.

?Terpios fugax: (26, 29). A blue sponge present in small amounts under boulders on the lower shore.

Dysidea fragilis: (1, 17, 23). Rare or Occasional under boulders.

Hymeniacidon perleve: (1, 2, 3, 4, 6, 8, 9, 11, 13, 14, 15, 17, 18, 20, 22, 23, 24, 25, 26, 29, 30, 31). Rare to Frequent on vertical and overhanging rock near to low water and in pools up to about midtide level. Usually present as very small colonies ('spots').

Haliclona sp.: (17, 19, 23). Recorded on the lower shore and in the midshore rockpool at Site 19.

Amphilectus fucorum: (1, ?10, 12, ?15). Occasional on the lower shore and lower midshore at Porth Cressa (1). Present in the rockpool at Little Castle Vean (12). Possibly this species under lower-shore boulders and overhangs at South of Smith Brow (10) and one patch on the midshore at English Island Point (15).

Myxilla incrustans: (6, 7, 14, 15, 17, 19). Rare to Frequent on the lower shore on vertical and overhanging surfaces, in boulder caves and under boulders.

Myxilla sp.: (1, 2, 5, 9, 10, 16, 20, 21, 24). Probably M. incrustans but species not recorded.

Microciona atrasanguinea: (1, 2, 4, 6, 10, 14, 17, 23, 24). Rare or Occasional on vertical or overhanging rock on the lower shore and in the boulder cave at Site 6. Present at Exposed and Very sheltered sites.

Ophlitaspongia seriata: (9, ?19). Occasional under overhangs and boulders on the lower shore.

Halichondria panicea: (2, 3, 4, 5, 6, 8, 9, 10, 11, 15, 16, 17, 18, 20, 21, 24, 27, 29, 30, 31). Occasional or Frequent on the lower shore and, in shaded or damp places, up to the midshore. Also present in pools, boulder caves and under boulders.

Porifera indet. (white encrusting): (1, 8, 13, 14, 17). Common under boulders at Site 1. Otherwise recorded as Rare or Frequent on the lower shore.

Porifera indet. (yellow encrusting): (1, 8, 10, 13, 14, 15, 17, 19, 22, 23, 24). Rare to Frequent on the lower shore and lower midshore; usually noted as present under boulders.

Porifera indet. (orange encrusting): (4, 5, 8, 14, 25, 33, 37, 38, 41, 42). Rare or Occasional on the lower shore and lower midshore under overhangs and boulders and in the midshore boulder cave at Site 4.

Porifera indet.: (6, 31). Under boulders on the lower shore.

COELENTERATA: HYDROZOA

Tubularia indivisa: (4, 5, 6, 9, 11, 33). Rare or Occasional under overhangs and in boulder caves on the lower shore at wave-exposed sites.

?Sarsia eximea: (4). Present in a lower-shore pool.

Eudendrium sp.: (4). Present in a lower-shore pool.

Clava sp.: (15). Small group in a midshore rockpool at English Island Point.

Obelia sp.: (25, 31, 40).

Laomedea flexuosa: (24). Frequent under stones and large boulders on the midshore and lower shore.

Lafoea sp.: (15). Small group in a pool.

Dynamena pumila: (1, 6, 15, 23, 24, 25, 26, 29, 30). Present on Fucus spp., Ascophyllum nodosum and sometimes on rock, including under boulders and the walls of boulder caves, on the lower shore to midshore. Rare or Occasional on 'Fairly sheltered' sites rising to Common on some 'Very sheltered' sites.

?Sertularia sp.: (10, 16). Present under overhangs.

COELENTERATA: SCYPHOZOA

Haliclystus auricula: (3, 18, 40). Rare. Attached to algae in pools.

COELENTERATA: ANTHOZOA

Actinia equina: (1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 14, 15, 16, 17, 18, 19, 20, 22, 23, 24, 25, 30, 31, 32, 33, 34, 35, 36,37, 38, 39, 40, 41, 42, 43, 44, 45, 46). Frequent to Common on most shores. Mainly occupying the lower midshore to upper midshore region. Recorded as Extremely abundant at North Tresco (4) and often noted as particularly abundant in crevices or boulder caves. Green and red forms recorded in the boulder cave at +3.5 m at North Tresco (4). Rare on type 1 (Super-exposed) shores and Occasional on type 9 (Very sheltered) shores.

Anemonia viridis: (1, 3, 5, 7, 8, 14, 15, 17, 18, 19, 21, 23, 24, 27). Occasional or Rare on the lower shore and lower midshore including under boulders at Fairly sheltered to Very sheltered sites. Extending to the upper midshore at Castle Vean (14). Present in rockpools at Sites 3, 7, 19 and 27 and in the outflow channel at Porth Hellick (21).

Urticina felina: (1, 3, 5, 6, 7, 9, 10, 14, 15, 16, 17, 18, 20, 21, 23, 24, 26). Rare or Occasional on the lower shore usually under boulders at wave-exposed sites with one record from a Sheltered site at Hangman Rock (23).

Bunodactis verrucosa: (7, 15, 18, 24, 25, 26). Rare or Occasional under boulders and stones on the lower shore to midshore at wave-sheltered sites. Present in pools at English Island Point (15).

Anthopleura ballii: (1, 15, 17, 25, 26, 29). Rare or Occasional amongst and under boulders on the lower midshore and lower shore.

Sagartia elegans: (1, 3, 4, 5, 6, 9, 10, 11, 20, 32, 40). Occasional on the lower shore and in pools at exposed sites. Present in rockpools up to midtide level at several sites and recorded under boulders at Site 5.

Cereus pedunculatus: (1, 3, 5, 6, 13, 20, 21, 29). Rare on the open lower shore. Many present in pools at Droppy Nose Point (6) and Darrity's Hole (20) and one observed in the lagoon at Porth Hellick (21).

Actinothoe sphyrodeta: (1, 5, 14, 17, 18, 21). Rare or Occasional under boulders, under ledges and in boulder caves on the lower shore and lower midshore.

Corynactis viridis: (4, 5, 6, 7, 10, 11, 14, 18, 20, 21, 23, 29). Present under overhangs and in boulder caves on the lower shore at sites exposed to fairly strong wave action (types 7 to 5 shores) but also recorded at Sheltered shores at Great Rag Ledge (29) and Hangman Rock (23) on the sides of boulders.

Caryophyllia smithii: (21, 23, 29). Rare or Occasional on the sides of boulders on the lower shore.

NEMATODA

Nematoda indet.: (6, 12). Collected in the boulder cave at Droppy Nose Point (6) and from under algae on the lower shore at Castle Vean (12).

NEMERTINI

Nemertini indet.: (18, 23). Rare on the midshore.

ANNELIDA: POLYCHAETA

Alentia gelatinosa: (26). Present under boulders at low water at Long Crow.

?Hermione hystrix: (7). Occasional or Rare in rockpool.

Lepidonotus squamatus: (26). Present under boulders at low water at Long Crow.

Lepidonotus clava: (1, 17). Rare under boulders.

Harmothoe extenuata: (15). Present under boulders on the lower shore at English Island Point.

Polynoidae indet.: (1, 7, 8, 17, 23, 25). Occasional or Frequent under boulders on the lower shore and lower midshore and in the rockpool at Stony Porth (7) at wave-sheltered sites.

Euphrosyne foliosa: (7). Collected.

Eulalia viridis: (1, 6, 9, 20, 30). Rare on the lower midshore and midshore particularly under boulders. Only eggs recorded at Site 30.

Odontosyllis sp.: (6). Collected.

Syllidae indet.: (1, 4, 6, 14). Collected from the lower shore at Site 1. Present in scrapings of barnacles etc. from walls of boulder cave at +3 m at North Tresco (4). Two species collected in the boulder cave at Droppy Nose Point (6). Collected from under boulders on the lower shore and amongst coralline algae at Castle Vean (14).

Leptonereis glauca: (4). Present in scrapings of barnacles etc. from walls of boulder cave at +3 m at North Tresco.

?Nereis pelagica: (17). Occasional on the lower shore, lower midshore and midshore.

Nereis sp. (juv.): (13, 14). Collected from the rockpool at +3.2 m and the lower shore at Castle Vean.

Perinereis cultifera: (14). Collected from under algae on the lower shore at Castle Vean.

Polydora sp.: (2, 5, 20). Present in encrusting calcareous algae on the lower shore and, at Site 20, in an upper midshore rockpool.

Cirriformia tentaculata: (8). Collected from Great Porth.

Cirratulidae indet.: (8, 15, 17, 22, 24, 26). Present in the sand below boulders on the lower shore to midshore at wave-sheltered sites.

Arenicola marina: (15, 21, 26). Collected from sediments under boulders at English Island Point (15). Casts present on sand at Sites 21 and 26.

Sabellaria spinulosa: (15). Present on rock below a boulder.

Amphitritides gracilis: (7, 8, ?18, ?30). Collected at Stony Porth (7) and Great Porth (8). Possibly this species on the lower shore at Sites 18 and 30.

Lanice conchilega: (23). Present in sand.

Terebellidae indet.: (7, 17, 29). Frequent amongst algae in the pool at Stony Porth (7). Present on the lower shore at Pernagie (17) and Great Rag Ledge (29).

Amphiglena mediterranea: (4, 6). Present in scrapings of barnacles etc. from walls of boulder cave at +3 m at North Tresco (4). Also present in samples from a boulder cave at Droppy Nose Point (6).

Fabricia sabella: (41). Collected from under algae on the lower shore at Castle Vean.

Oriopsis armandi: (6). Collected from the boulder cave at Droppy Nose Point.

Sabellidae indet. (4, 14, 17, 23). Occasional or Frequent on the lower shore amongst coralline algae and in boulder caves.

Pomatoceros triqueter: (1, 5, 9, 10, 15, 16, 19, 20, 21, 23, 24, 25, 29, 33). Rare or Occasional under boulders and under overhangs on the lower shore and lower midshore at Exposed and Sheltered sites.

Filograna implexa: (17). Rare under boulders at Pernagie.

Hydroides norvegica: (15, 23). Rare or Occasional under boulders on the lower shore.

Spirorbis spirorbis: (1, 5, 8, 15, 17, 18, 19, 22, 23, 24, 25, 29, 30, 31). Frequent on Fucus vesiculosus and F. serratus at Semi-exposed to Sheltered sites.

Spirorbis rupestris: (1, 4, 8, 20, 23, 24, 25, 26, 30, 31). Identified from these sites but probably more widely distributed. Present on rocks covered by encrusting calcareous red algae ('lithothamnia') on the lower shore and lower midshore and in pools mainly at wave-exposed sites.

?Spirorbis inornatus: (1, 2, 5, 8, 14, 15, 17, 20, 23, 24, 25, 26). Recorded in the field as 'Spirorbis on Gigartina/Chondrus' and most likely S. inornatus. Occasional or Frequent on the lower shore and lower midshore of Semi-exposed to Sheltered shores.

Spirorbis corallinae: (4, 6, 15, 16). Present on Corallina officinalis on the lower shore and in pools.

Spirorbinidae indet. (on rock): (1, 5, 8, 10, 14, 15, 17, 18, 22, 23, 24, 25, 26, 27, 42). Probably three species are included in this group: Spirorbis rupestris, S. tridentatus and Janua pagenstecheri. Records of Occasional to Common Spirorbinidae on rock were made from the lower shore to the upper midshore. Often recorded from stones and dominant under boulders at many sites. Also noted on Gibbula at Site 8.

OLIGOCHAETA

Oligochaeta indet.: (24, 33). Collected from under midshore and lower midshore boulders at Carn Near (24). Rare on the lower midshore at Round Island (33).

SIPUNCULOIDEA

Golfingia sp.: (8). Collected from under boulders on the lower shore at Great Porth.

CRUSTACEA: OSTRACODA

Ostracoda indet.: (13). Collected from the rockpool at +3.2 m at Castle Vean.

CRUSTACEA: CIRRIPEDIA

Chthamalus montagui: (1, 2, 4, 5, 6, 8, 9, 14, 15, 16, 17, 18, 20, 22, 23, 24, 25, 30, 31, 32, 33). Occasional to Common from the midshore to upper shore at sites exposed to and sheltered from wave action. Dominant over C. stellatus on the upper shore. Incompletely recorded during the July survey.

Chthamalus stellatus: (1, 2, 4, 5, 6, 8, 9, 14, 15, 16, 17, 18, 20, 22, 24, 25, 31, 33, 34, 35, 36, 37, 38, 29, 40, 41, 42, 43, 44, 46). Occasional to Abundant at a few sites, Superabundant or Extremely abundant from the lower midshore to the upper shore with the centre of the population at midshore level. Occasional on the lower shore at a few sites. Less abundant at sheltered sites.

Balanus perforatus: (1, 2, 4, 6, 9, 11, 14, 16, 20, 33, 35, 39, 42, 43, 44). Occasional or Frequent from the lower shore to upper midshore at type 5 ('Fairly sheltered') to type 0 ('Super-exposed') shores. Often present in large amounts in boulder caves.

Verruca stroemia: (4, 10, 17, 21). Present under boulders including on Balanus perforatus in the boulder cave at Site 4. Recorded at present in particularly large amounts in the outflow channel of Porth Hellick lagoon (21).

CRUSTACEA: MALACOSTRACA: TANAIDACEA

Tanaidae indet.: (6). Collected in the boulder cave at Droppy Nose Point.

CRUSTACEA: MALACOSTRACA: ISOPODA

Gnathia sp.: (1). Collected from +1.6 m amongst boulders.

Sphaeroma serratum: (24). Collected from under boulders on the upper midshore.

Cymodoce truncata (15). Under boulders on the lower shore.

Dynamene bidentata: (1, 13, 22, 29, 30, 31). Occasional to Abundant under boulders on the lower shore and lower midshore. Collected from the pool at +3.2 m at Castle Vean (13).

Campecopea hirsuta: (14). Collected on the upper shore at Castle Vean.

Idotea neglecta: (7, 15). Collected at Stony Porth (7) and from under boulders on the lower shore at English Island Point (15).

Idotea granulosa: (4). Collected from Corallina on the lower shore.

Idotea sp. (1, 3, 7, 8, 15, 24, 28, 32, 33, 36, 38, 42). Occasional or Rare on the lower midshore and midshore amongst algae.

Jaeropsis brevicornis: (14). Collected from under algae on the lower shore at Castle Vean.

Jaera sp.: (22). Collected at Samson Hill (several in samples).

Ligia oceanica: (20). Frequent on the upper shore.

CRUSTACEA: MALACOSTRACA: AMPHIPODA

Lysianassa ceratina: (14). Collected from under algae on the lower shore at Castle Vean.

Stenothoe monoculoides: (12, 13). Collected from the rockpools at +3.2 and +7 m at Castle Vean.

Apherusa jurinei: (12, 17). Collected from the rockpool at +7 m at Little Castle Vean (12) and on the lower shore at Pernagie (17).

Apherusa cirrus: (12). Collected from the rockpool at +7 m at Castle Vean.

Gammarella fucicola: (17). Collected on the lower shore at Pernagie.

Gammarellus angulosus: (32). One specimen amongst algae collected at Bishop Rock.

Maera grossimana: (17). Collected from the lower shore at Pernagie.

Chaetogammarus ?stoerensis: (1). Upper shore, Porth Cressa.

Elasmopus rapax: (14). Collected from under algae on the lower shore at Castle Vean (14).

Eulimnogammarus obtusatus: (1, 8, 15, 22, 24). Widely distributed under stones and boulders at wave-sheltered sites. Collected from under stones on the lower shore at Porth Cressa (1), English Island Point (15) and Samson Hill (22), under boulders on the upper midshore at Carn Near (24), and on he upper hsore at Porth Cressa (1). Also collected at Great Porth (8).

Iritaeta gibbosa: (1). Collected at low water at Porth Cressa (1).

Orchestia mediterranea: (8, 22). Collected from the upper shore at Great Porth (8) and from Samson Hill (22).

Hyale pontica: (3, 4). Collected from rockpools at Morning Point (3). Present in Corallina officinalis on the lower shore at Site. 4.

Hyale stebbingi: (13, 14). Collected in the rockpool at +3.2 m at Castle Vean (13). Possibly this species collected from the lower shore at Castle Vean (14).

Hyale perieri: (32). Several in samples of algae from Bishop Rock (32).

Hyale spp.: (9, 20). Large numbers were collected in scrapes of dead barnacles at Site 9 at +4.8 m. Frequent on Pelvetia at Site 20.

Amphithoe rubricata: (8). Collected from Great Porth.

Jassa falcata: (17). Collected on the lower shore at Pernagie.

Parajassa pelagica: (4, 32). Collected at wave-exposed sites from Corallina officinalis on the lower shore at North Tresco (4) and in samples of algae from Bishop Rock (32).

Amphipoda indet.: (1, 3, 4, 5, 6, 7, 8, 9, 12, 13, 15, 17, 18, 19, 22, 23, 24, 25, 31, 33, 34, 36, 38). These records include several which were later identified and are included above with notes on the habitats in which they were found.

CRUSTACEA: MALACOSTRACA: DECAPODA

?Palaemon serratus: (18). Frequent in large midshore pools. Recorded as 'prawns'.

Galathea squamifera: (1, 5, 7, 8, 10, 11, 14, 15, 17, 18, 23, 29). Rare to Frequent under boulders on the lower shore and lower midshore. Recorded as Common at Stony Porth (7).

Pisidia platycheles: (5, 7, 15, 17, 18, 19, 21, 22, 24, 25, 26, 27, 29, 30, 31). Occasional or Frequent under boulders including boulders in rockpools from the midshore to lower shore at wave-sheltered sites.

Porcellana longicornis: (8, 15, 17, 18, 19, 29). Rare or Occasional under boulders at wave-sheltered sites. 'Large numbers' were noted under boulders at English Island Point (15).

Pagurus bernhardus: (3, 10, 29). Two in rockpools at Morning Point (3), one under boulders at South of Smith Brow (10) and noted as Occasional on the lower shore at Site 29.

Anapagurus hyndmanni: (7, 23). Common under boulders on the lower shore at Stony Porth (7) and Occasional at Hangman Island (23).

Cancer pagurus: (1, 8, 10, 15, 17, 18, 19, 22, 25, 30). Rare to Frequent under boulders on the lower shore and in rockpools particularly at wave-sheltered sites.

Liocarcinus puber: (7, 8, 15, 17, 26). Rare. Under boulders on the lower shore.

Carcinus maenas: (1, 8, 15, 17, 18, 24, 25, 26, 29, 30, 31, 43). Rare to Frequent under stones and boulders at lower shore to upper shore stations at wave-sheltered sites. Adults present especially at 'Very sheltered' sites in the region of the Bryher-Tresco channel.

Xantho incisus: (1, 5, 7, 8, 17, 23). Rare or Occasional under boulders on the lower shore particularly at sites Sheltered from wave action.

Pilumnus hirtellus: (1, 18). Rare under boulders.

ARACHNIDA: ACARINA

Apletodon microcephalus: (18). Rare on the lower shore at St. Warna's Cove.

Diplogaster bimaculata: (18). Rare on the lower shore at St. Warna's Cove.

Mites: (24). Common on the lower midshore.

ARACHNIDA: PYCNOGONIDA

Nymphon gracile: (7). A few individuals under boulders on the lower shore.

INSECTA: APTERYGOTA

Anurida maritima: (20, 22, 23, 24, 33). Recorded under stones and boulders on the midshore and upper midshore. Recorded in densities of 1-4/0.01 m^2 at midshore, upper midshore and upper shore stations at Site 33.

MOLLUSCA: POLYPLACOPHORA

Polyplacophora indet.: (10, 15, 18, 21, 26). Present under boulders on the lower shore and, at Site 15, the upper midshore. At Porth Hellick (21), present outside of the lagoon.

MOLLUSCA: GASTROPODA: PROSOBRANCHIA

Patella aspera: (2, 4, 5, 6, 9, 10, 14, 15, 16, 20, 24, 32, 33, 34, 35, 36, 37, 39, 40, 41, 42, 43, 45, 46). Common to Superabundant from the lower shore to the midshore and, at wave-exposed sites, higher. Not recorded from wave-sheltered sites.

Patella vulgata: (1, 2, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 30, 31, 33, 36, 37, 38, 40). Generally distributed. Reaching large numbers over much of the shore at most sites but less abundant on Sheltered and Very sheltered shores and possibly absent from the most exposed shores.

Patina pellucida: (2, 6, 9, 17, 18, 23, 25, 33, 40, 41). Rare to Frequent on rock covered by encrusting calcareous algae on the lower shore.

Acmaea virginea: (4, 5, 9, 14, 17, 20). Frequent on rocks covered by encrusting calcareous algae at low water but only recorded from a few sites. Also present in a midshore pool at Site. 4.

Calliostoma zizyphinum: (2, 5, 6, 8, 11, 15, 17, 18, 19, 22, 23, 25, 26, 29, 30). Occasional or Frequent on the lower shore to midshore under boulders at 'Exposed' to 'Very sheltered' sites.

Monodonta lineata: (1, 3, 7, 8, 11, 15, 17, 18, 22, 23, 24, 25, 30, 31, 38). Occasional or Frequent from the midshore to the upper shore at wave-sheltered sites. Recorded as Abundant at Carn Near (24) and Bar Point (25) with young individuals present under boulders at Site 24.

Gibbula magus: (21). Up to 10/m^2 in the lagoon at Porth Hellick (21).

Gibbula cineraria: (1, 2, 3, 5, 6, 7, 8, 10, 11, 13, 14, 15, 17, 18, 19, 21, 22, 23, 24, 26, 27, 28, 29, 30, 31, 38, 40). Generally Frequent on the lower shore and lower midshore at Semi-exposed to Sheltered sites. Present higher up the shore in pools and under boulders. Often present in very high numbers under boulders.

Gibbula umbilicalis: (1, 5, 7, 8, 14 15, 17, 19, 22, 23, 24, 25, 39, 31, 38). Occasional to Common from the lower midshore to the upper midshore at wave-sheltered sites. Present on the lower shore at some sites. Abundant under midshore boulders at Site 15 and Carn Near. Common in a large upper-shore pool at Site 7.

Tricolia pullus: (14). Rare on the lower shore and lower midshore.

Lacuna sp.: (3). One in a rockpool.

Littorina nigrolineata: (1, 2, 5, 7, 8, 9, 14, 15, 17, 22, 24, 25, 30, 31, 33, 34, 35, 36, 37, 38, 40, 41, 42, 43, 44). Occasional or Frequent in crevices on the upper midshore and upper shore and sometimes in the splash zone mainly at wave-exposed sites though not recorded from the two most exposed sites. Common to Abundant at Sites 41 and 44.

Littorina rudis: (2, 22, 33, 34, 35, 36,37, 38, 39). This species was not generally separated from the L. 'saxatilis' aggregate during the March/April survey. Occasional or Frequent from the midshore to upper shore and sometimes extending into the splash zone. Often present in very large numbers in crevices.

Littorina 'saxatilis': (1, 4, 5, 6, 8, 9, 15, 16, 17, 20, 22, 23, 24, 25, 30, 31, 32, 33, 46). Occasional or Frequent on the upper midshore and upper shore with some records from the midshore and splash zone. Present in large numbers in crevices at a few sites. (See also L. rudis.)

Littorina littorea: (15). Frequent on the midshore.

Littorina mariae: (1, 5, 6, 15, 17, 19, 22, 24). Usually Rare or Occasional on the lower midshore and midshore amongst algae at wave-sheltered sites. Unusually low abundance on some shores with large numbers of fucoids. Recorded as Common to Abundant at Site 24.

Littorina obtusata: (1, 2, 3, 4, 5, 7, 8, 14, 15, 20, 22, 23, 24, 25). Occasional to Abundant from the lower midshore to the upper midshore at Sheltered sites amongst fucoid algae. Also present in rockpols. Juveniles only recorded at Site 4 and many juveniles recorded at Site 5.

Littorina 'littoralis' (refers to undifferentiated L. mariae and L. obtusata): (5, 18, 30, 31). Present amongst algae on the lower shore and lower midshore.

Littorina neglecta: (1, 2, 4, 5, 6, 8, 9, 14, 15, 17, 20, 23, 24, 25, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44). Occasional to Common from the lower midshore to the splash zone at exposed sites. Particularly large individuals recorded fro the Bishop Rock (Site 32).

Littorina neritoides: (1, 2, 3, 4, 5, 6, 8, 9, 14, 15, 17, 20, 23, 24, 25, 30, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44). Occasional to Common in crevices from the midshore to the splash zone at wave-exposed sites. Not recorded or very rarely recorded at the most wave-exposed sites.

Cingula semicostata: (8). Collected from sandy turf at low water from Great Porth.

Rissoa parva: (1, 13). Present on the lower midshore at Porth Cressa (1) and in the midshore pool at Castle Vean (13).

Rissoa sp.: (3, 8, 13, 14, 17). Present in the algal turf on the lower shore and in rockpools.

Barleeia ?rubra: (1). Collected from amongst large boulders and small pebbles from the midshore at Porth Cressa.

Rissoella diaphana: (13). Collected from the rockpool at +3.2 m at Castle Vean.

Rissoella opalina: (13). Collected from the rockpool at +3.2 m at Castle Vean.

Skeneopsis planorbis: (4, 8, 12, 13). Present in rockpools and from a sandy algal turf at Site 8.

Cerithidium sp.: (1). Collected from the lower shore.

Clathrus clathrus: (1). Collected from lower shore at Porth Cressa.

Trivia arctica: (14). Rare on the lower shore.

Trivia monacha: (14, 15, 17, 29). Rare under boulders on the lower shore.

Ocenebra erinacea: (23). Rare on the lower shore.

Nucella lapillus: (1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 14, 15, 16, 17, 18, 19, 20, 22, 23, 24, 25, 30, 31, 35, 36, 37, 38, 40, 41, 42, 43, 44). Widely distributed and generally Frequent from the lower midshore to upper midshore. Often aggregated in crevices. Less abundant at the most sheltered sites. Not recorded at the most exposed sites.

Nassarius reticulatus: (21). One observed in the sand in Porth Hellick lagoon.

Nassarius incrassatus: (1, 8, 14, 17, 23, 26, 30). Occasional on the lower shore and lower midshore. Usually under boulders.

Nassarius reticulatus: (30). Present on sand.

MOLLUSCA: GASTROPODA: OPISTHOBRANCHIA

Turbonilla ?elegantissima: (17). Collected from the lower shore at Pernagie.

Turbonilla sp.: (1, 17, 19). Present in pools.

Runcina coronata: (13, 20). Abundant in midshore rockpools.

Aplysia punctata: (8, 24). Single records on the lower midshore.

Berthella plumula: (29). Occasional on the lower shore.

Archidoris pseudoargus: (15). One under boulders on the lower shore.

Cadlina laevis: (17). Occasional on the lower shore.

Rostanga rubra: (15). One feeding on Tubicellepora magnicostata under a boulder.

Aeolidia papillosa: (15). One present under boulders on the lower shore.

MOLLUSCA: GASTROPODA: PULMONATA

Otina ovata: (9). One recorded at +4.8 m on barnacles.

MOLLUSCA: BIVALVIA

Modiolus modiolus (juv.): (15). Present under boulders.

Modiolus phaseolinus: (17). Collected from the lower shore at Pernagie.

Modiolus sp.: (1, 4, 15, 17). Occasional on the shore and under boulders.

Musculus sp.: (8). Collected from under boulders on the lower shore at Great Porth.

Mytilus edulis: (2, 3, 4, 5, 6, 9, 17, 20, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 44, 46). Occasional or Rare mostly at midshore and upper midshore stations at exposed sites. Common individuals and clumps near midshore at the most exposed sites. Not recorded from sheltered sites.

Chlamys distorta/varia: (19). Present under a boulder in the rockpool at +3.5 m.

Kellia suborbicularis: (1). Collected from lower shore at Porth Cressa.

Hiatella arctica: (1, 6, 14, 15). Single records from under boulders and under algae on the lower to midshore.

Lasaea rubra: (4, 9). One at 4 m at Site 4. Large numbers in scrapes of dead barnacles at 4.8 m at Site 9. Most likely present in large amounts at several sites but hidden.

BRYOZOA

Crisidia cornuta: (4). Collected from under overhangs at +1 m on North Tresco.

Crisiidae indet.: (4, 14, 20, 40). Rare or Occasional under overhangs on the lower shore at sites exposed to fairly strong wave action.

Electra pilosa: (1, 2, 4, 5, 15, 17, 20, 24, 29, 40). Present on Gigartina stellata.

Scrupocellaria reptans: (4, 10, 14). Present under overhangs and boulders on the lower shore.

Schizoporella unicornis: (14, 29). Collected on the lower shore.

Schizomavella linearis: (15). Collected from under boulders.

Cryptosula pallasiana: (4, 6). Encrusting over Balanus perforatus collected from cave at North Tresco at +3.2 m (4). Collected from the walls of the boulder cave at Droppy Nose Point (6).

Escharoides coccineus: (15). Present under boulders.

Cryptosula pallasiana: (6). On wall of the boulder cave at the head of the surge gully, Droppy Nose Point.

Umbonula littoralis: (2, 4, 9, 15, 16, 20, 23, 24, 29). On vertical or overhanging rock and under boulders on the lower shore.

Turbicellepora magnicostata: (identified from specimen at Site 15, probably this species recorded as Cellepora pumicosa at Sites 1, 5, 15, 16, 17, 19, 21, 25 and 26). Colonies of this large bulbous orange bryozoan were recorded from under boulders and often in large amounts on the lower shore. At Pernagie (17) it was Occasional to Common from the midshore down to the lower shore.

Bryozoa indet. (encrusting): (8, 10, 11, 15, 24, 33, 38). Present under boulders and overhangs from the lower shore to midshore on a wide range of shore types. Several of these records are identified above.

Celleporina hassalli: (4). Collected on Corallina officinalis at North Tresco.

Alcyonium spp.: (22, 23, 25). Rare or Occasional on the midshore, lower midshore and lower shore respectively at these wave-sheltered sites.

Flustrellidra hispida: (15, 24). Present on lower midshore and midshore fucoids at English Island Point (15) and Carn Near (24).

Antedon bifida: (7, 8, 17). Occasional or Rare under boulders.

Asterina gibbosa: (1, 7, 8, 17, 18, 19, 21, 22, 26,27, 30). Rare to Frequent under boulders on the lower shore and lower midshore and under boulders in pools higher on the shore.

Asterias rubens: (15, 21). One under a boulder on the lower shore (15) and present under boulders at the seaward side of the bar at Porth Hellick (21).

Luidea ciliaris: (15, 17, 18). Single records from the lower shore.

Marthasterias glacialis: (1, 17, 21). Single records from the lower shore and from under midshore boulders on the bar across the entrance to Porth Hellick (21).

Ophiothrix fragilis: (1, 4, 7, 15, 17, 18, 19, 21, 23). Occasional small individuals under boulders and in the Corallina turf of rockpools. Some large individuals under boulders in the outflow channel at Porth Hellick (21).

Amphipholis squamata: (1, 13, 14, 17, 19, 25). Present under boulders at Site 1. Present in midshore rockpools at Sites 13 and 19 and collected from under algae on the lower shore at Site 14.

Echinus esculentus: (1, 10, 14, 18, 21). Single urchins observed on the lower shore amongst boulders.

Psammechinus miliaris: (15, 17, 19). Rare under boulders on the lower shore.

Holothuria forskali: (18). One on the lower shore.

Aplidium glabrum: (25). Collected at Bar Point.

Aplidium pallidum: (25). Collected at Bar Point.

Morchellium argus: (15, 29). Present on the sides of boulders.

Aplidium ?proliferum: (15, 24, 26, 29). Present on the sides of boulders on the lower shore at Sheltered and Very sheltered sites.

Polyclinidae indet.: (5, 8, 14, 15, 17, 18, 19, 24, 26, 27, 29, 30, 31). Including some of the species identified above. Occasional on overhanging rock, the sides of boulders and under boulders particularly at wave-sheltered sites.

Sidnyum turbinatum: (1, 15). Collected from under bolders on the lower shore.

Didemnidae indet.: (1, 5, 6, 9, 10, 14, 15, 17, 18, 19, 20, 21, 23, 25, 26, 27, 29). Occasional or Rare on vertical and overhanging rock, boulder caves and under boulders at Very exposed to Very sheltered sites. Recorded from the lower shore or lower midshore but extending to the upper midshore at Pernagie (17).

Diplosoma listerianum: (2, 9). Small patches present on the lowest shore at Dutchman's Carn (2) and Barrel of Butter (9).

Dendrodoa grossularia: (1, 4, 5, 6, 8, 21, 22, 23, 25, 30, 31). Dominant on the walls of boulder caves at North Tresco (4), Droppy Nose Point (6) and Porth Hellick (21) at wave-exposed sites. Also in the surge gully at Site 6. Also Occasional or Frequent on and under large boulders on the lower shore at sites Very sheltered from wave action in the region of the Bryher-Tresco channel (22, 23, 30, 31) and in the sheltered bay of Great Porth (8). Present under overhangs (4, 5).

Botrylloides leachii: (21). Present under boulders in Porth Hellick Bay.

Botryllus schlosseri: (1, 10, 14, 15, 17, 18, 19, 21, 24, 27, 31). Rare or Occasional under boulders from the lower shore to midshore and under boulders in rockpools from Semi-exposed to Very sheltered shores.

Nerophis lumbriciformis: (17, 18, 30). Single records on the lower shore at Sites 17 and 30. Recorded as Occasional at Site 18. With eggs at Site 30.

Nerophis ophidon: (3). One in a rockpool.

Crenilabrus melops: (18, 30). Single fish on the lower shore at St. Warna's Cove (18) and Plumb Island (30).

Gobiidae indet.: (17). Occasional in midshore pool.

Pholis gunnellus: (18, 30). Rare at St. Warna's Cove (18), Occasional at Plumb Island (30).

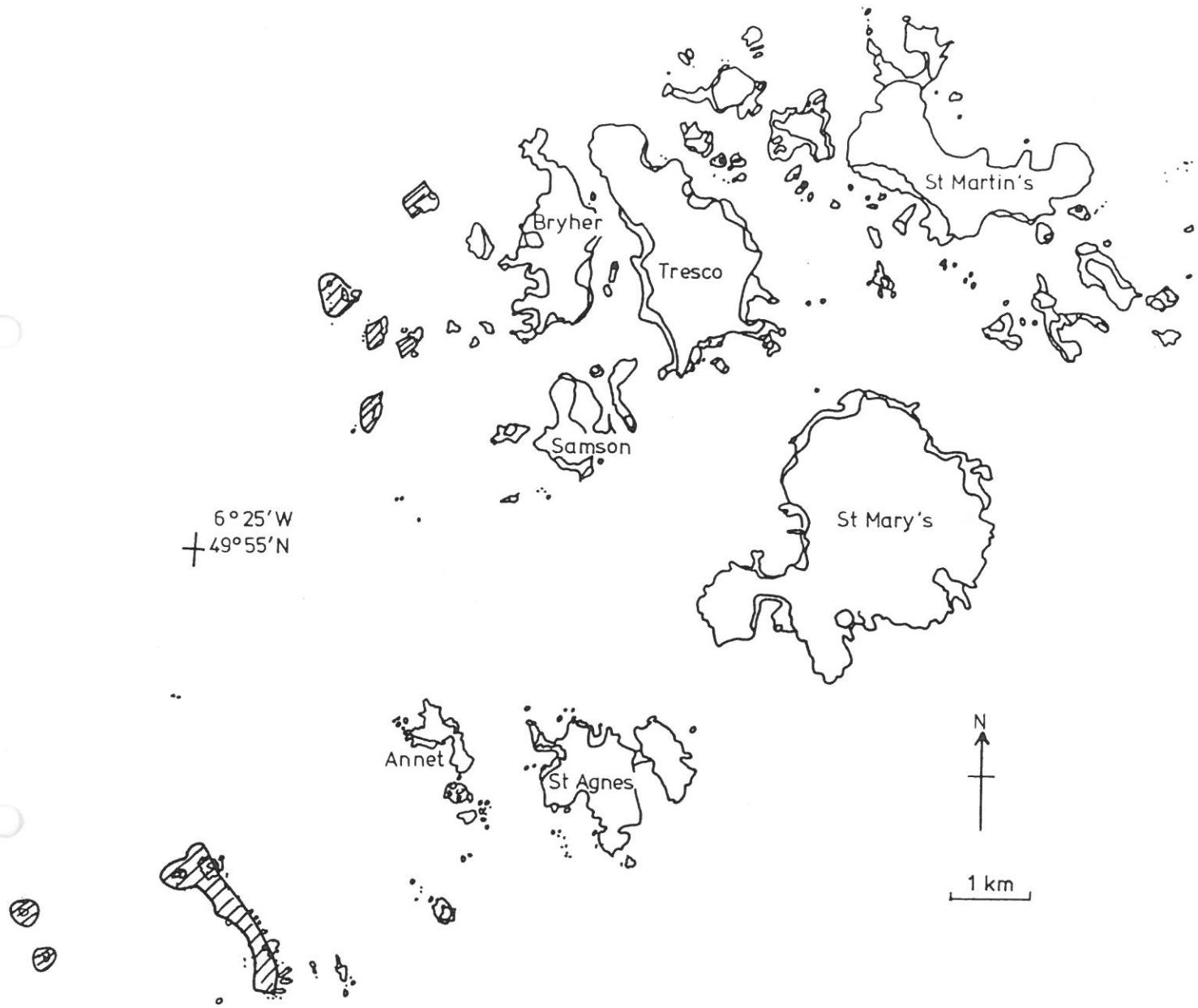
Lepadogaster lepadogaster: (17, 18). One on the lower midshore at Pernagie (17) and recorded as Occasional at Site 18.

Gobiusculus flavescens (two-spot goby): (14). One.

Taurulus bubalis: (30). Present on the lower shore.

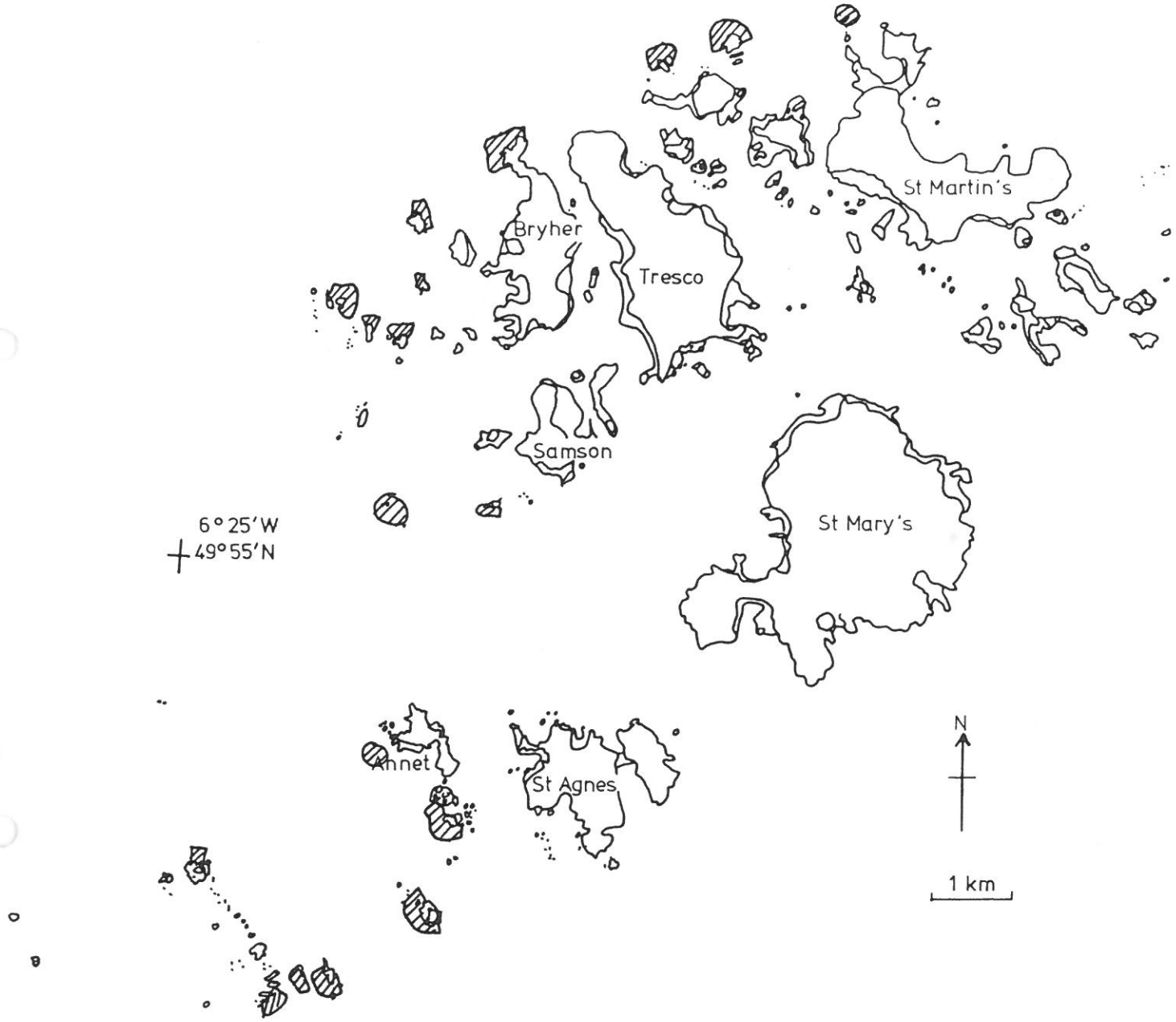
Appendix 8.1

Distribution of shore type 1a.



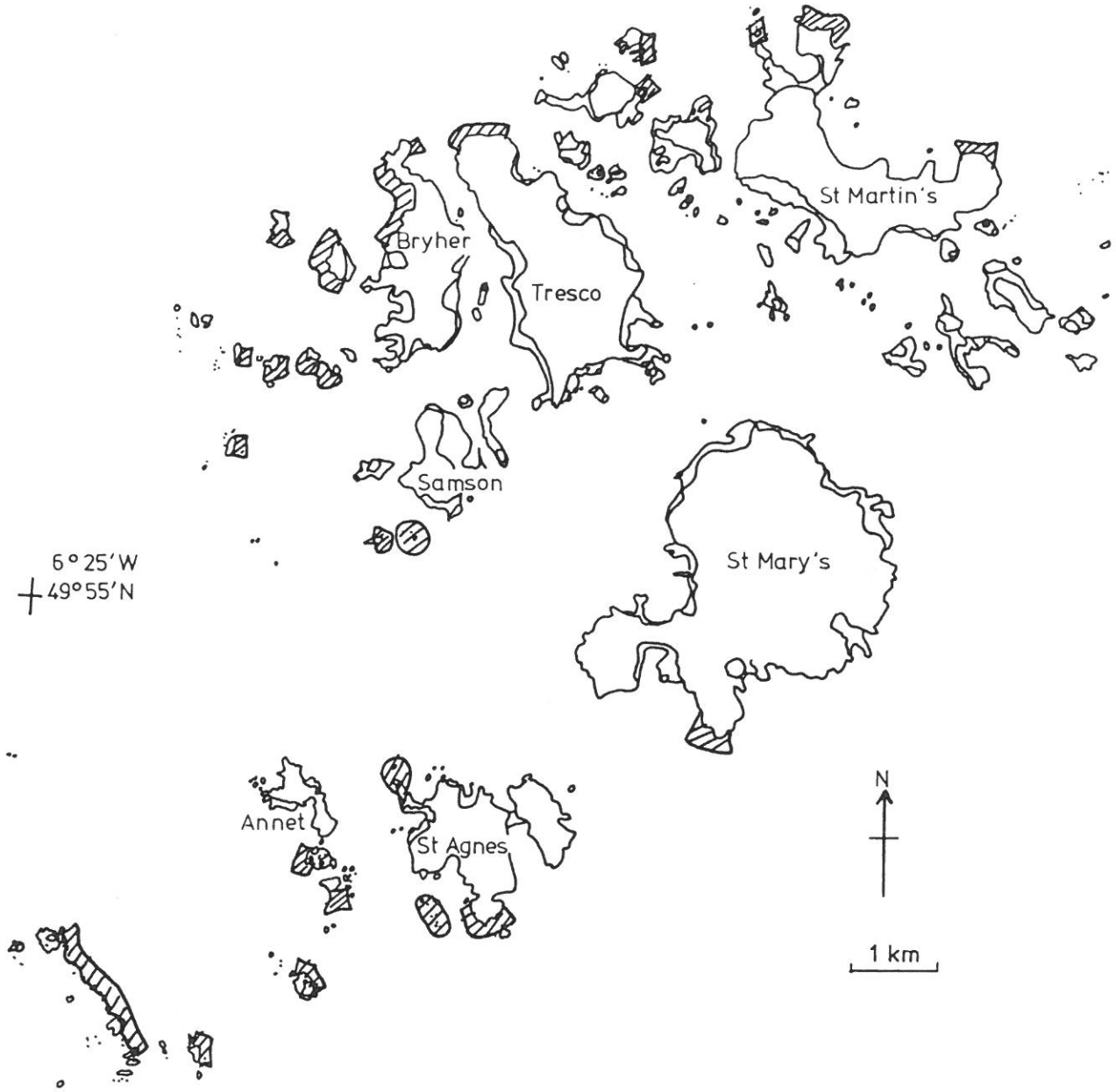
Appendix 8.2

Distribution of shore type 1b



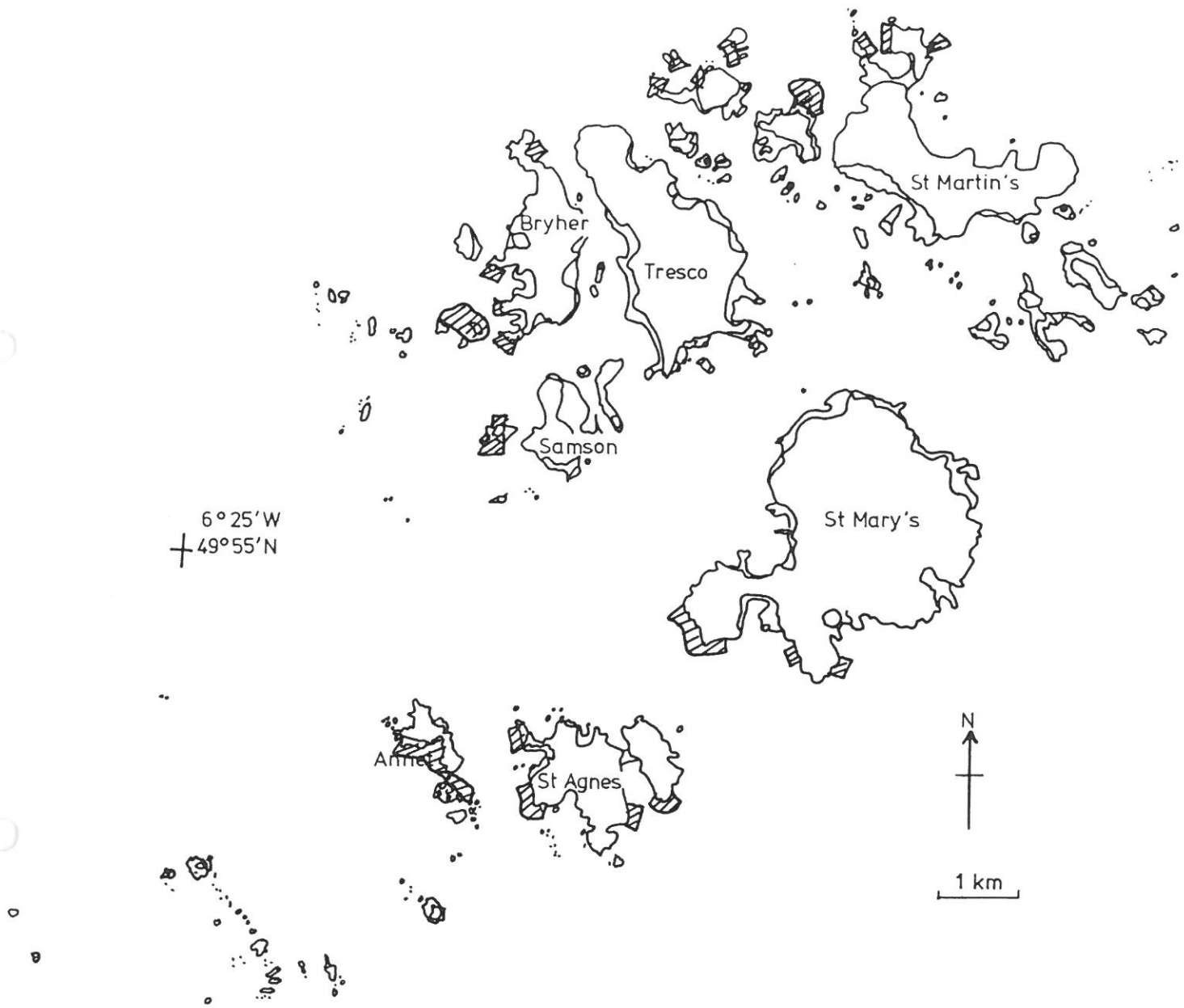
Appendix 8.3

Distribution of shore type 2



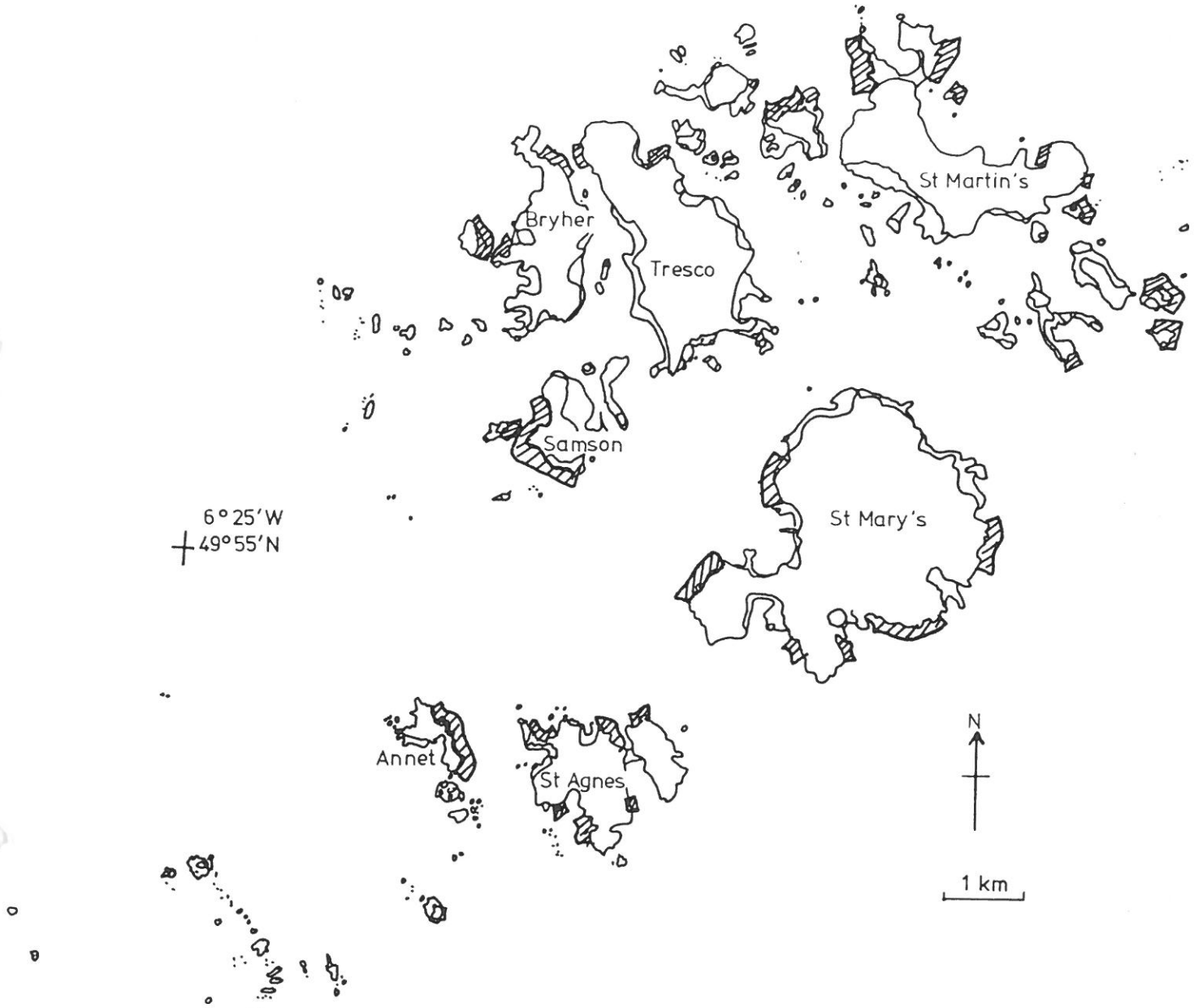
Appendix 8.4

Distribution of shore type 3.



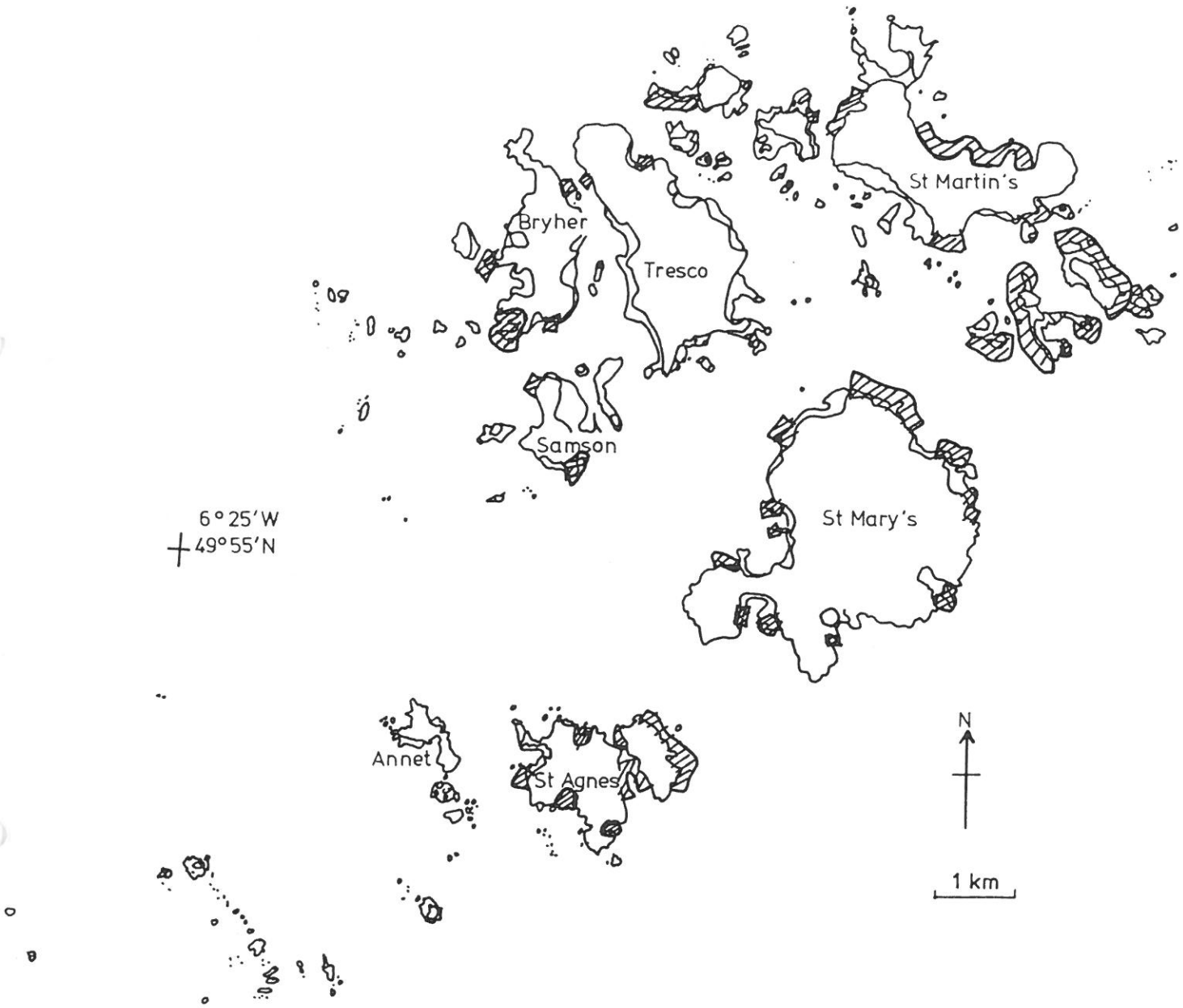
Appendix 8.5

Distribution of shore type 4



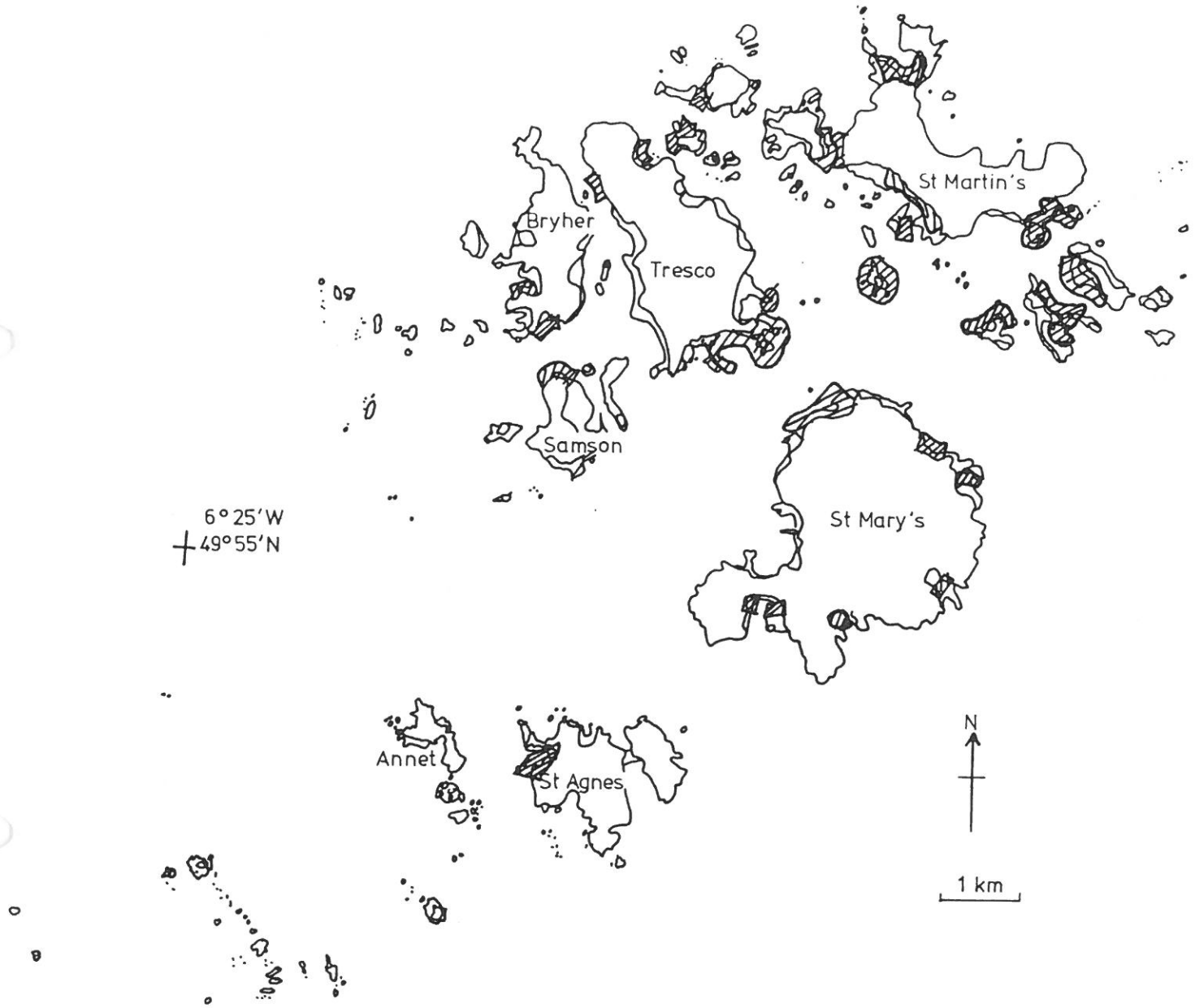
Appendix 8.6

Distribution of shore types 5a & 5b.



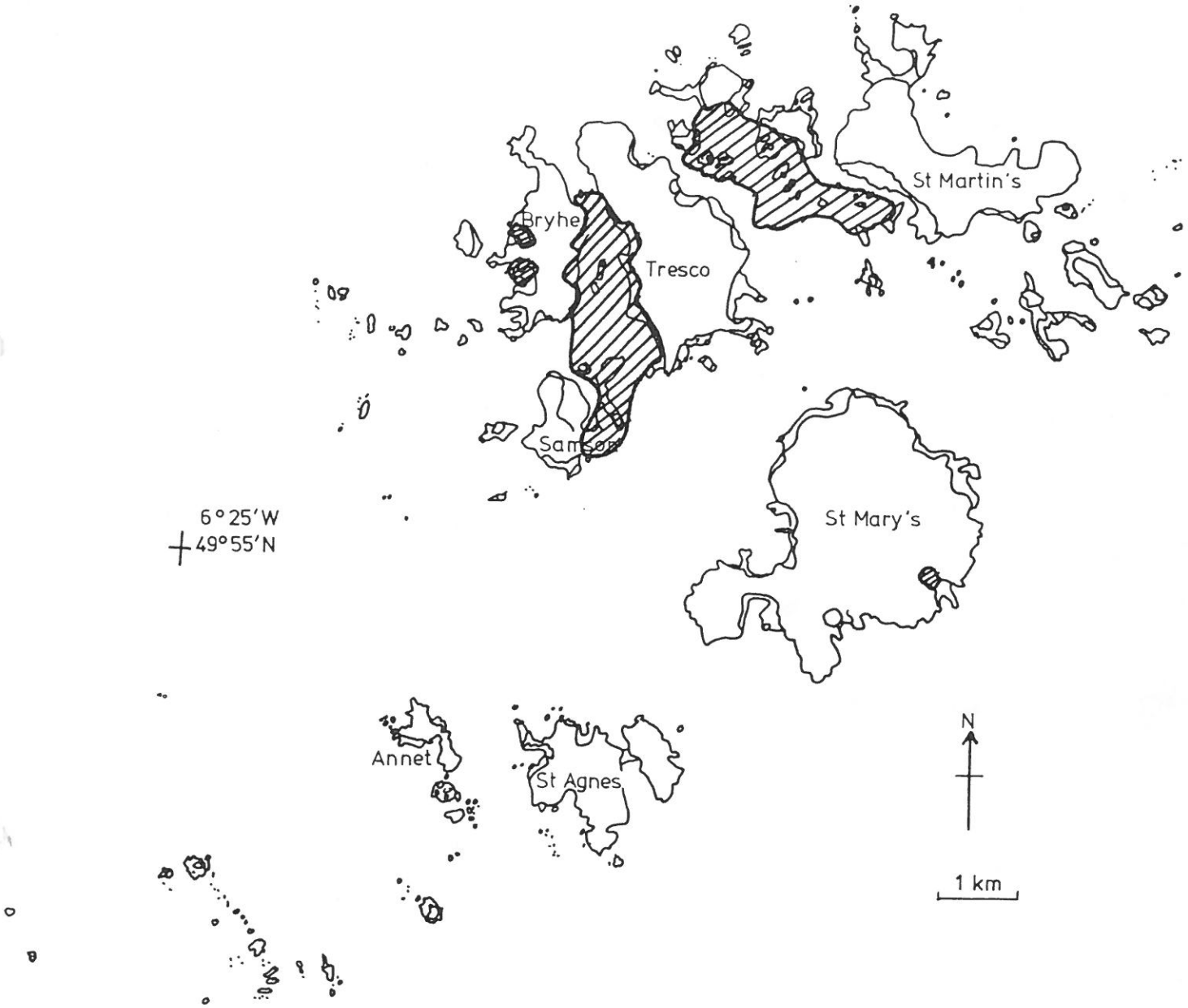
Appendix 8.7

Distribution of shore type 6.



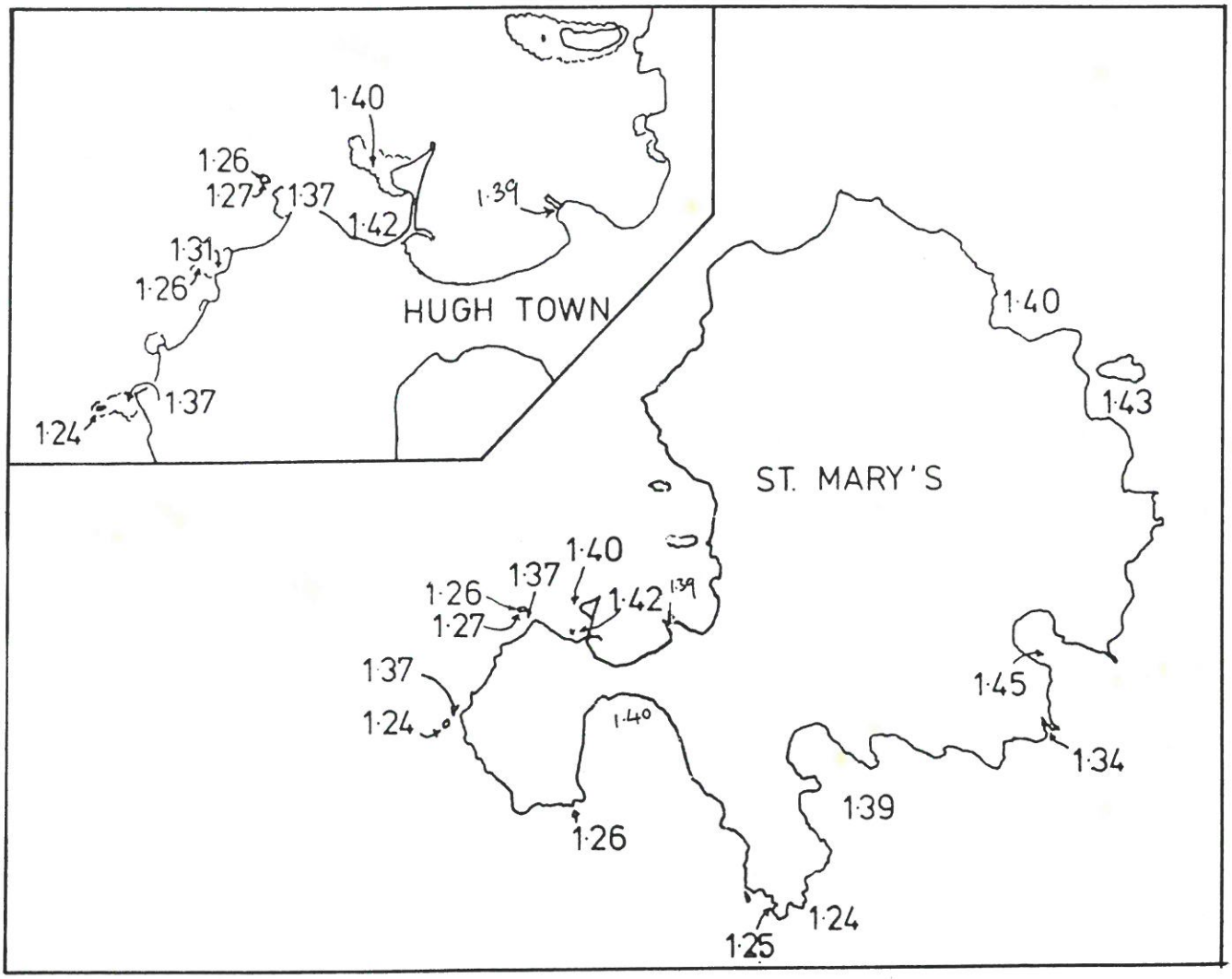
Appendix 8.8

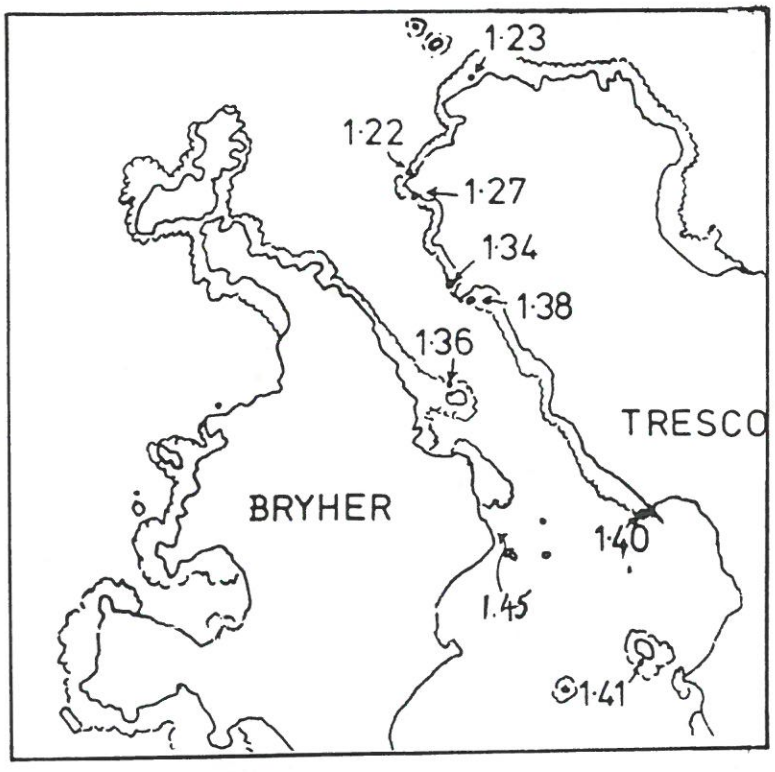
Distribution of shore type 7.



Appendix 9

The ratio of shell length divided by aperture (L/Ap) in Nucella lapillus (information supplied by John Crothers).





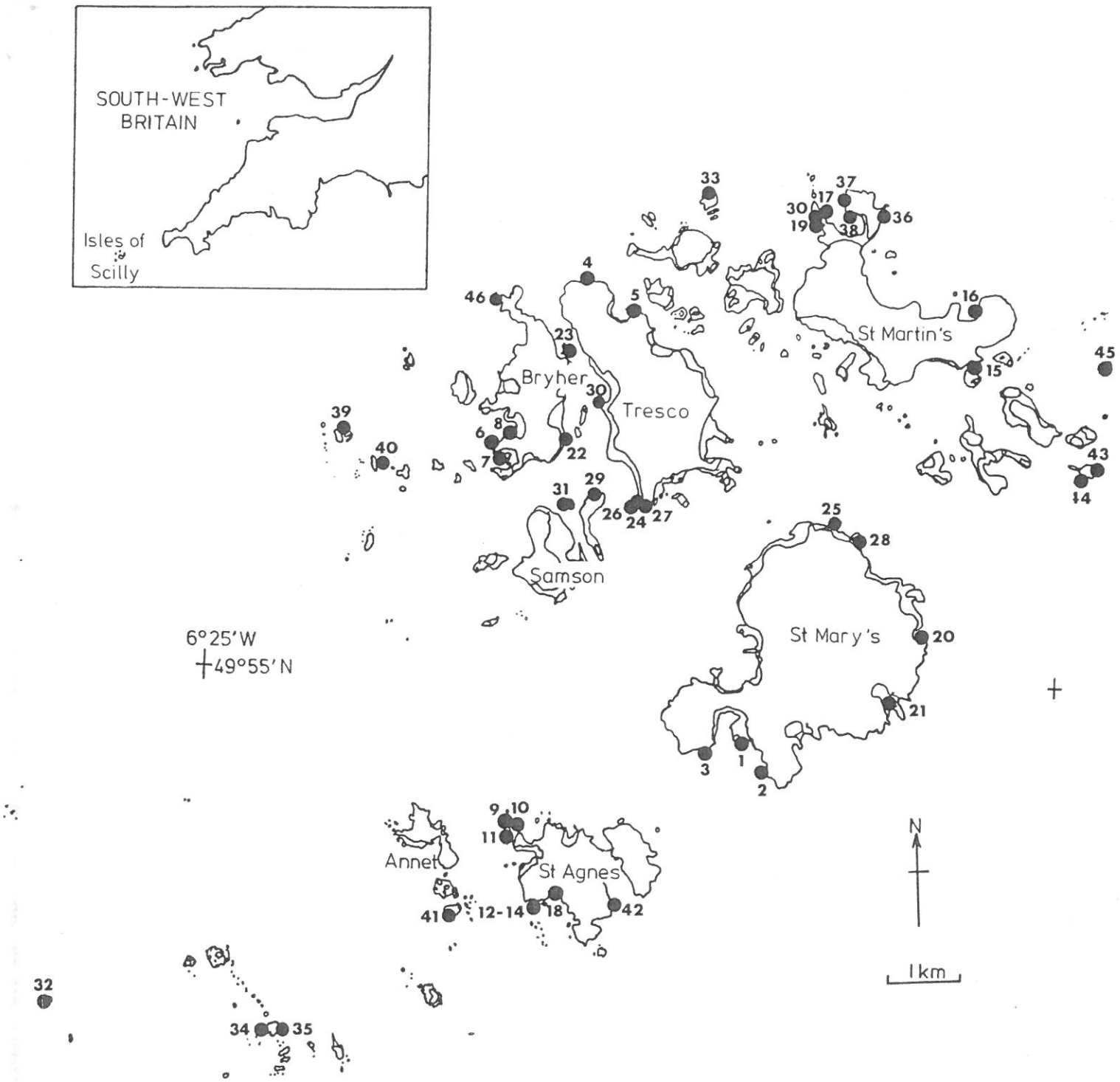


Fig. 1. Location of rocky shore sites surveyed by FSC and NCC staff in March/ April and July 1983.