

A SUBLITTORAL SURVEY OF THE CENTRAL FIRTH OF LORNE

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NATURE CONSERVANCY COUNCIL

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A SUBLITTORAL SURVEY OF THE CENTRAL FIRTH OF LORNE

Results of an expedition to Luing and surrounding islands on
September 10 - 24 1983

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1. INTRODUCTION

1.1 Aims of the survey

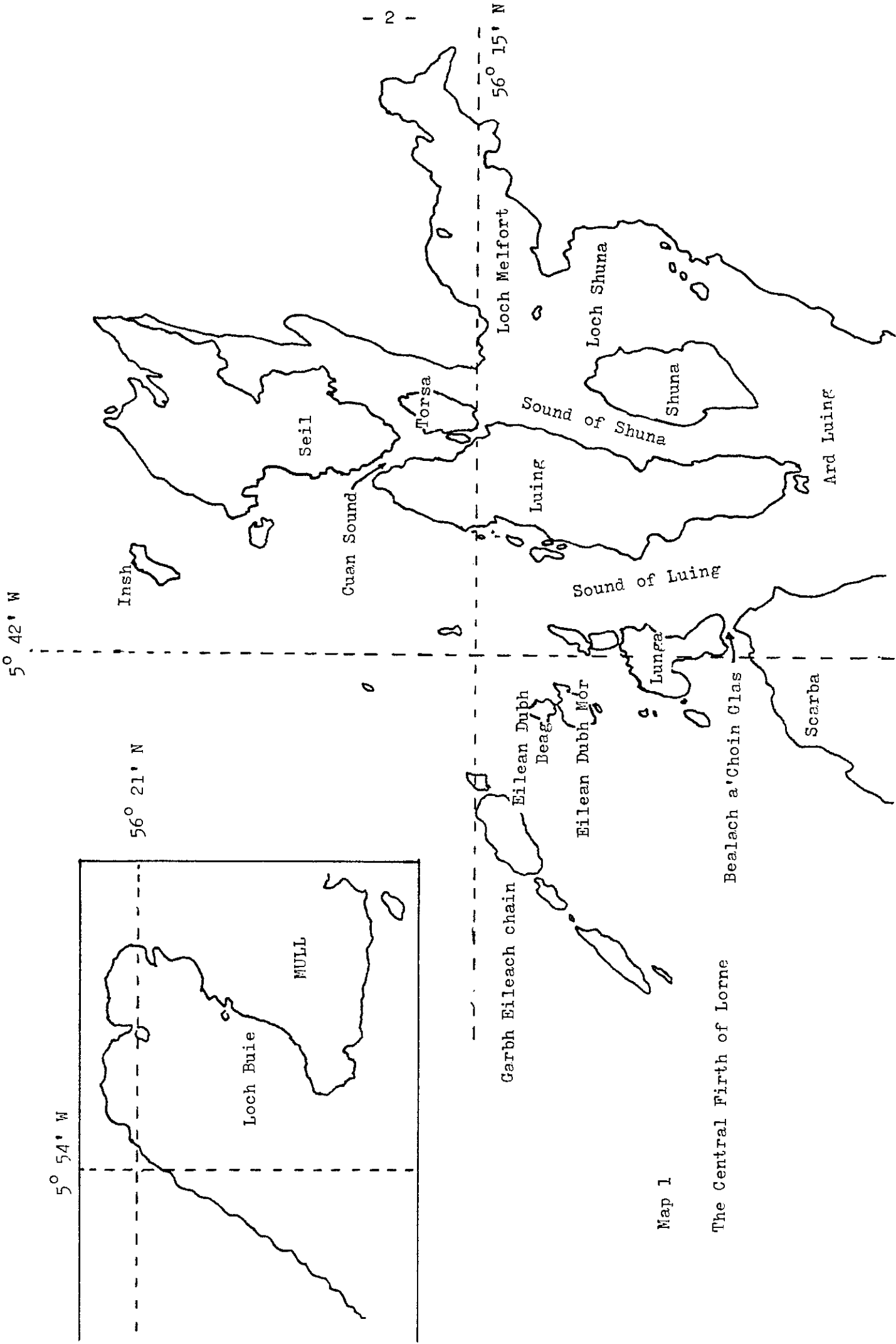
The three main purposes of the survey were: first, to describe a representative selection of sublittoral habitats in the central Firth of Lorne and the species associated with them; second, to photograph these habitats along with their animal and plant communities; and finally, to provide an opportunity for sports divers to participate in and assist with a marine biological survey.

1.2 Area of the survey

The Firth of Lorne is an area of the Atlantic separating the Isle of Mull from the Scottish mainland (Map 1). The present survey was concentrated upon that area of the Firth easily accessible from the island of Luing, and included the waters between Mull and the mainland to the west and east, the island of Insh to the north, and south-east Lunga to the south. The Firth is an area of great diversity in underwater habitats. Its western half is a deep, broad channel over 200 m. deep in places, and mostly well out of the reach of the sports diver. This area was not covered by the survey, though two sites on the southeastern coast of Mull were examined. Further east the sea floor rises (100 m. and shallower) and becomes extremely irregular. There are many islands, islets and rocky shoals in this region. The eastern boundary of the Firth is marked by the sea lochs of Loch Melfort, Loch Shuna and (further south) Loch Craignish.

1.3 Sites surveyed

These are presented in Map 2 and summarized with grid references in Table 1. Sites were selected (after reference to the personal diving records of MLB and KGV) so as to include a variety of habitat types, and numbered according to the order in which they were originally visited. The number of sites surveyed was relatively small: this was partly intentional (every diver was encouraged to dive at every site in order that the maximum number of observations could be made) and partly accidental (bad weather occasionally made it necessary to return to sheltered sites that had already been surveyed).



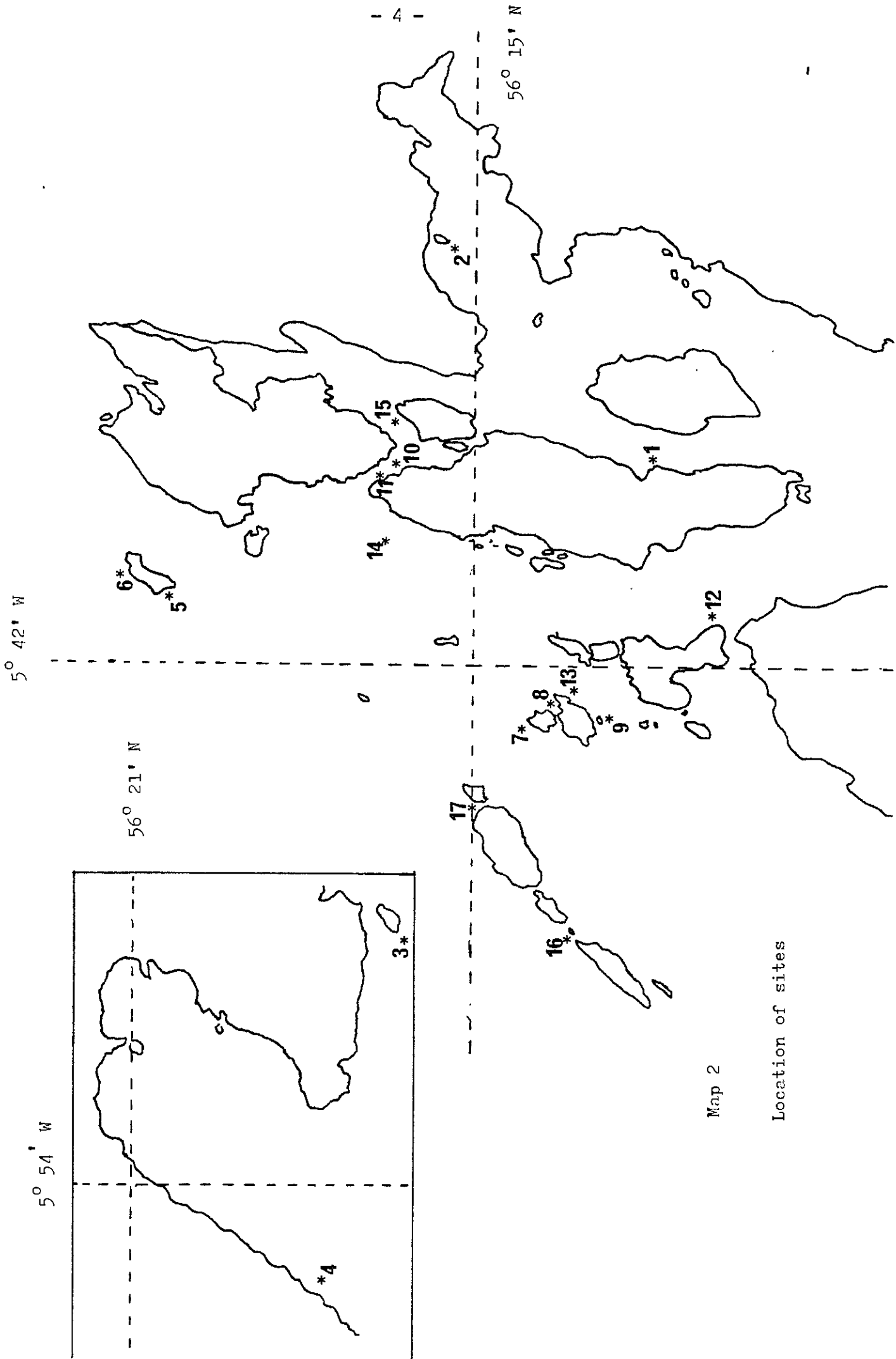
Map 1

The Central Firth of Lorne

Table 1: SITE LIST

1a	TOBERONOCHY (slate slope)	56° 12.95' N	5° 37.6' W
1b	TOBERONOCHY (mud)	56° 12.95' N	5° 37.6' W
2	EILEAN COLTAIR / CAMPBELL ROCK	56° 15.3' N	5° 33.2' W
3	FRANK LOCKWOOD'S ISLAND, MULL	56° 18.2' N	5° 51' W
4	'MELDON', LOCH BUIE, MULL	56° 19.5' N	5° 56' W
5	INSH (SW)	56° 18.7' N	5° 40.5' W
6	INSH (NW)	56° 19.1' N	5° 39.9' W
7	EILEAN DUBH BEAG (NW)	56° 14.3' N	5° 43.4' W
8	EILEAN DUBH BEAG/MOR CHANNEL	56° 14.1' N	5° 42.9' W
9	EILEAN DUBH MOR (SW: LIATH SGEIR)	56° 13.5' N	5° 43.2' W
10	CUAN SOUND	56° 16' N	5° 37.7' W
11	CUAN SOUND BAY	56° 16.1' N	5° 38' W
12	LUNGA (SE)	56° 12.3' N	5° 41' W
13	SGEIR MHOGALACH	56° 13.85' N	5° 42.5' W
14	CULANACH	56° 16.2' N	5° 39' W
15	TORSA SOUND	56° 16.95' N	5° 36.6' W
16	SGEIR LETH A'CHUAIN	56° 13.8' N	5° 47.8' W
17	DUN CHONAIL	56° 14.9' N	5° 44.9' W

The names of individual divers are not given, as, with very few exceptions, all divers dived at all sites.



Map 2

Location of sites

1.4 Previous marine surveys

Until recently, the sublittoral habitats of this area have not been examined in any systematic or detailed manner. What studies there are are summarized in Smith (1984). The Nature Conservancy Council in conjunction with the Marine Conservation Society has sponsored surveys in several parts of Scotland (see summary in Mitchell, Earll and Dipper, 1983) but of these only one recent study (Picton, Howson, Connor & Williams 1982) has been in the Lorne area. The area of the present survey overlaps to some extent with that covered by Picton et al., but extends further to the north and east, and includes the distinctive habitats found in Loch Melfort. More recently still, Smith (1984) has presented a report to the NCC on a survey of the shores of Luing and some of the neighboring islands. The data presented in this report were collected by Dr Smith during the present survey expedition, and will prove a most valuable addition to the data reported in the present report.

2. ENVIRONMENTAL CONDITIONS

2.1 Geology

The geology of the area is extremely complex, and is briefly summarized in Smith (1984). Most of the sites visited involved bedrock from the Dalradian assemblage (pre-Cambrian or early Cambrian). At many sites (eg. 5 and 7) igneous intrusions were conspicuous at the margins of the island shores, and in some cases it appeared that these continued underwater to form a distinctive part of the sublittoral substrate (see site 7). More details of the geography of the Firth of Lorne can be found in Anderton & Bowes (1983), Hudson (1983), Donaldson (1983) and Peacock (1983).

2.2 Bathymetry and seabed characteristics

These vary considerably over the area surveyed. The chains of islands, rocks and shoals in the eastern part of the Firth of Lorne tend to be oriented along a northeast - southwest axis, and to be separated by deep channels running in the same direction. The maximum depth of these channels varies from about 100 m. in the area of the Garbh Eileach chain to about 60 m. in the Sound of Shuna. The rocks, islands, and mainland coasts in the eastern Firth typically are bounded by underwater cliffs of bedrock, or steeply shelving bedrock and boulder slopes, which fall to a more gently sloping gravel,

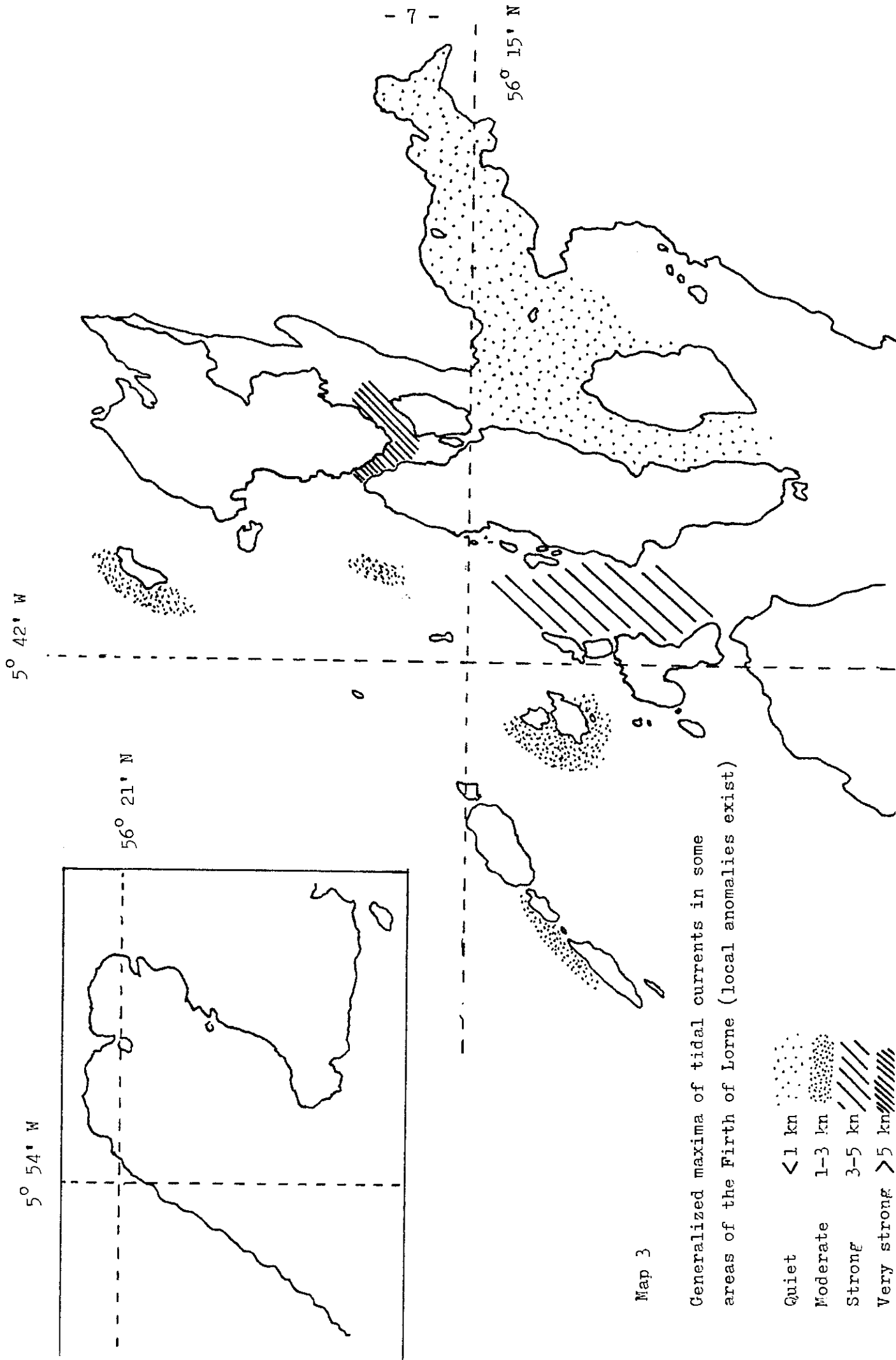
sand or sediment bottom, the ultimate depth of which depends on the particular site. This pattern is found even along the shores of Loch Melfort. Shelving beaches, though present (see sites 3 and 6), are not common. The nature of the bottom was different at different sites, and varied from coarse slate gravel and exposed rock, through sand and shell gravel, to fine mud and silt.

2.3 Exposure to wave action

The prevailing winds in this area are from the westerly quarter: largely southwesterly, but with some strong northwesterly gales, especially in the winter. Many sites on the west side of islands (eg. 5, 9 and 14) may thus be exposed to considerable wave action and surge. The presence of the island of Mull to the west, however, protects the entire region from the worst effects of the Atlantic swell. Sites on the east side of islands (eg. 3, 12 and 13) may be subject to wave action if the winds are easterly, but this happens relatively rarely, and easterly winds are generally not strong. Due to the complex topography of the area, many sites are well protected from winds in any quarter (eg. 2, 8 and 10).

2.4 Exposure to tidal currents

The tidal streams in this area are extremely complex. The general direction of the flood tide is roughly north-northeast and the ebb south-southwest, but the currents are diverted by the many islands and the irregular contours of the sea bed. Currents can be very fast (7 to 8 knots in Cuan Sound) and overfalls and whirlpools are common (eg., the northern mouth of Cuan Sound, the northern part of the Sound of Luing, and the Bealach a'Choin Glas). On the other hand, there are large areas with scarcely any perceptible current (sites 1 and 2). Due no doubt to the complexity of the tides in the area, it is difficult to find detailed and accurate information about tidal currents in the Firth of Lorne. The data presented in this report are based largely upon information from local people, and from the personal records of MLB and KGV, who have been logging currents (direction and estimated strength) in this area for five years. A general summary of maximum tidal strengths in the area is presented in Map 3.



3. SURVEY METHODS

3.1 Expedition details

The expedition group consisted of seven divers and a non-diving scientist, and was based on the island of Luing. Living accommodation was obtained at 'Cluain', a large and comfortable house in Cullipool. A small cottage in Cullipool was used for the 'wet-sorting' of specimens and also as a changing and equipment storage facility for divers. Most dives were done from the mv 'Paula', a well-appointed converted fishing vessel, whose skipper Bruce Howard also dived with the group, and provided very useful information about local conditions and sites for possible exploration. All dives at Toberonochy (sites 1a and 1b) were done from the shore, by kind permission of J. Galbraith.

3.2 Collection of data

All divers were asked to complete two survey forms after each dive: one on the habitat observed (the UCS (=MCS) Sublittoral Habitat Recording Scheme sheet, used on many previous MCS expeditions: Appendix 1); and one on species seen (the Inner Hebrides and Summer Isles Sublittoral Survey (1981) Faunal Check List: Appendix 2). One member (A.B.) also completed sheets of the draft MCS Sublittoral Habitat Record Sheet (test version, June 1983, as provided by K. Hiscock: Appendix 3); while another (N.B.) with a special interest in algae, completed the Nature Conservancy Council Scottish Sub-Littoral Surveys Algae Check List (1982) (Appendix 4). Reference is made in the Results section to the "personal records of MLE and KGV": these have been kept since 1976 and include details of sites visited in the Lorne area, species seen at these sites, and tidal currents. Collections of specimens from various sites were also made. Five of the seven divers were experienced underwater photographers, and films were taken of both habitat and species at each site. Several photographic systems were used by the various photographers, from macro (extreme close-up) to wide-angle. The 15mm Nikonos lens proved especially useful in photographs of general appearance of underwater habitats.

3.3 Processing of data

Identification of collected specimens was as far as possible done on Luing. Some specimens were preserved for later examination by

S. Smith. Photographs were processed as soon as possible after diving (generally on the same day). After the expedition, identification of species from the photographs was made, and all the data from survey forms and identification records collated.

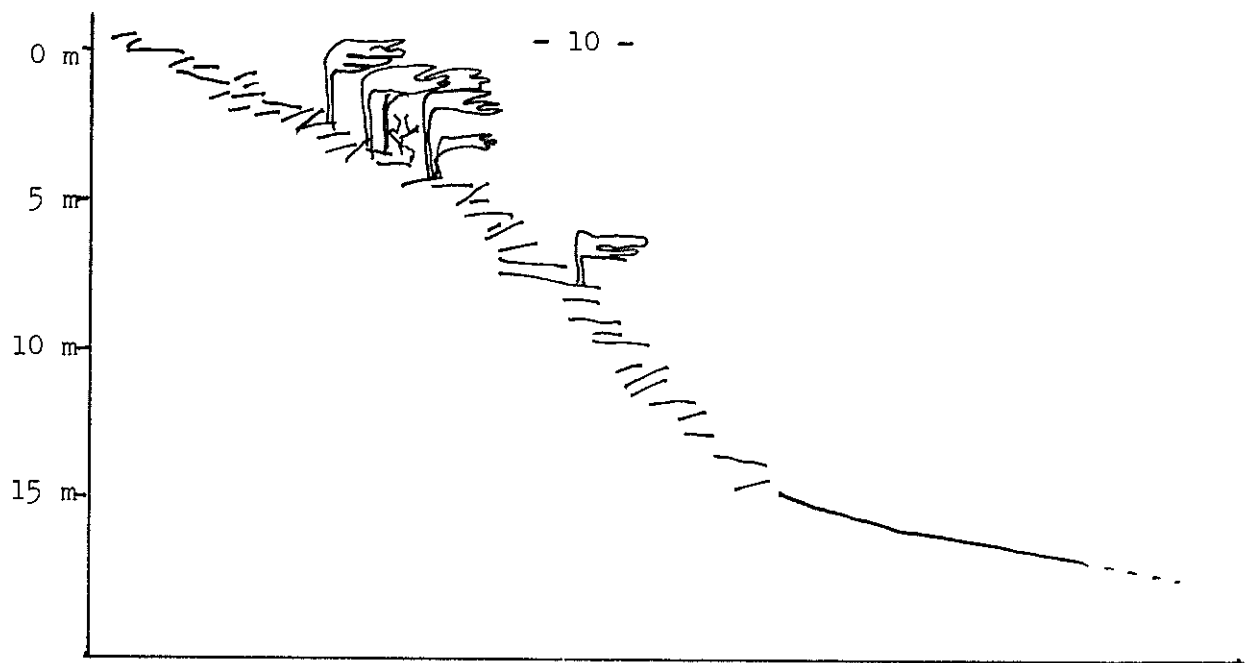
4. RESULTS

4.1 Details of sites visited (all depths to Chart Datum)

4.1.1 Toberonochy: Sites 1a and 1b. 56°12.95' N, 5°37.6' W
Diving was done from the southernmost of two man-made slate jetties extending into the Sound of Shuna from Toberonochy village. The site must be subdivided into two distinct zones: 1a refers to the slates of the jetty itself; 1b to the mud-sand floor of the Sound upon which the slate jetty rests. Both areas are well protected from wind and wave action, and tidal currents are minimal (< 1 knot).

Site 1a. The substrate of the slope is mainly slate quarry spoil: slabs from 0.25 to 1 m in diameter, and 4 to 20 cm in thickness. They are irregularly piled upon each other with many crevices and small caves between and under them. There is moderate silting upon the rocks. The depth of the bottom varies from 10 to 14 m. There is a forest of Laminaria hyperborea and L. saccharina down to 6 m (though isolated plants are found to 10 m.) The slates are mostly bare or covered with 'lithothamnion', but occasional patches of hydroid turf are seen. Echinus are numerous on the slates, and can reach considerable densities in places (~5 per m²: subjective estimate). Antedon and Asterias are abundant. Marthasterias and Henricia are common, as are small fish and crustaceans. The only sponges observed were isolated specimens of Suberites carnosus and S. domuncula, and one Pachymatisma. Apart from occasional Caryophylla, the only anthozoan species seen were a few small Alcyonium digitatum, Protanthia, and isolated specimens of Anemonia and Metridium. Ascidia mentula and Corella parallelogramma are abundant.

Site 1b. At the bottom of the slate pile is a gently sloping bottom of silt, fine sand and mud extending to charted depths of 40 to 60 m in the middle of Shuna Sound. There is considerable shell debris at shallow depths (15 m) which becomes less noticeable in deeper water. Isolated small rocks lying on the bottom support occasional Laminaria saccharina and Chorda filum in shallow water (15 m.). There are also isolated unattached Laminaria fronds at all depths which appear to serve as shelter for small fish and crustaceans. Virgularia mirabilis and Cerianthus lloydii, with



Representative section of Sites 1a and 1b

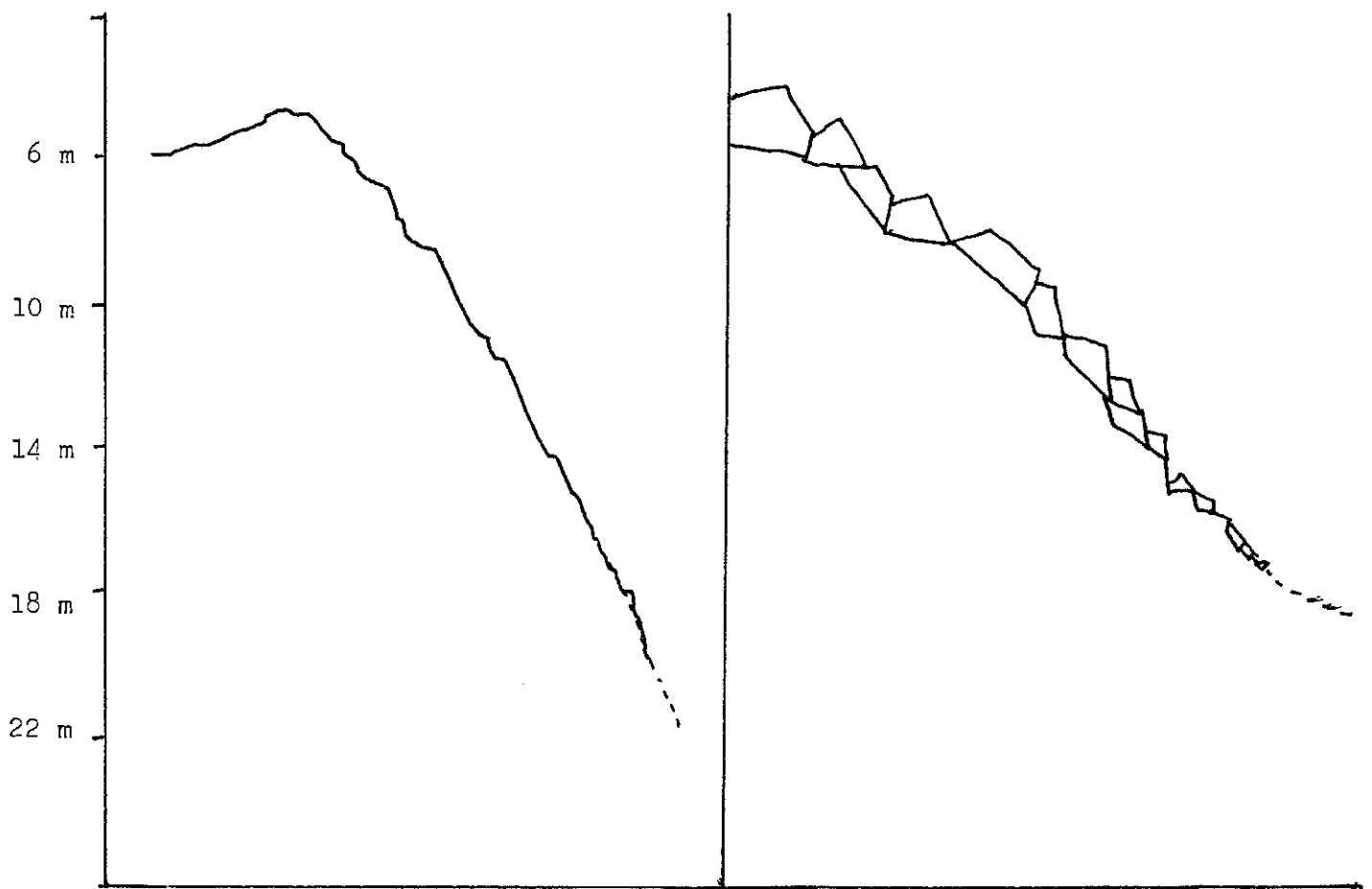
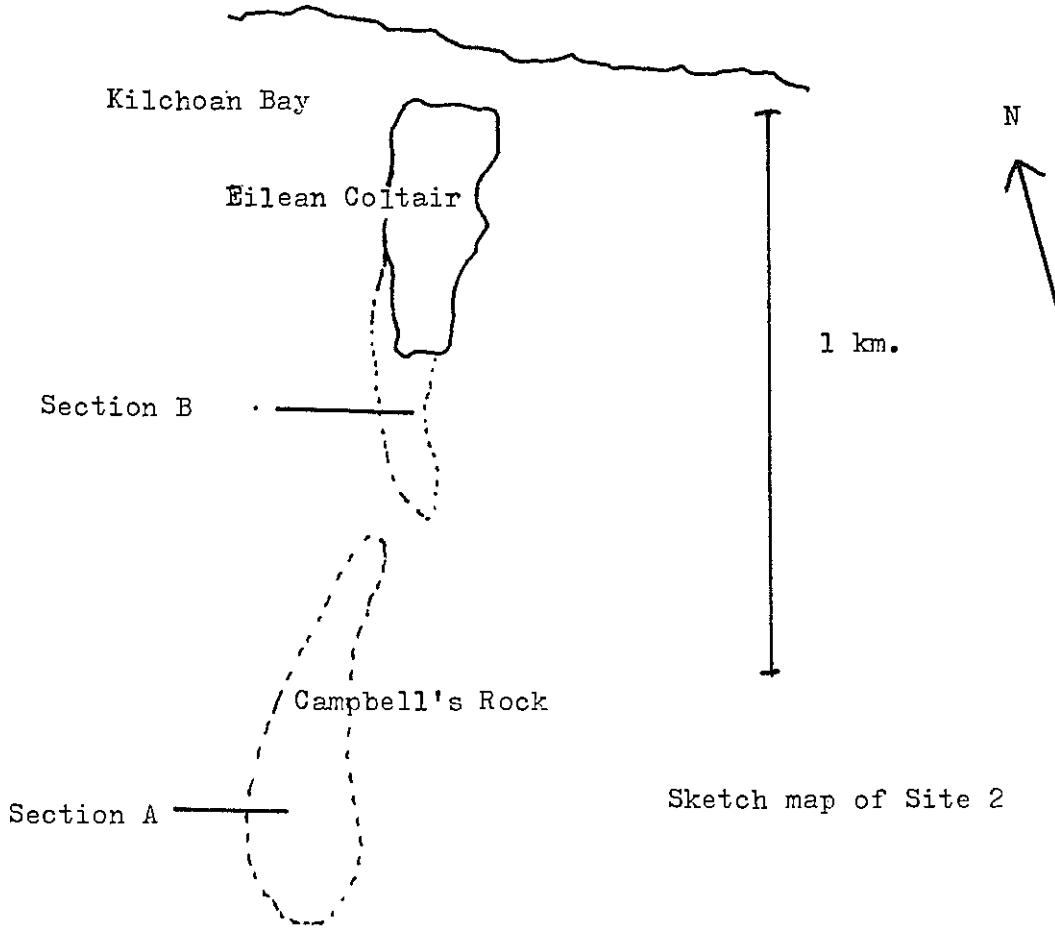
occasional Lanice conchilega are found on this slope from 15 m down, while Pennatula phosphorea and burrows of Nephrops norvegicus become common at 20 m and deeper. Liocarcinus depurator, small Inachus and hermit crabs are frequent. Funiculina and Anseropoda are occasional to rare in deeper water (30 metres and deeper) (personal records of MLP and KGV). There is sporadic human debris in this area, in particular long-established mooring chains and abandoned lobster creels. These support thick encrustations of Mytilus and Sabella, with Protanthia and many other species.

This habitat and its inhabitants are representative of the entire western side of the Sound of Shuna, from Ard Luing in the south to Ardinamir in the north (personal records of MLP and KGV). The eastern side of the Sound has not been extensively explored by the present author, but has in many places a steep rocky cliff falling to a deep muddy bottom and supporting an abundant population of Antedon bifida.

4.1.2 Eilean Coltair: Site 2. 56°15.3' N, 5°33.2' W

This site consists of a single ridge projecting from the shore of Kilchoan Bay south into Loch Melfort. The southerly (underwater) part of this ridge is charted as Campbell Rock: the northern part forms the island known as Eilean Coltair. Both sites are well protected from wind and wave action, and experience little or no perceptible tidal current.

Campbell Rock: The top of this submerged ridge is flat at 10 m, and covered with thick, easily disturbed and non-settling sediment.



Representative section of Site 2
Section A

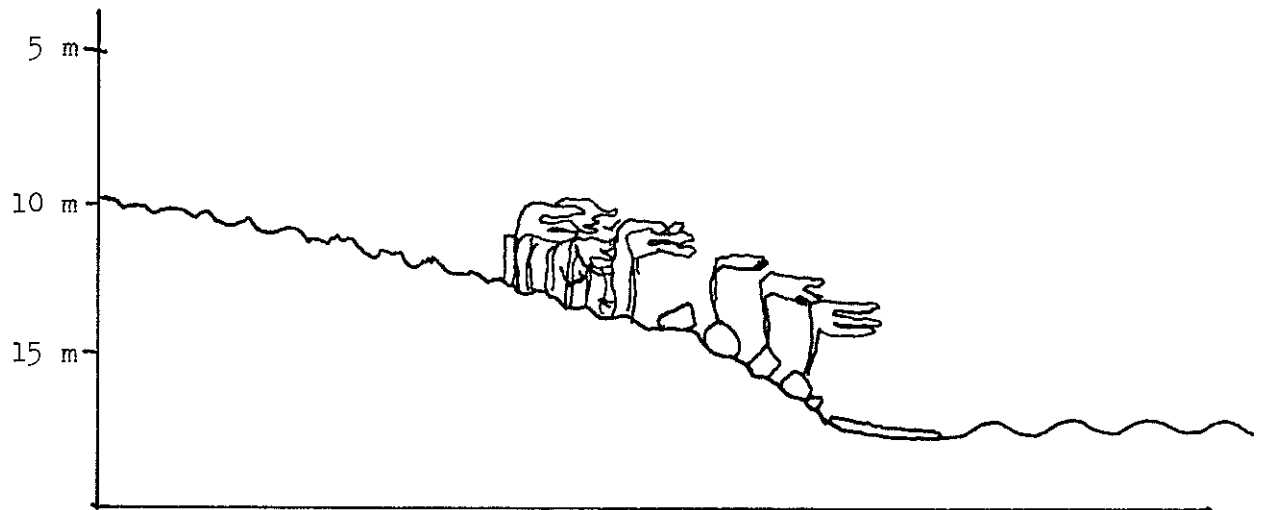
Representative section of Site 2
Section B

At its western edge, there is a small ridge (to 6 m) and then a steep drop-off ($50 - 60^\circ$) consisting of a ledged slope of bare rock with many pockets of silty sediment. This was explored to 22m but extended deeper (the charted depth here is 38 m). The top of this ridge is covered by a thick mat of brittle stars (predominantly Ophiothrix fragilis in several colour morphs) and algae. There were few other species in this area aside from occasional Asterias and Anemonia sulcata. The slope of the ridge is inhabited by a greater number of species. Chorda filum was common, as were Echinus, Asterias, Marthasterias, and ascidians including Ascidia mentula, Ascidiella aspersa and Clavelina lepadiformis, but the density of individuals of any species was not high. Tubes of Chaetopterus and crabs (especially Cancer and Liocarcinus puber) were reported as frequent. Fish seen included Pholis gunnelis, Scyliorhinus canicula, and several types of wrasse.

Eilean Coltair. Just south of this island, the rock of the ridge that is so conspicuous at Campbell Rock is largely obliterated by large ($\sim 1 - 3$ m) tumbled boulders. To the west there is a dropoff ($\sim 45^\circ$) to a bottom of muddy sand and shell, with scattered rocks. This bottom slopes to the south from 10 m to 25 m and deeper, depending on the distance into the loch. The deeper the bottom of the ridge, the smaller were the constituent rocks, so that at 25 m the slope consisted of cobbles (~ 30 cm) rather than the large boulders characteristic of the shallower slopes. Silting of the rocks is moderate. The rocks support the association of Protanthia, Gonactinia, Chaetopterus, and Aurelia schyphistomae that is typical of rocky substrates in Loch Melfort (personal records of MLB and KGV). Patches of Phoronis were also common on vertical and underhung rock surfaces. Sponges are not common in Loch Melfort, and occasional specimens of Suberites carnosus were the only ones reported. Many Liocarcinus depurator were seen, with several pairs in amplexus.

4.1.3 Frank Lockwood's Island, Mull: Site 3. $56^\circ 18.2'N$, $5^\circ 51'W$
This site is exposed to the east, and consists of a gentle ($\sim 30^\circ$) slope of ridged bedrock (the ridges running at a 45° angle to the shore) supporting a thick Laminaria forest down to 12 m, with a dense undergrowth of red foliose algae. At 12 m the kelp thins, and the ridged rock gives way to an area of large boulders (~ 1 m diameter), large slate cobbles and large, flat, scoured slate 'flagstones'. on a floor of coarse sand and slate gravel. This area extends only for 2 - 3 metres before giving way to a flat

bottom of coarse slate and shell gravel, thrown into waves running parallel to the shore. There was little information available to us about tidal streams in this area, but currents appear to be moderate in strength (2 - 3 knots maximum). The site is totally exposed to winds from the east. There was little or no silting of any substrate.



Representative section at Site 3

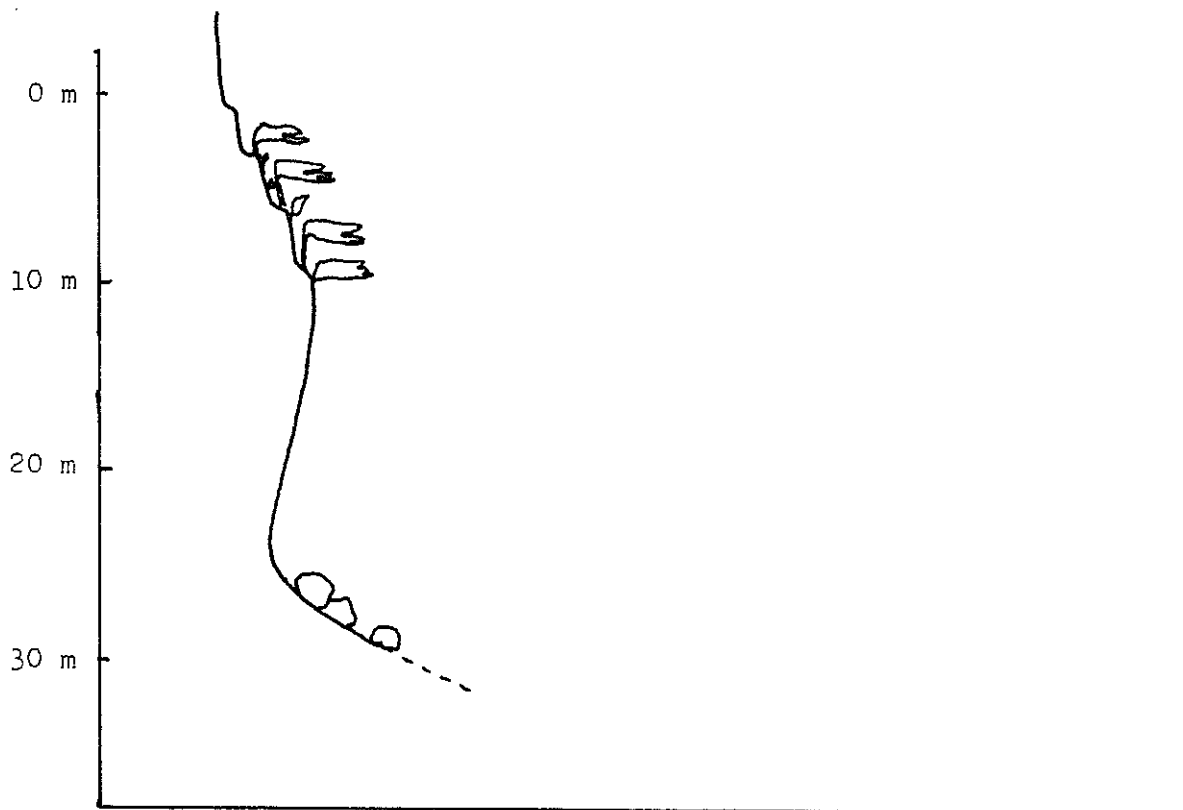
With the exception of the red algae on Laminaria stipes, there appeared to be few species or individuals at this site, both in the kelp forest and on the rock and gravel bottom. The kelp fronds supported patches of Membranipora (with several Polycera faeroensis associated with it) and also frequent small Patina pellucida. On the slate gravel, the most conspicuous and numerous species were Crossaster papposus and Asterias. Tealia felina were abundant in places where the gravel impinged upon rock surfaces, and were quite large (6 - 8 cm).

4.1.4 ss Meldon, Loch Buie, Mull: Site 4. 56°19.5' N, 5°56' W
This is a small wreck, largely intact, in a moderately exposed situation in shallow water near the mouth of a large sea loch on the southeasterly side of Mull. The sea bed is of bedded sedimentary rock and boulders, lying on deep, coarse shell and slate gravel with burrowing molluscs. There is profuse red and green algal growth both on the wreck and on the rocks upon which it lies. The wreck is covered with a thick turf of hydroids and bryozoa. There is profuse growth of Tubularia and Sagartia elegans. Metridium is also common. Many large Cancer and fish (Pollachius and Labrus

spp.) were reported. Several large Crossaster were seen of a very distinctive and unusual yellow-orange colour.

4.1.5 Insh (SW): Site 5. 56°18.7' N, 5°40.5'W.

The southwest side of Insh is exposed to waves driven by winds from the west (which can be considerable at this site) but tidal currents are moderate. The site examined was a cliff falling vertically from the surface (at one point) to 20 - 35 m, though the topographical details of the cliff differ according to which part is being studied. For the most part it is sheer and, in many places, undercut, though with many crevices and 'chimneys'. At its bottom is a scree of rocks and boulders of various sizes (up to 2 m.) on a sand and gravel slope which leads to another steep rock slope falling to (unexplored) depths below 40 m. The cliff supports patches of hydroid turf and various other encrusting growths. The number of species present and the number of individuals are both high. Sponges and brachiopods are particularly numerous. Several species are characterized by local, but not general, abundance: for example an area of undercut cliff at 18 m. supports a dense growth of exceptionally large and robust Sabella, whose tubes are thickly encrusted with bryozoa, hydroids, Filograna, small Alcyonium and other encrusting growth. Similarly, Parazoanthus anguicomis occurs in thick but isolated patches in crevices at about 20 m.



Representative section of Site 5

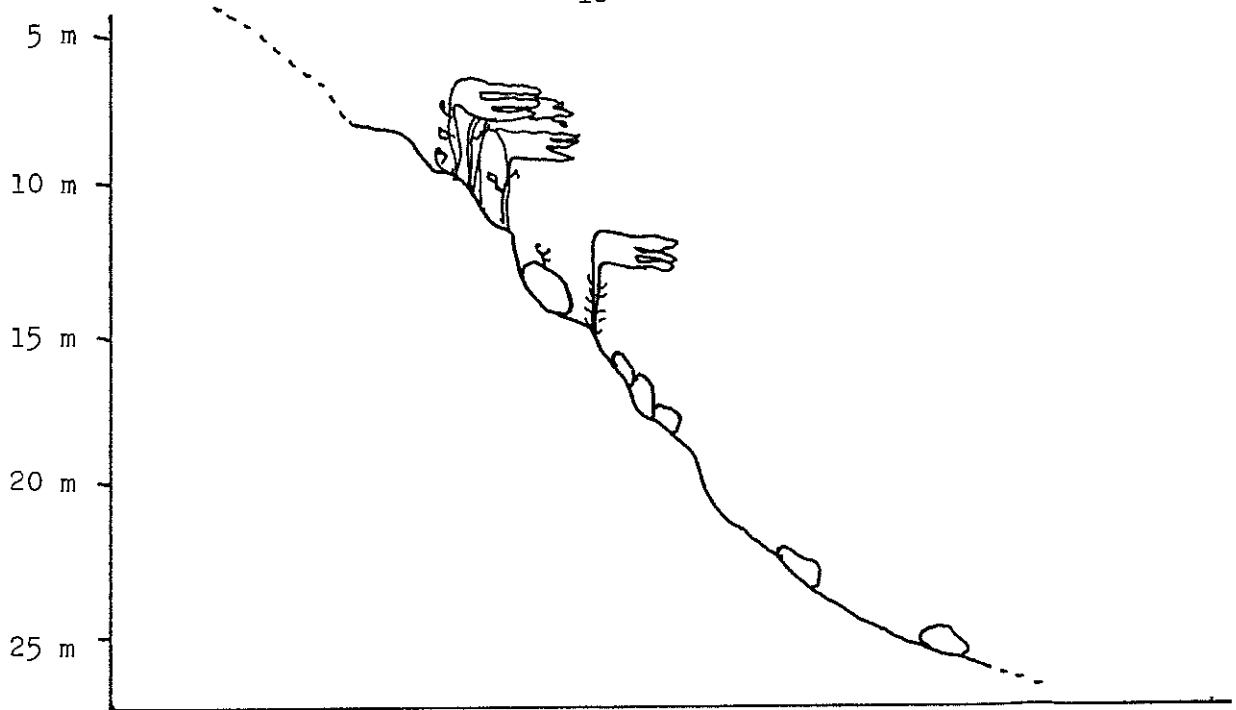
The variety of species present at this site makes it difficult to draw generalizations about those that are 'dominant', or even particularly abundant. However, the association of Axinella infundibuliformis, Diazona violacea and Swiftia pallida so characteristic of many exposed cliff faces in Lorne was well marked, and Hymedesmia pauperatus was frequent. The richness of the sponge growth as a whole was remarked upon by the divers, but this could be due to the relative scarcity of sponges at sites previously visited.

4.1.6 Insh (NW): Site 6. 56°19.1' N, 5°39.9'W

This site is exposed to roughly the same conditions as site 5 (strong wave action, moderate tidal currents) but is a shallowly shelving bottom with a sea bed of coarse slate gravel sloping from a shallow bay on Insh to 15 m. and deeper. Rocks and boulders (up to 1.5 m.) lie on the gravel bottom and support a population of Laminaria hyperborea and foliose red algae. Though there is much encrusting and "epiphytic" life on the kelp, the gravel floor appears largely bare (though occasional Tealia felina are seen). Aplysia were particularly common upon the foliose red algae growing upon the kelp stipes.

4.1.7 Eilean Dubh Beag (NW): Site 7. 56°14.3'N, 5°43.4'W

The site examined was at the extreme northwestern corner of this island: it is exposed to winds from the west and south, but is exposed to only moderately strong tidal currents (~2 knots maximum). Off the shore of the island at this point there is a steep (45 - 60°) fall of bedrock and small boulders, with pockets of shell gravel, supporting a kelp forest to 14 m. (and isolated plants thereafter to 20 m.) This slope continues to about 22 m., then becomes less steep (25 - 30°) with a relatively larger proportion of rocks and boulders to bedrock, and larger expanses of shell gravel and sand to 25 m. and deeper. North of the island proper, the slope of bedrock and boulder is replaced by one of sand and shell gravel, with only a few rocks and small boulders interspersed in it. At two places in this site steeply sloping spits of bedrock extend out from the slope, and supported a particularly dense population of Alcyonium and Pachymatisma. It is possible that these were underwater continuations of the igneous intrusions which could be seen at the margin of the island. (A similar correlation of igneous intrusions in shore rocks, underwater spits and ridges, and unusually thick growths of Alcyonium has been noted at another site (west side of

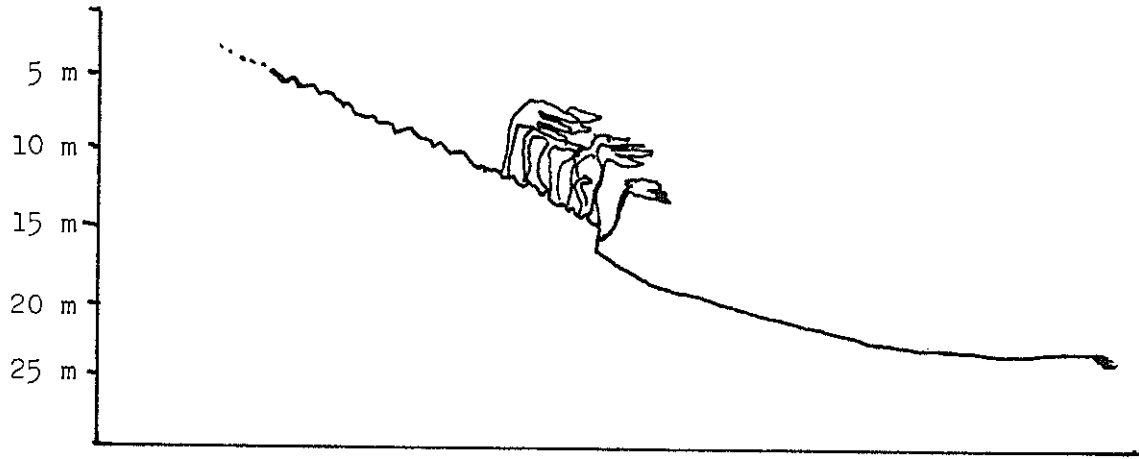


Representative section of Site 7

Fiola Meadhonach) not dived on this expedition (personal records of MLB and KGV.) The stipes of the Laminaria hyperborea supported a varied population of epiphytic plants and animals: several Eledone were also seen in areas of tangled weedy growth in the kelp forest. Below 15 m. or so, the stipes of isolated Laminaria often supported massive accumulations of Antedon bifida. This was another site considered by the divers to be very rich in the variety of species observed, and again it is difficult to generalize about common species and species associations. However, the site was noted for the extremely thick growths of Securiflustra (and some Flustra) on the rocks. Tritonia hombergi (including some very large individuals) were frequent, sometimes but not always associated with the locally dense growths of Alcyonium digitatum.

4.1.8 Channel between Eilean Dubh Beag and Mor: Site 8.

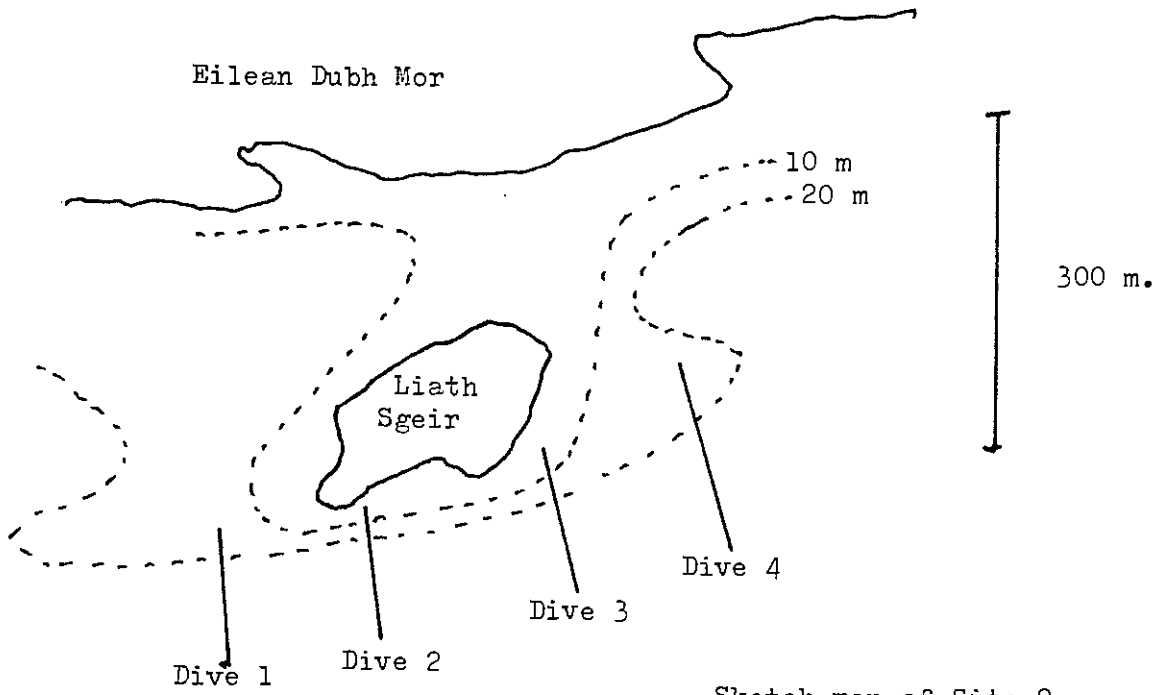
56°14.1' N, 5°42.9' W. This funnel-shaped channel is the eastern part of the narrow strait separating the islands of Eilean Dubh Beag and Eilean Dubh Mor. It is well protected from wind from any direction. No detailed information was available about tidal currents, but local knowledge and our own observations indicated that these are minimal: less than 1 knot at any time. The sides of the channel are sloping bedrock from the surface to 14 m., supporting a thick kelp growth, and ending in a small vertical cliff (1.5 to 2 m. high). The floor of the channel is a gentle slope of silty mud and sand,



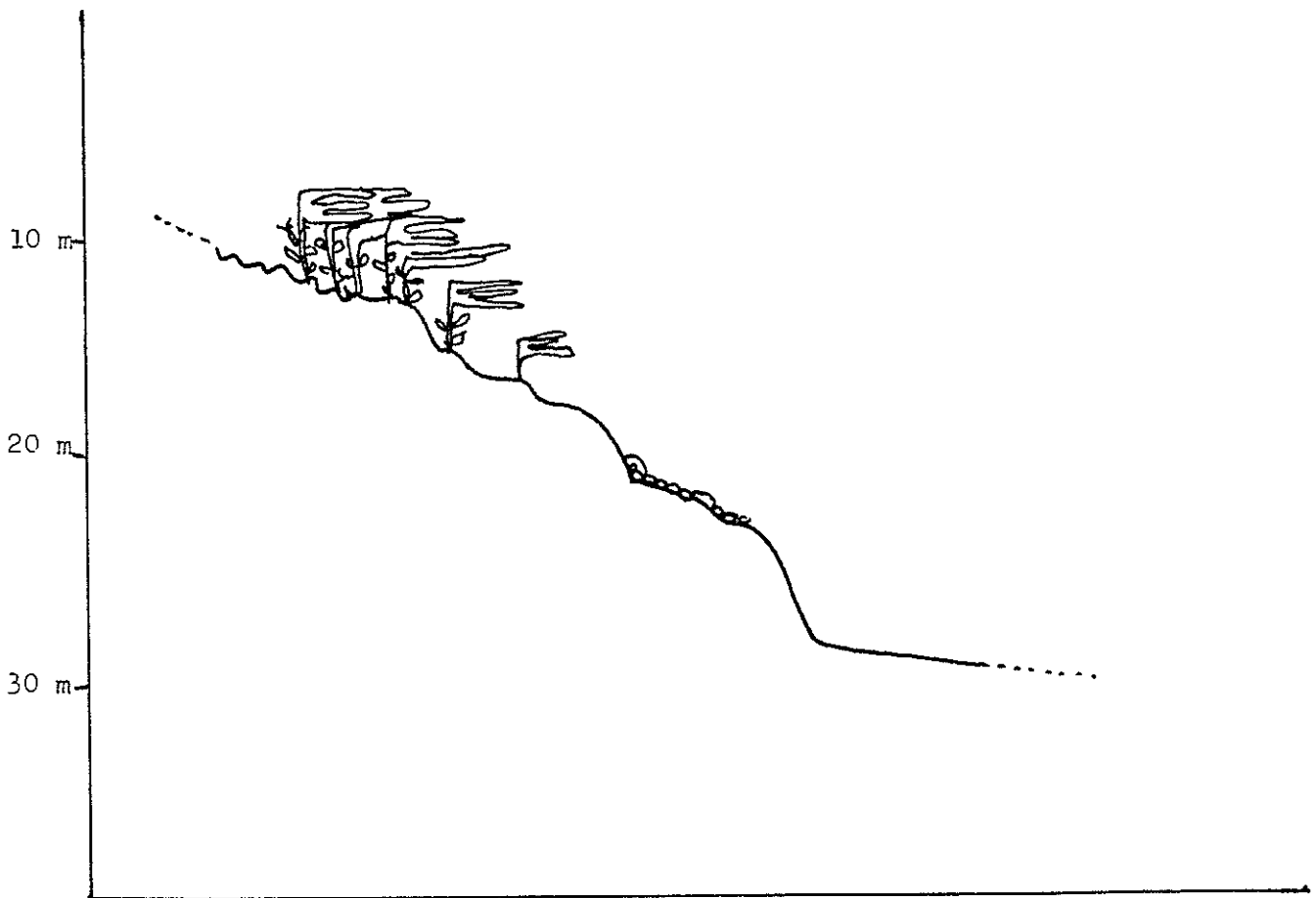
Representative section of site 8

which falls to a depth of about 20 m. in the middle of the channel. This site is of particular interest as the home of two relatively unusual anthozoan species: Pachycerianthus multiplicatus and Arachnanthus sarsi. Both live in the silty bottom between 15 and 20 m., along with Cerianthus lloydi, Pennatula, Virgularia, and Nephrops burrows. The latter four species are common in the Sound of Shuna (see site 1b) but neither Pachycerianthus nor Arachnanthus has yet been reported from that site.

4.1.9 Eilean Dubh Mor (Liath Sgeir): Site 9. $56^{\circ}13.5'N$, $5^{\circ}43.2'W$
Dives were done at several places along the small island of Liath Sgeir, which lies off the south-southeastern corner of Eilean Dubh Mor. This site is only moderately exposed to both wind and tidal currents. Although different pairs of divers explored different areas of the site, the general picture of the region was the same in all cases, and the profile presented, although to some extent an amalgamation of details reported by four pairs, is generally correct for all areas dived. From 10 to 14 metres, the site is characterized by shallow but rugged gullies in bedrock, running parallel to the shore. There is then a steep but somewhat irregular fall of bedrock to a silty gravel and sand bottom at 24 to 26 m. These steep slopes consist both of bare, silty bedrock, and screes of cobbles and small boulders, interspersed with pockets and shelves of silty gravel. The shallow forest of Laminaria hyperborea supports thickly growing foliose red algae on their stipes, as well as other encrusting and epiphytic animal growth. Nudibranchs were especially abundant in this area, both in number of species and of individuals. The steep bedrock that falls from 14 to 26 m. is silty and relatively sparsely populated (except by Caryophylla, which are abundant on steeply



Sketch map of Site 9

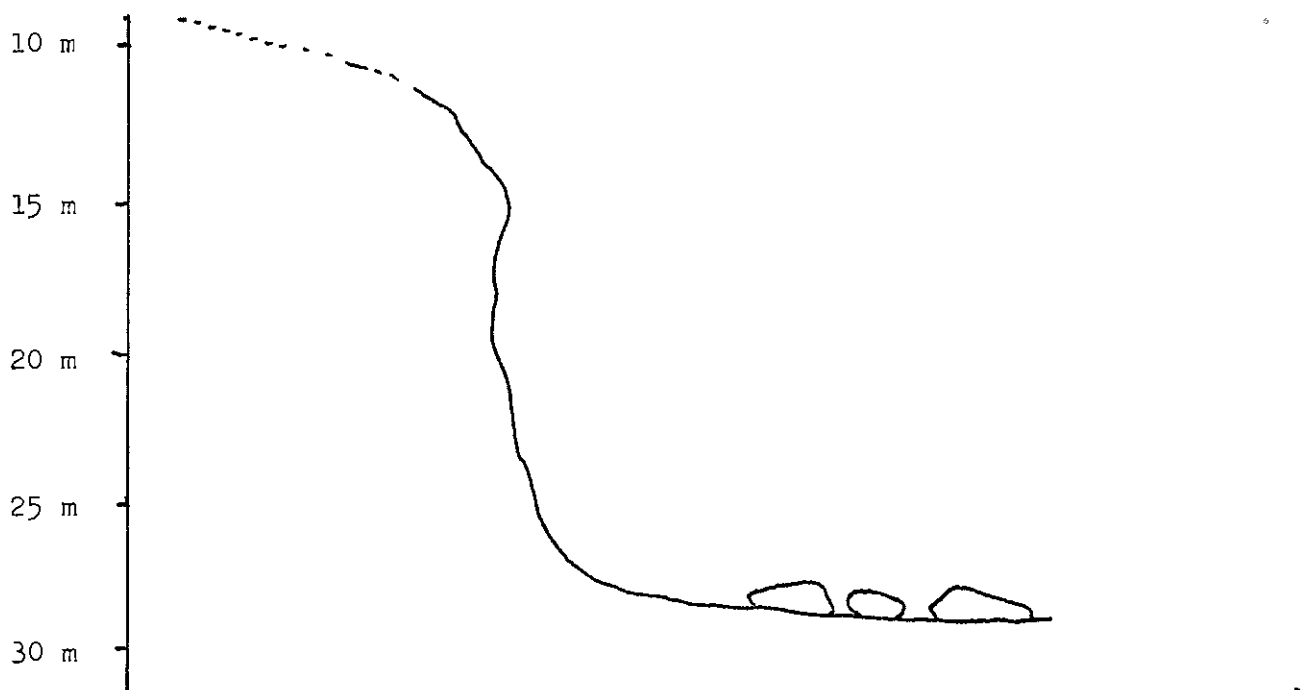


Representative section of Site 9

sloping surfaces). However, there are patches of dense bryozoan cover (largely Securiflustra) and many crevices providing cover for large crustaceans. Brittle stars (Ophiothrix fragilis and some Ophiocomina nigra) were common in this area.

4.1.10 Cuan Sound: Site 10. 56°16' N, 5°37.7 W

The channel between Luing and Seil is well protected from wind, but is subject to very strong tidal streams (>6 knots) which run for most of the tidal cycle. Observations were made of the bottom of the channel through its narrowest part (approximately 200 m. north and south of the path of the Cuan Ferry) and of the walls of the channel in the same area. Both the east and west walls are steep and, in some places, undercut cliffs of bedrock extending from 12 to about 26 m. (the precise depth depending on the particular place). Shallower, there are bedrock ridges extending out from the shore, bearing a thick Laminaria hyperborea forest. In some places, these ridges form the lateral boundaries of shallow, sand-bottomed bays (see site 11). The bottom of Cuan Sound appears flat from east to west (across the Sound) but slopes down to the northern end: from 22 m. 100 m. south of Cuan ferry, to 32 m. and deeper some 200 m. north of the ferry. The substrate of the bottom is coarse slate gravel with many tumbled rocks and large boulders of various sizes up to 2 m. in diameter. The irregular nature of the bottom and the extremely rapid tidal currents cause almost constant turbulence in the Sound, visible at the surface as overfalls and whirlpools.



Representative section of Site 11 (southwest side)

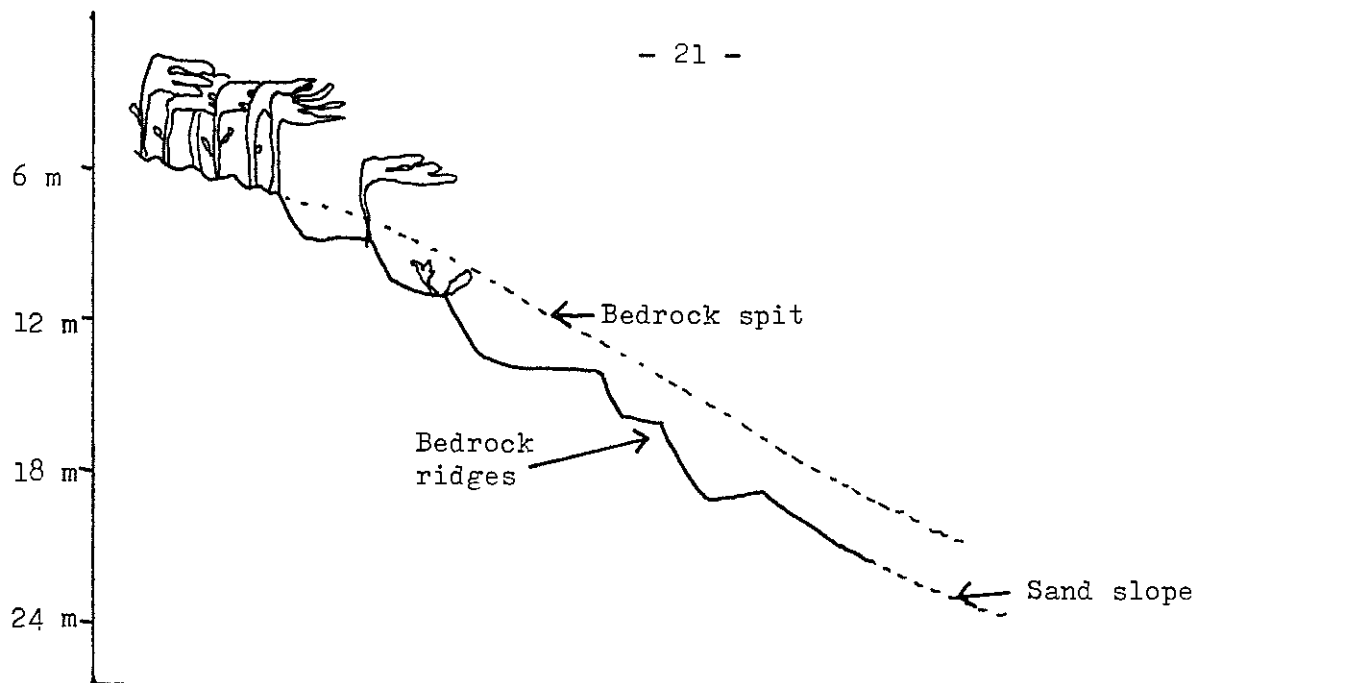
Slack water does occur, but is limited to two short periods in each complete tidal cycle (Buehr and Vaughan, personal records). The rocky sides of the channel below 18 m. and the boulders on the bottom are covered by a very characteristic association of sponges and Tubularia. Sagartia elegans of several varieties, and Pachymatisma are also particularly abundant. Alcyonium digitatum are only occasional on the channel floor, but form thick growths on the cliffs above 18 or 20 metres. An unusually large and colourful colony of Corynactis viridis was seen on these cliffs at 14 m. (in most other places in Lorne where it occurs, Corynactis is seen only as isolated, drab and inconspicuous individuals).

4.1.11 Cuan Sound Bay: Site 11. 56°16.1'N, 5°38' W

This is a shallow bay on the southwestern side of Cuan Sound (site 10). It is sheltered from wind and not appreciably affected by tidal currents. The bottom is a gradual northeastern slope from the shore to 11 - 13 m. (depending on the precise location) at which depth the slope increases, rocky outcrops appear and the cliffs which form the margin of the Sound fall to depths over 20 m. The bay is bounded laterally by outcrops of bedrock which extend down to 14 m., but the floor of the bay is of silty sand, with occasional large rocks (0.5 - 1 m.). There is thick Ascophyllum nodosum on shallow rock bearing Clava and Coryne. Thick growths of Laminaria saccharina and L. digitata are supported by the rocky ridges to the sides of the bay, and many detached fronds of these lie on the bottom. Most of the species recorded from the bay were associated with the kelp (nudibranchs or small crabs) or rocks (Sagartia and Actinothoe): Cerianthus and Tealia were the only conspicuous residents of the bottom proper.

4.1.12 Lunga (SE): Site 12. 56°12.3' N, 5°41' W

Dives were done just east of the un-named rock off the southeast corner of Lunga, just north of the east mouth of the Bealach a'Choin Glas. This is an east-facing shore, protected from the prevailing westerly winds but subjected to strong tidal currents (3 - 4 knots). The underwater topography is complex, involving bedrock outcrops in a slope (roughly 30°) of mud and sand. From a kelp forest on ridged but level rock at 6 m., a series of ledges falls to about 22 m., with pockets and shelves of silty sand between them. At 22 m. the slope is predominately fine sand, but with periodic bedrock ledges running parallel to the shore. These ledges are occasionally



Representative section of Site 12

interrupted by broad (3 - 5 m. subjective estimate) spits of bedrock extending out into the Sound, and providing in places a rocky substrate to 30 m. and deeper (personal records of MLB and KGV). There are a variety of habitats and substrates within a relatively small area at this site, and a variety of different species associations in them which overlap to some extent. The association of Axinella infundibuliformis, Diazona violacea, and Swiftia pallida that is characteristic of exposed cliffs (as at sites 6 and 14) is found here, but sponges are less abundant than at most cliff sites examined. Virgularia is locally common in some places. This is the site at which Amphianthus dohrni was first described living upon Swiftia, and the observation was repeated on this expedition. Leptometra celtica was also found here in 1980, and was seen again this year.

4.1.13 Sgeir Mhogalach: Site 13. 56°13.85' N, 5°42.5' W

This is a rock close to the eastern side of Eilean Dubh Mor, exposed to moderate wave action and moderate tidal currents. There is a rock slope of about 10° to 12 m. with a Laminaria hyperborea forest. At 12 m. the kelp forest ends and the slope increases to about 45°. Dive depths did not exceed 20 m., but the slope extends deeper. The substrate is largely bare bedrock with occasional crevices and shelves, scattered boulders (0.5 - 1 m.) and pockets of silty sand. The slope appeared to be dominated by Caryophylla and Ascidia mentula. The numbers of species and individuals was low: 75% of the rock was estimated to be clear of life. Amphianthus was seen

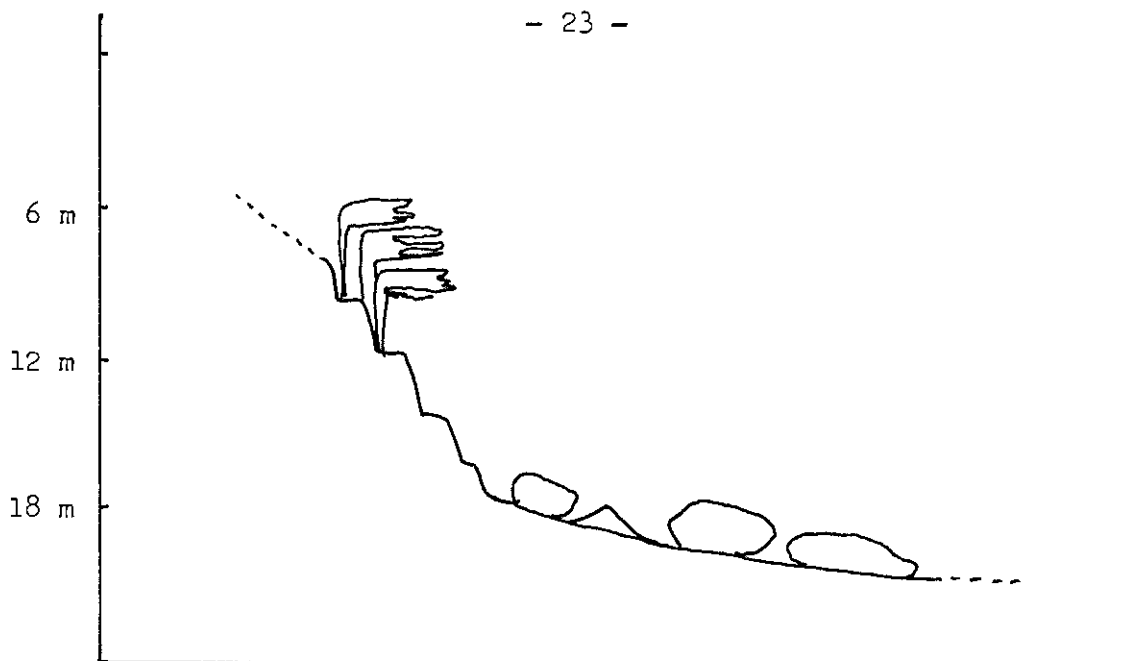
on Swiftia.

4.1.14 Culanach: Site 14. 56°16.2' N, 5°39' W

Culanach is an elongated rock which dries at low water, located off the western shore of Luing, just south of the mouth of Cuan Sound. It is exposed to considerable wave action if the wind is in the west, but tidal currents at the site appear to be moderate (2 knots or less). West of Culanach rock itself there is a broad (~150 m., but varying) underwater plateau of bedrock, with a depth varying from 8 m. in the south to 14 m. in the north. This breaks suddenly into a sheer drop to depths varying from 20 m. (at the southern extremity of the cliff) to 40 m. and deeper (in the north). The cliff runs roughly northeast - southwest, and is sheer in many places, interrupted only by small crevices and irregularities. When the bottom of the cliff was observed, the sea floor consisted of a fine sand and silt slope. One dive made on another occasion (personal records of MLB and KGV) at the northern part of the cliff revealed that the main cliff just described ended at 34 m. in a fall of large boulders (~2m. diameter) but that smaller cliffs, interspersed with short slopes of fine sand, continued to 45 m. and deeper. All dives during the present expedition were done on the central and southern sections of the cliff. The shallow plateau above the cliff bears a dense growth of Laminaria hyperborea. The cliff itself supports a very diverse fauna, and some foliose red algae down to 18 m. Ascidia mentula is abundant, and those species so characteristic of exposed cliffs (Axinella infundibuliformis, Diazona violacea and Swiftia pallida) are all frequent. Sponges and tunicates (especially Ciona intestinalis) are common. Holothuria forskali has been reported from this site (both in shallow water, and in 40 m. at the bottom of the cliff: personal records of MLB and KGV) but was not seen on this occasion.

4.1.15 Torsa Sound: Site 15. 56°16.95'N, 5°36.6'W

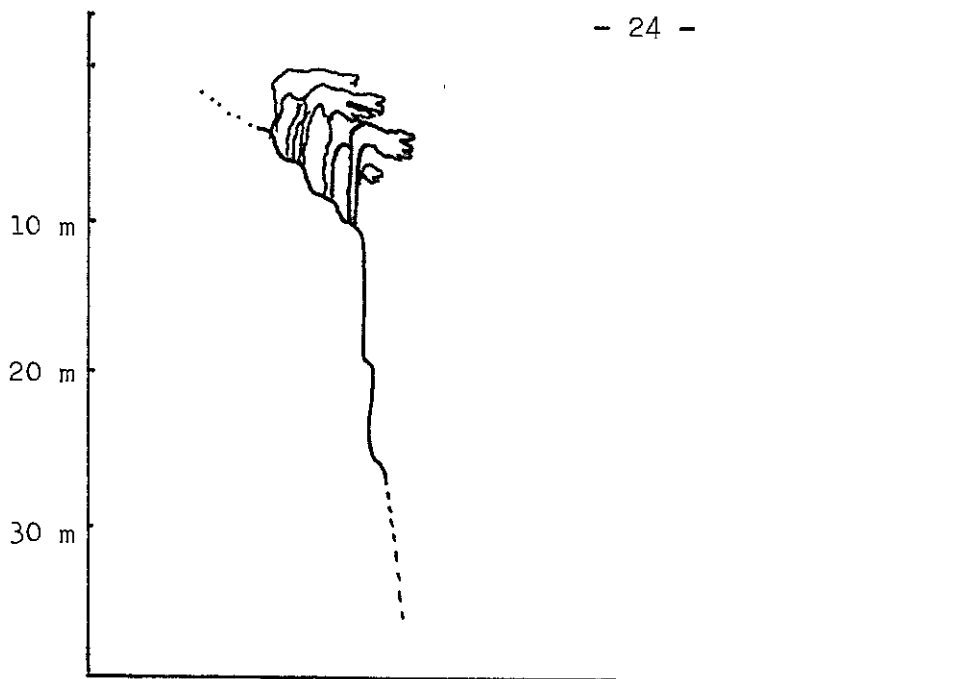
This is the channel between the islands of Seil and Torsa. It is well protected from winds from any direction, but is subject to extremely strong tidal currents (>5 knots). The east side of the Sound (the only site explored) is characterized by steep shelves of bedrock (with a thick Laminaria hyperborea forest above 12 m.) falling to 15 to 18 m., and then a relatively flat bottom of slate gravel sloping gradually towards the middle of the channel. There are numerous scattered outcrops and ridges of bedrock and slate on



Representative section of Site 15

this gravel bottom, with no apparent consistent orientation. There was no silting of the substrate under 14 m. The strong tidal currents during the dives limited the number of species observations made and photographs taken, but this appeared to be a site rich in number and variety of species. Although continuous with Cuan Sound (site 10) with a similar topography and similar exposure to strong tidal currents, this site differed from Cuan in many of the species seen. The Tubularia - sponge association so typical of the rocks at the bottom of Cuan Sound was absent. But there were thick growths of hydroids (especially Abietinaria abietina) not particularly conspicuous at Cuan. Nor were dense accumulations of Alcyonium found. However, Sagartia were abundant, and many nudibranchs were seen on the numerous hydroids (especially Doto spp. on Nemertesia).

4.1.16 Sgeir Leth a'Chuain: Site 16. $56^{\circ}13.8' N$, $5^{\circ}47.8' W$
Dives were done in a narrow sound between two islands of the Garbh Eileach chain. The site is moderately exposed to winds from the west and southwest. There is little information available about tidal currents in this sound, but according to local sources they are not strong (~ 2 knots). Rocky ledges of bedrock with a kelp forest fall from the surface at an angle of about $30 - 45^{\circ}$ to 10 m. There is then a sheer cliff to a charted depth of 45 m. The cliff was only explored above 25 m. In this area, it is broken



Representative section of Site 16

in places by small crevices and shelves, but there is in general an uninterrupted sheer fall and, in some places, undercuts. The cliff is thickly covered with life, including numerous Metridium senile (very rare or absent at other Lorne sites), Sagartia elegans of several varieties, and Pachymatisma. Antedon are extremely abundant on some ledges on the shallower part of the cliff (above 18 m.) and in places form an uninterrupted covering of the substrate. Just at the edge of the dropoff (10 m.) were assemblages of many Onchidoris bilamellata with large masses of egg coils. In this region were also large patches of bare rock bearing the marks of recently removed barnacles.

4.1.17 Dun Chonail: Site 17. 56°14.9' N, 5°44.9' W

This is a channel between the two northernmost islands of the Garbh Eileach chain, with moderate exposure to both wind and tidal currents. On the north-east side of the channel there is a continuous 45° slope of small boulders lying upon bedrock ridges from the surface to 18 m., at which depth there is a flat bottom of sand. The kelp forest (Laminaria hyperborea) stops at 12 m., but there are scattered plants to 18 m. The rocks are bare or covered with hydroid turf, and hydroids seemed the most numerically dominant group. Tunicates (especially Ascidia mentula and Ciona intestinalis) were common.

4.2 Habitats and communities

As previously mentioned, the Firth of Lorne is in many ways a very complex area, and it is difficult to draw generalizations about 'typical communities' that are applicable to all similar sites. In Lorne, two sites may be very close together, with apparently similar exposure to wind and tides, yet support quite different communities. Similarly, a normally uncommon species may be particularly abundant at two sites with apparently different environmental conditions. However, it is possible to define some associations of animal species which are conspicuous to the diver, and which seem to be typical of certain habitats.

4.2.1 Infralittoral bedrock. Thick Laminaria hyperborea forests grow on virtually all rocky shores (though other Laminaria species occur, especially at protected sites). The depth of this forest is often limited by a sudden drop-off of the bottom into sheer cliffs (as at sites 14 and 16) but where the bottom is a gradual rocky slope (as at site 7) the kelp forest is generally limited to a depth of 12 - 14 m., with occasional individual plants to 18 m. In exposed sites, the substrate of these kelp forests is normally clean, ridged bedrock covered with 'lithothamnion'. In sheltered sites (as 1 and 2) kelp often grows on silty rocks and boulders, as well as upon bedrock. In most areas the kelp forest supports a rich underflora of red algae, as well as many animal species. Though this region was not always extensively studied, our observations with regard to the common species at more exposed sites agree with those of Picton et al. (1982). However, kelp communities in the Loch Melfort area (sites 1 and 2) are much more limited both in the number of species and of individuals supported. Often, the animal species in a kelp forest clearly reflect the species commonly found in the deeper areas of the same site: eg., Metridium is common under kelp at site 16 (where it is abundant at depth) but largely unknown at other sites; Actinothoe is common at site 11 (which represents the shallow water margin of site 10, where Actinothoe is also common) but rare in other kelp communities.

4.2.2 Vertical cliffs. These were found at several sites, but because of conspicuous differences in the communities they support, will be described separately.

4.2.2.1 Sites 5 and 14: moderate exposure to wind, moderate exposure to tidal currents. These are perhaps the most 'typical' of cliffs and steep rock surfaces to the west of Luing, and they support a very characteristic association of species, the most conspicuous of which are Swiftia, the sponge Axinella infundibuliformis, and the ascidian Diazona violacea. Sponges of several species are abundant, and Hymedesmia nauperatus is particularly characteristic. Terebratulina is common. Caryophylla can be abundant on otherwise bare steep surfaces. Porania pulvillus is much more likely to be seen here than in other areas. The only specimens of Parazoanthus anguicomis so far known in the area are found at site 5. These cliffs support a great number of species and individuals of all phyla, and are of considerable marine biological interest.

4.2.2.2 Sites 10 and 15: very protected from wind, very strong tidal currents. Although geographically continuous, and similar in exposure to wind and current, these two sites support noticeably different communities. The cliffs at site 10 are typically covered with very thick growths of Alcyonium, Sagartia and Actinothoe. Tubularia, and Pachymatisma and other sponges are also abundant. This site supports an unusually dense growth of Corynactis viridis. Cliffs at site 15, on the other hand, are relatively poor in Alcyonium, Sagartia and sponges, but are rich in hydroids, in particular Abietinaria abietina.

4.2.2.3 Site 16: moderately exposed to wind; exposure to tidal currents uncertain but thought to be slight to moderate. This deep and sheer cliff is covered by a dense growth of Sagartia and Metridium (the latter species is otherwise very uncommon in the area of the survey). Pachymatisma is also common. This cliff was only explored to a depth of 25 m (though falling to a charted depth of 40 to 50 m.) and it is of course not possible to say whether or not deeper communities are similar to those seen in shallow water.

4.2.3 Boulder slopes. These are common in some form or another at most sites, and vary in species associations depending on the site.

4.2.3.1 Sites 1a and 2: tumbled rock slopes in very quiet water, moderately to well-protected from wind. In these sites silting of the rocks is moderate to high. The number of species and

of individuals is relatively low in comparison to that observed in more exposed sites. Echinus, Asterias and Marthasterias are abundant, and numerous very small individuals (1 - 2 cm.) are found. Fish are more commonly observed than at other sites, and include in particular Pholis gunnelis, Thorogobius epihippatus, Ctenolabrus rupestris, Labrus mixtus (male and female), pipefish, and shoals of small gadids (probably Pollachius). Crustaceans are numerous: shrimp of several species, Cancer, Liocarcinus puber and L. depurator, hermit crabs of several species, Hyas, Galathea and Munida are common. Chitons are locally abundant. At sites 1 and 2 (as well as at several other Loch Melfort sites not examined on the present expedition) there is also a very distinctive association of Protanthia, Gonactinia and Aurelia schyphystomae on 'lithothamnion' covered rocks (Phoronis and Anemonia are frequently found in the same situation) but whether this is due simply to the quiet water at this site, or whether some other factor is involved is not clear. Within the Firth of Lorne Protanthia seems to occur in abundance only in the Loch Melfort area. It is similarly abundant in other sheltered loch conditions (as in Loch Fyne: personal records of MLB and KGV) and factors in common to both sites include not only minimal wind and current exposure, but also fresh-water run-off (particularly great in Loch Melfort: data from Alan Brittain).

4.2.3.2 Sites 7,9,12 and 17: moderate exposure to wind and tidal currents. These sites are usually characterized by rocks of various sizes (15 - 150 cm.) scattered on slopes of bedrock or sand-gravel from 10 to 25 or 30 m. C.D. Normally these sites support very diverse communities consisting of a great variety of species, and it is difficult to select a few as characteristic of this category of habitat. However, dense growths of bryozoa are common (especially Securiflustra at site 7) and Antedon, though virtually ubiquitous in the Firth of Lorne, are particularly abundant in this type of habitat, in some places forming a continuous 'turf' on rock or kelp stipes. Crustaceans (including Munida, Liocarcinus puber, Cancer, Homarus and Palinurus) are common, as are the larger Asteroidea and some hydroids, especially Abietinaria and Nemertesia. Lentometra is found on a boulder slope at site 12, although apparently absent from other sites of similar topography and exposure. Besides these relatively shallow boulder slopes, many steeply sloping boulder screes can be found under the cliffs described in the preceding section, at depths from 30 to 50 metres. These were not investigated during

the present survey, but previous dives (personal records of MLB and KGV) have shown that these deep slopes support comparatively sparse animal communities consisting mostly of species common on the cliffs above them (especially Swiftia) or, in the sandy shelves and crevices between the rocks, of species characteristic of sand-mud bottoms.

4.2.4 Soft substrates

4.2.4.1 Coarse gravel and small stones. This substrate is commonly found in channels with very strong tidal currents (sites 10 and 15) or at shallow, shelving sites with evidence of wave action (sites 3 and 6). The gravel is mostly of slate and commonly has larger slates or other rocks embedded in it. Few animal species are visibly associated with the gravel itself, though Tealia felina can be common (especially along the bottom of embedded rocks) and Crossaster are occasionally seen. The larger rocks do, however, support communities which vary with the particular site (e.g., sponges and Tubularia at site 10; Laminaria hyperborea and its associated species at site 6).

4.2.4.2 Maerl. Small patches of dead maerl lying on silty sand at 10 m. were seen at site 11, but were so small and isolated that no particular community or species could be associated with them.

4.2.4.3 Coarse to medium sand and shell gravel. This was the predominant soft substrate beneath and between rocks at many sites to the west of Luing (e.g., 7, 9 and 12) and also at the foot of the cliffs at sites 5 and 14. It was not a homogeneous substance, however, and pockets of finer sand and silt were frequently found, especially between rocks. At many of the sites examined the sand and gravel formed a relatively small proportion of the total substrate, and it was consequently difficult to determine what species were specifically associated with it (rather than with the rocks between which it lay). It did appear, however, that rocky crevices with sandy floors were preferred habitats for some of the larger crustaceans (Murida, Homarus and Palinurus). Where broad expanses of coarse sand were found in deep water, Pecten maximus was common. At site 11, this substrate was associated with Cerianthus, Lanice and Tealia felina.

4.2.4.4 Fine sand and mud. Although found in isolated pockets at some exposed sites, this substrate is generally limited to sites protected from wind and tidal currents: in particular, sites

1b, 2 and 8. It is often combined with considerable shell debris, particularly in shallow, protected sites (as 1b). Previous dives (personal records of MLB and KGV) show that it is typical of virtually all sites to the east of Luing, from Ard Luing to Ardinamir, and east into Loch Melfort and Loch Shuna. In this area it supports a very distinctive association of species, including Pennatula, Nephrops, Cerianthus, Virgularia and Funiculina. Anseropoda is occasionally found. Pecten maximus and Chlamys opercularis were at one time abundant, but their numbers have declined drastically in recent years (personal records of MLB and KGV), possibly as a consequence of the intensive scallop-dredging that has recently taken place in this area. Site 8, to the west of Luing, is very similar to the Loch Melfort area in the nature of the substrate and in its sheltered position, and shares many of the same species, in particular Pennatula, Nephrops, Virgularia and Cerianthus. This site is particularly remarkable, however, as the home of two uncommon anthozoans (Pachycerianthus and Arachnanthus) at present unrecorded elsewhere in Lorne. This site is unusual in providing extremely sheltered conditions in the middle of an area noted for exposure to strong tidal currents and winds.

4.3 Species lists

The total number of species identified was small in comparison with the number reported by Smith (1984) and Picton et al. (1982). This is largely because most of the collection and identification work was not shared equally by all expedition members. Some members were relatively inexperienced in identifying marine life, or were primarily occupied with underwater photography (or, in some cases, both). However, the expedition was not intended to be devoted totally to collecting, but rather to combine some collection of marine life with a more general survey of selected habitats representative of those to be found in the area, and to photograph these habitats and the communities typically found in them. The photographs that were taken represent a substantial part of the expedition results, and it is unfortunate that financial considerations make it impossible to reproduce all of the relevant photographs in this report. Most of the photographs (originals or duplicates) are held by MLB, who also has a record of pictures of interest kept by other expedition members.

4.3.1 Algae (list and notes compiled by Norma Brandt) The number of species seen or collected was surprisingly limited compared with the diversity of animals. Laminaria hyperborea was the dominant species at all rocky sites. Most of the red algae were epiphytic on its stipes, or attached to the bedrock or cobbles under the kelp or just below the kelp limit. Desmarestia aculeata, Dictyota dichotoma and Cutleria multifida were the usual smaller brown algae. At many sites Delesseria sanguinea or Phycodrys rubens were the dominant epiphytes. They were usually very tattered and starting new growth upon the margins of the old, which made them difficult to distinguish from each other. At three sites where strong currents were probably experienced (sites 6, 10 and 15) Membranoptera was the commonest epiphytic red alga. The rocky sites were also notable for the many varied shapes and sizes of Callophyllis laciniata. The site at which the greatest diversity of algae was seen was the wreck of the 'Weldon' in Loch Buie (site 4). The outstandingly different site was Campbell's Rock in Loch Melfort (site 2) which was apparently carpeted equally with a greenish-brown alga and brittle stars. The definitive specimen was lost, but Stilophora rhizoides, which was collected near the shore, closely resembled the weed seen elsewhere in the loch. The survey of algae on this expedition was limited, as it was made by only one diver who was also involved with underwater photography.

CHLOROPHYTA

Cladophora sp. 1a, 2, 4, 6, 11. Common on rock in shallow water
Enteromorpha sp. 1a, 11. On shallow pebbles
Ulva sp. 7, 8, 11, 16. On shallow pebbles

PHAEOPHYTA

Alaria esculenta 4. Occasional patches on shallow rock
Asperococcus turneri 2.
Chorda filum 1a, 2, 8, 11. Occasional, mostly on slate
Chordaria fragiliformis 4
Cutleria multifida 1a, 6, 12, 16. Frequent on rock under kelp
Desmarestia aculeata 4, 5, 12. Frequent on rock under kelp
Dictyota dichotoma 4, 9. Frequent on rock under kelp at some sites
Furcellaria lumbricalis 4.
Halidrys siliciosa 1a, 8, 11, 15. Common on shallow rock.
Laminaria digitata 1a, 11. On stones in sandy places

Laminaria hyperborea all sites. Very common on rock
Laminaria saccharina 1a, 7, 8, 9, 11, 17. Common deeper than L. hyperborea
Sacchorhiza polyschides 8. Only one or two specimens
Stilophora rhizoides 2. Very abundant among mats of brittle stars

RHODOPHYTA

Acrosorium reptans 4, 7.
Acrosorium uncinatum 4, 16.
Adouinella sp. 15, 17.
Antithamnion plumula 7, 9. Epiphytic on other algae
Bonnemaisonia asparagoides 4, 5, 16, 17. Common on rock under kelp
Calliblepharis sp. 4. On wreck
Callophyllis lacina 4, 5, 6, 9, 12, 13, 15, 16, 17. Very abundant,
both on kelp stipes and rock below the kelp forest level
Ceramium sp. 1a, 4, 5, 7. Occasional
Chondrus crispus 4, 8, 11. On rock above chart datum
Cruoria sp. 5, 16, 17. Very abundant on rock under kelp, and on rock
below kelp level
Cryptopleura ramosa 5, 9, 15. Abundant on kelp stipes at site 5
Delesseria sanguinea 5, 6, 9, 10, 12, 13, 16, 17. Abundant on stipes
Dilsea carnosa 1a, 4, 11, 12. Occasional on cobbles
Gracilaria verrucosa 8. Occasional on pebbles in sand
Griffithsia corallinoides 4, 5, 7, 14, 16. Locally frequent on stipes
Heterosiphonia plumosa 5, 7, 16, 17. On rock or cobbles
Kallymenia reniformis 7, 13, 16. On rock or cobbles below the kelp level
Membranoptera alata 6, 10, 15. Very abundant on kelp stipes in
strong currents
Nitophylum punctatum 4, 12, 13. Occasional on kelp stipes
Odontothalia dentata 5, 9, 15. Locally frequent on stipes, or on
cobbles under kelp
Palmaria palmata 6, 10, 16. Frequent on kelp stipes near chart datum
Phycodrys rubens 4, 5, 6, 7, 8, 9, 14, 16, 17. Very abundant on
kelp stipes
Plocamium cartilagineum 1a, 4, 7, 9, 12, 13, 14, 16, 17. Very
abundant on rock or cobbles under kelp, and some on stipes
Polysiphonia urceolata 5.
Polysiphonia sp. 2, 4, 5, 6.
Ptilota plumosa 4, 5, 14. On kelp stipes
Rhodophyllis sp. 5. On rock, occasional
Scinaia turgida 12. On pebbles in clean sand (not recognizeably maerl)

'Lithothamnia' All sites

4.3.2 Porifera The number of sponges collected and identified was smaller than expected: both Picton et al. (1982) and Smith (1984) report a relatively greater number of species. This may in part be due to the (unintentional) concentration of the present survey on areas where sponges may not be particularly abundant. In particular, few dives were done in shallow water, or in which kelp forest communities were analysed in detail, but rather in deeper water where sponge populations were often sparse. Of the sites dived, those richest in number and variety of sponges were the steep cliff faces of the islands to the west of Luing (in particular site 5) most of which are subject to moderate tidal currents and moderate to heavy wave and surge action. The relationship of sponge density to tidal currents was not clear: at site 10 (very strong currents) sponges were abundant whereas at site 15, continuous with site 10 and with very strong currents, sponges were infrequent. The waters east of Luing (sites 1 and 2) support very few sponges: Suberites domuncula, S. carnosus and one specimen of Pachymatisma were the only ones observed sublittorally, and then infrequently. However, Smith (1984) reports Hymeniacion and Halichondria from the shores of Toberonochy (site 1). This could be due to the latter species growing on kelp stipes at shallow depths, while the divers in the present survey concentrated their efforts at greater depths.

Axinella infundibuliformis 5, 7, 9, 12, 13, 14, 16, 17. Common on vertical rock surfaces.

Clathrina coriacea 9, 17.

Cliona celata (raphyrus stage) 5, 14, 16. On vertical rock surfaces below 15 m.

Dysidea fragilis 17.

Halichondria panicea 4, 9, 11, 15, 17. Most frequently reported as epiphytic on kelp stipes.

Haliclona sp. M 5, 7, 14, 16. On vertical rock faces

Haliclona sp. J 7, 17.

Haliclona sp. E 5.

Hemimycale columella 5, 7, 12, 16.

Hymedesmia pauperatas 5, 14.

Hymedesmia sp. A 5.

? Hymedesmia sp. 5. Tentatively identified from a photograph by B. Picton as his Hymedesmia sp. B, previously recorded by him only from this site.

? Iophonopsis nigricans 5. Tentatively identified from a photograph by B. Picton.

Leucosolenia botryoides 5, 7, 9, 17.

Myxilla rosacea 6 (identified from a photograph).

Pachymatisma johnstonia 1a, 5, 6, 7, 9, 10, 14, 16, 17. Normally on vertical rock surfaces in areas of moderate to very strong tidal currents. Varies in abundance according to site: can be locally very abundant.

Polymastia boletiformis 5, 7, 9, 12, 13, 14, 16. Widely distributed but never common at any site.

Raspailia hispida 5, 7, 9, 12, 14, 16. Frequent in sites where it is found (rocky cliffs and vertical surfaces in moderate currents).

Raspailia ramosa 5, 16.

Stelligera rigida 5.

Stelligera stuposa 5 (identified from a photograph).

Suberites carnosus 1, 2, 5, 7, 12, 14, 16.

Suberites domuncula 1, 12, 14. Suberites was the only genus of sponge commonly found on the eastern side of Luing (sites 1 and 2) where both species were seen growing on rocks lying in or on the soft substrate. S. carnosus is more widespread than S. domuncula, and more abundant in those sites where they occur together.

Sycon ciliatum 11.

Tethya aurantium 14.

4.3.3 Hydrozoa Though there did not appear to be a great number of species at the sites inspected, the density of individuals could be quite high, especially at site 10 (Tubularia) and 15 (Abietinaria). Nemertesia, Halecium and Aglaeophenia were also common. Nemertesia was frequently associated with nudibranchs, especially Doto spp.. Hydroid 'turf' was recorded from both protected and exposed sites. Generally, the greatest number of species and individuals were found on rock substrata at sites subjected to wave action, tidal currents, or both.

Aglaeophenia sp. 4, 5, 6, 7, 9, 14, 15, 17. Common on exposed rock faces in moderate to strong tidal currents.

Abietinaria abietina 7, 10, 15, 16, 17. On rock. Occasional except at site 15 where it is extremely abundant and in places the numerically dominant species.

Bouganvillia ramosa 9, 14.

Clava squamata 9, 11. On Ascophyllum.

Coryne coryne 11. On Ascophyllum.

Diphasia rosacea 11. On kelp stipes.

Dynamena numila 16. Probably under-recorded: see Smith 1984.

Eudendrium sp. 14.

- Halecium halecinum 2, 10, 15, 16, 17. On rock. Particularly abundant at sites with strong currents, though also present in quiet water.
- Halopteris catharina 1a.
- Hydractinia echinata 1, 9, 11. On hermit crab shells. Probably under-recorded.
- Hydrallmania falcata 17.
- Kirchenpaueria pinnata 2, 5, 7, 9, 14.
- Kirchenpaueria sp. 8, 12.
- Nemertesia antennina 1a, 2, 7, 9, 10, 12, 13, 14, 15, 16, 17. On rock. Frequently associated with Doto spp and egg coils.
- Nemertesia ramosa 2.
- Nemertesia sp. 1a, 8.
- Obelia geniculata 1, 3, 5, 6, 7, 8, 9, 11, 13, 14, 15, 16. Very abundant on kelp fronds. Frequently associated with Dendro-notus frondosus. Probably occurs on kelp at all sites.
- Plumularia setacea 5, 10, 14.
- Polyplumaria frutescens 7, 9.
- Sertularia cupressina 17.
- Sertularia sp. 14.
- Thecocarpus myriophyllum 1a, 5, 7, 12, 14. Common and locally abundant.
- Tubularia indivisa 4, 10, 12. Abundant in areas of very strong current.
- Tubularia larynx 4.
- Hydroid "turf" 1a, 4, 5, 14.

4.3.4 Scyphozoa

- Aequorea vitrina 7. (identified from a photograph)
- Aurelia aurita "Adult" medusae infrequent at sites 1, 4 and 9. Scyphistomae extremely abundant at sites 1a and 2, where they form dense patches on the undersides of 'lithothamnion' covered rocks.
- Cyanea capillata 2, 4, 8. Occasional in wind-exposed bays and coves.
- Lucernaria campanulata 6, 8. On kelp fronds.

4.3.5 Anthozoa 28 species were identified (including the unconfirmed identifications of Isozoanthus and Tealia eques) which is greater than the number of anthozoan species seen in previous NCC surveys of the west of Scotland (see summary in Picton et al. 1982). Though the initial impression of the divers on this survey was that anthozoan species were few, many species (Metridium, Actinothoe, Pennatula, Sagartia, Swiftia), though not widely

distributed, are extremely abundant where they do occur.

Actinia ecuina 1, 11. Very shallow.

Adamsia maculata 1, 2. Very common on hermit crabs.

Alcyonium digitatum All sites except 11. The abundance and robustness of specimens appeared in most cases to vary directly with current strength. In some cases the nature of the rocky substrate seemed to influence the number of individuals at a site (see site 7). Small specimens were frequent on kelp stipes.

Alcyonium glomeratum 12. One small specimen on kelp stipe.

Amphianthus dohrnii 12, 13. On Swiftia.

Anemonia sulcata 1a, 2. Reported only from the Loch Melfort area, where it is commonly associated with brittle star beds.

Arachnanthus sarsi 8. Reported from this site by Picton et al. (1982) and seen again by the present expedition.

Actinothoe sphyrodeta 10, 11, 12, 14, 15, 16, 17. Locally abundant.

Cereus pedunculatus 2.

Cerianthus lloydi 1b, 8, 11, 12. Locally common in soft sediments.

Caryophyllia smithi 1a, 2, 4, 5, 6, 7, 9, 12, 13, 14, 15, 17.
Probably at all sites. Particularly typical of smooth, steep slopes of bare bedrock, in which situation they may be the numerically dominant species.

Corynactis viridis 10, 14, 16. Only at site 10 were these abundant. At sites 14 and 16 they were isolated and inconspicuous, and it is possible that they may have been overlooked at other sites.

Epizoanthus couchii 5, 7, 17.

(Funiculina quadrangularis Known from site 1b at depths below 25 meters (MLB and KGV personal records) but not noted on the present expedition, most probably because dives were not made to the appropriate depths.)

Gonactinia prolifera 2. Occasional among Protanthes.

?Isozoanthus sulcatus 14.

Pachycerianthus multiplicatus 8.

Parazoanthus anguicomis 5.

Pennatula phosphorea 1b, 8. Locally common.

Protanthes simplex 1a, 2. Locally abundant along the shores of Loch Melfort (MLB and KGV personal records).

Sagartia elegans var. venusta 4, 10, 12, 15, 16, 17.

Sagartia elegans var. miniata 4, 9, 10, 16, 17.

Sagartia elegans var. nivea 4, 10, 12, 15, 16.

Sagartia elegans var. rosea 10.

At sites 10 and 16 this species is very abundant, forming large patches on rock and in many places the numerically dominant species.

Sagartia troglodytes 4.

Sagartiogeton undatus 1b. (identified from photograph)

Sarcodictyon roseum 5, 8, 15. On stones and shells.

Swiftia pallida 5, 9, 12, 13, 14. Typically on rock or in shallow pockets of sediment in exposed, steep, rocky areas. Locally common.

?Tealia eques 5. Tentacles retracted: identification not confirmed.

Tealia felina 1a, 2, 3, 4, 5, 6, 7, 9, 11, 12, 15, 16, 17. Among rocks and gravel in shallow water. The most widely distributed of the anemones, though nowhere particularly abundant.

Virgularia mirabilis 1b, 8, 9, 12. In soft sediment, below about 12 metres. Tolerant of current at site 12.

4.3.6 Ctenophora

Pleurobrachia sp. 1, 7, 8, 9, 11.

Beroe sp. 7.

4.3.7 Platyhelminthes

Oligocladus sanguinolenta 1b.

4.3.8 Nemertina

Amphiporus lactiflorens 4.

Cerebratulus fuscus 4, 15.

Gibulanus sp. 1a.

Lineus longissimus 1a, 2, 4, 5, 16.

Oerstaedia dorsalis 4, 15.

4.3.9 Annelida

Alentia gelatinosa 2. Identified from photograph.

Arenicola marina 8, 9, 11, 12.

Chaetopterus variopedatus 1a, 2. Common in the Loch Melfort area.

Eunicid sp. 8.

?Eunoe nodosa 12.

?Eupolytmia nebulosa 1a.

Filograna implexa 5, 7, 9, 12, 14, 15, 17. At site 5, forms large aggregations on Sabella tubes.

Harmothoe extenuata 1a, 4, 5.

Harmothoe impar 4, 9.

Hesionids 10.

Hydroides norwegica 1b, 8.

Lanice conchilega 1, 2, 8.

Lepidonotus clava 10.

Lepidonotus squamatus 2, 4, 5, 10, 12.

Myxicola infundibulum 1b, 8.

Nereis pelagica 4, 5.

Pectinaria koreni 8.

Polydora sp. 2.

Polymnia nebulosa 1a. Identified from a photograph.

Pomatoceros triquetus 1, 2, 5, 6, 7, 9, 10, 11, 12, 14, 15, 16.

Probably at all sites.

Sabella pavonina 1, 2, 4, 5, 7, 9, 12, 14, 15, 16, 17. Mostly small, isolated individuals except for dense growths on mooring chains and ropes at site 1, and a large group of unusually robust specimens on a rock underhang at site 5.

Spirorbis sp. 1, 2, 11, 14. On kelp fronds and other algae. Probably under-reported.

Syllid sp. 4.

Terebellid sp. 7, 15

4.3.10 Phoronidae

Phoronis sp. 2. Locally common in Loch Melfort

4.3.11 Sipuncula

Achelia sp. 5.

Golfingia sp. 5

Nymphon sp. 5

4.3.12 Mollusca The diversity of species recorded at any one site largely reflects the extent and nature of the collecting done at that site: eg., at site 8, where a dredge sample was taken, the number of species is high. At other sites, those species living upon kelp and other easily collectable substrata will be represented more frequently than those from less accessible habitats. Eledone was unusually abundant in the region; local residents on Luing referred to a "plague of octopus" this autumn. The most numerically abundant nudibranch was Dendronotus frondosus, though it appeared absent from the Loch Melfort area. Records of observations made at other times of the year (MLB and KGV personal records) do not record this species in comparable numbers, with the exception of dives made in the winter of 1977. It is possible that the local abundance of Dendronotus may be seasonal.

- Abra alba 1, 8
Abra nitida 8.
Acanthocardia echinata 8.
Acanthochitona crinitus 14, 16.
Acmaea virginea 16.
Aequipecten (=Chlamys) opercularis 1, 7, 12, 15, 16.
Anomia sp. 1, 3, 7, 9, 12, 14, 16.
Antalis (=Dentalium) entalis 8.
Buccinum undatum 1, 3, 4, 6.
Calliostoma ziziphinum 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16, 17.
Callochitona achatinus 2, 16.
Chamelea gallina (=Venus striatula) 8.
Chlamys distorta 10.
Chlamys sp. , 7, 8, 9, 12, 13, 14, 17.
Circomphalus (=Venus) casina 8, 10.
Clausinella (=Venus) fasciata 8.
Corbula gibba 8.
Crenella decussata 8.
Emarginula fissuria 1, 2, 12.
Ensis sp. (shell) 4, 9.
Helcion pellucidum (=Patina pellucida) 1, 3, 4, 12, 14, 16.
Hiatella arctica 4, 12, 15, 16.
Hinia incrassatus 4.
Hinia (=Nassarius) reticulata 4.
Jujubinus (=Cantharidus) clelandi 1b.
Kellia suborbicularis 8.
Lacuna crassior 15.
Lacuna pallidula 16.
Lacuna parva 14.
Lacuna vincta 3, 4, 5, 9, 11, 12, 14, 15, 16.
Lamellaria latens 5, 10, 14, 15.
Lamellaria perspicua 5.
Lepidopleurus asellus 1, 2, 8.
Lepidopleurus sp. 9.
Limatula subauriculata 8.
Littorina mariae 12.
Lucinoma borealis 8.
Lunatia (=Natica) alderi 3.
Lyonsia norwegica 8.
Margarites helycinus 8, 12, 16.

- Modiolarca tumida 10, 12, 14.
Modiolula phaseolina 8.
Modiolus modiolus 8.
Monia patelliformis 1.
Monodonta sp. 5.
Musculus discors 10, 14, 15, 16.
Musculus marmoratus 1.
Mya truncata 8, 12, 16.
Mya sp. 1b, 11.
Myrtea spinifera 8.
Mysella bidentata 8.
Mysia undata 8.
Mytilus edulis 1a, 4, 16.
Nassarius sp. 7.
Nucella capillus 10.
Odostomia eulimoides 8, 12.
Onoba semicostata 8, 16, 17.
Palliolum (=Chlamys) similis 8.
Palliolum tigerinum (=Chlamys tigerina) 10.
Paphia (=Venerupis) rhomboides 8.
Parvicardium ovale 8.
Parvicardium scabrum 8.
Pecten maximus 1, 2, 8, 9, 11, 12, 13.
Phaxas pellucidum 8.
Pododesmus (=Monia) patelliformis 1, 8, 10, 12.
Pododesmus (=Heteronomia) souamula 12, 14.
Proneomenia aglaeopheniae 1b, 8.
Rissoa interrupta 4, 12, 14.
Rissoa parva 4, 5, 8, 12, 14, 15, 17.
Skeneopsis planorbis 12.
Tellina tenuis 8.
Thracia villosiuscula 8.
Thyasira flexuosa 8.
Timoclea (=Venus) ovata 8.
Tonicella marmorea 1.
Tricolia pullus 12, 14, 15.
Trivia arctica 1, 4, 8, 14.
Trivia monacha 12, 14, 16, 17.
Turbona beanii 8, 15.
Turritella communis 1, 2, 7.

Venerupis senegalensis (= V. pullastra)

Opisthobranchs

Acanthodoris pilosa 3, 5, 12, 14.

Adalaria sp. 8.

Antiopella cristata 8, 9, 14, 15.

Aplysia punctata 4, 5, 6, 8, 9, 14. Common on red algae. At some sites associated with egg masses.

Archidoris pseudoargus 1, 3, 4, 7, 12, 17.

Cadlina laevis 1, 5, 6, 14.

Coryphella lineata 1a.

Coryphella pellucida 9.

Coryphella verrucosa 1, 7, 9.

Cuthona sp. 5, 15, 16.

Dendronotus frondosus 4, 7, 8, 9, 11, 12, 15, 17. Common on kelp fronds with Obelia.

Doto coronata 14, 16, 17.

Doto fragilis 9, 14. With egg coils on Nemertesia.

Doto hystrix 1.

Doto pinnatifida 15. With egg coils on Nemertesia.

Elysia viridis 1a, 2.

Eubranchus farrani 9, 15.

Eubranchus pallidus 1b.

Eubranchus tricolor 9, 12, 17.

Eubranchus sp. 12, 15.

Eubranchus ?new species. 14. Identified from photograph by B. Picton as possibly identical with new species described by him from western Ireland.

Facelina bostoniensis 1, 12. At site 1, on cables and ropes among Mytilus.

Facelina coronata 9. With eggs on Bougainvillea ramosa.

Goniodoris castanea 5.

Goniodoris nodosa 4, 5, 10, 12, 15, 16.

Hero formosa 7, 9.

Hero sp. 7.

Jorunna tomentosa 1a.

Limacea clavigera 2, 5, 15, 17.

Onchidoris bilamellata 4, 16. With eggs at site 16.

Onchidoris muricata 10, 11, 17.

Polycera faeroensis 3, 8, 9, 12, 14, 17. On Membranipora.

Polycera quadrilineata 7, 9, 15. On Membranipora.

Tritonia hombergi 4, 7, 9.

Tritonia lineata 5, 14. One pair copulating at site 14.

Cephalopoda

Eledone cirrhosa 1, 4, 7, 9, 12, 14, 16. In shallow water (above 10 metres) among tangled weeds.

Brachiopoda

Terebratulina retusa 1, 2, 5, 7, 9, 12, 14, 15. Especially common on steep, rocky cliffs subjected to moderate tidal currents.

4.3.13 Bryozoa Few species were recorded in spite of frequent collection of kelp stipes. Bryozoan turfs appeared rare. The most common species was Securiflustra securifrons which often formed dense patches on rock in moderately exposed positions. Other species were locally common (such as Omaissecosa at site 5 and Porella at site 9).

Alcyonidium gelatinosum 2, 3, 5, 9, 16, 17. Isolated specimens on rock.

Alcyonidium hirsutum 4.

Bugula sp. 4, 5, 7, 9, 10, 12, 16, 17. Common on rock surfaces.

Caberea ellisii 14.

Cellaria sp. 5, 12, 15.

'Crisiidae' 3, 4, 5, 9, 12, 14, 15.

Electra pilosa 2, 11, 12, 15. On kelp.

Flustra foliacea 7, 9, 12, 13, 16.

Membranipora membranacea. 3, 4, 5, 12, 15. Very common: not regularly reported but probably present at all sites.

Omaissecosa sp. 5, 9, 14. At 5 forms encrusting growths on Sabella tubes.

Porella compressa 5, 7, 9. Some very thick growths at site 9.

Scrupocellaria reptans 4, 9, 11, 12, 14, 15.

Securiflustra securifrons 1, 5, 7, 9, 12, 13, 14, 15, 16, 17.
Abundant at sites 5 and 7.

Encrusting bryozoa 1, 2, 4, 9, 12, 14, 16, 17.

4.3.14 Arthropoda

4.3.14.1 Cirripedia Cirripeds were widely distributed but nowhere very common (in the depths at which most dives were done) except at site 16, where large patches of barnacles appeared to have been denuded, probably by Onchidoris bilamellata, which were also abundant in the area.

Balanus balanus 1, 5, 12, 16, 17.
Balanus crenatus 1, 4, 11, 14, 16.
Verruca stroemia 3, 4. On Laminaria

4.3.14.2 Decapoda

Cancer pagurus Reported from all sites except 3 and 15. Probably at all sites. Found in a variety of habitats, from kelp forests to crevices in steep cliffs, to flat sediment plains.

Carcinus maenas 1, 9, 10, 11.

Caprellidae (mostly recorded as Caprella linearis) 4, 5, 9, 10, 12, 16.
Noted as 'common' when recorded: probably under-reported.

Crangon crangon 12.

Ebalia tuberosa 11.

Ebalia tumifacta 8.

Galathea strigosa 1a, 5, 7, 9.

Galathea sp. 6, 9, 11.

Homarus vulgaris 1a, 2, 4, 5, 10, 14.

Hyas araneus 1, 4, 10, 11, 17.

Hyas coarctatus 8, 10.

Hyas sp. 9.

Idotea pelagica 10.

Inachus phalangium 1a, 5, 10. Can be locally very common in shallow kelp.

Inachus dorsettensis 1b, 16.

Inachus ?leptochirus 9.

Inachus sp. 1, 9.

Liocarcinus depurator 1, 2, 8, 9, 10, 16, 17. On sand and sediment.

Liocarcinus puber Recorded from all sites.

Macropodia rostrata 2.

Macropodia sp. 5, 6, 7, 9, 11. Probably mostly M. rostrata? Common among kelp.

Munida bamffica 1, 2, 5, 7, 9, 12, 13, 16, 17. Widespread; usually in rocky crevices.

Nephrops norvegicus (burrows) 1b, 8.

Palinurus elephas 5, 7, 9, 13, 14. On steep boulder slopes and rocky crevices.

Pagurus bernhardus 16.

Pagurus prideauxi 1, 16.

Pagurus sp. 1, 11.

Palaemon serratus 4.

Xantho pilipes 1.

"Shrimps and prawns" were abundant at nearly all sites (with the

exception of sites 10, 11 and 15). These were difficult to collect, and no identification underwater was attempted. Photographs were taken of several specimens, but identification of these has proven difficult.

4.3.14.3 Pycnogonida These were not systematically collected, but specimens were occasionally found in collections of other animals.

Nymphon sp. 5.

Endeis spinosa 10.

4.3.15 Echinodermata Large echinoderms are some of the most conspicuous and numerous of animals in the Firth of Lorne. Asterias, Echinus, Crossaster and Antedon were virtually ubiquitous in all the sites visited, and other asteroidea are also very common. The presence of Leptometra celtica in relatively shallow water (18 m.) was first noted in this area in 1980 at site 12 (MLB and KGV, personal records), recorded from an adjacent site in 1982 (Picton et al 1982) and reconfirmed by the present survey. (All individuals of this species so far seen appeared to be conspicuously striped in red and white.) Though brittle stars are common throughout the area, extensive beds (mostly Ophiothrix fragilis) were only seen at site 2, upon a substrate of silt-covered bedrock. The Loch Melfort area was also noted for the large quantities of very small (1-2 cm or smaller) specimens of Echinus and Asterias reported.

Acrocnida brachiata 8.

Amphipholis squamata 4.

Amphiura sp. 2.

Anseropoda placenta 1b.

Antedon bifida Reported from all sites except 10 and 11, but probably can be found in all parts of the area. Forms dense "turf" on rock and Laminaria stipes at sites 7 and 16.

Asterias rubens Reported from all sites.

Astropecten irregularis 1b.

Crossaster papposus Reported from all sites except 10.

Cucumaria saxicola 7, ?16.

Cucumaria sp. 7, 8.

Echinocyamus pusillus 8.

Echinus esculentus All sites except mid-channel of site 10. Variable density, but never very thickly abundant except at site 1a.

Henricia oculata Occasional at all sites.

(Holothuria forskali) Known from site 14 (MLB and KGV personal records) but not recorded on this survey.

Labidoplax buski 9.

Leptometra celtica 8, 12.

Leptopentacta elongata 2 In silty sand.

Luidia ciliaris 9 One specimen only

Marthasterias glacialis 1, 2, 3, 4, 5, 7, 9, 10, 12, 14, 15, 16, 17.
Common at site 1; otherwise occasional.

Ophiocomina nigra 1, 2, 7, 9, 12, 17.

Ophiothrix fragilis 1, 2, 4, 7, 9, 9, 12, 17. Forms extensive beds at site 2.

Ophiura albida 1, 2, 7, 8, 9, 12, 16.

Ophiura texturata 1.

Ophiura sp. 1, 7, 9.

Porania pulvillus 5, 14. Occasional.

Psammechinus miliaris 15.

Solaster endeca 1, 3, 5, 9, 12, 14, 16.

4.3.16 Ascideacea Large solitary ascidians are common, and Asciidiella aspersa, Ascidia mentula and Ascidia virginea probably occur at all sites. Diazona violacea is one of the most characteristic species of steep rocky cliffs in exposed conditions, and can be seen in many sizes from collections of a few individuals to colonies with a diameter of 20 cm and more. Moribund and necrotic colonies were also seen at site 14. Smaller colonial and encrusting species are common on kelp stipes and fronds in sheltered or moderately exposed sites.

?Aplidium sp. 12, 14

Ascidia conchilega 12.

Ascidia mentula 1, 2, 5, 7, 9, 12, 13, 14, 15, 16, 17.

Ascidia virginea 1, 2, 4, 5, 7, 9, 12, 13, 14, 16, 17.

Asciidiella aspersa 1, 2, 3, 4, 5, 7, 9, 11, 12, 14, 15, 16, 17.

Asciidiella scabra 12, 14, 15.

Botryllus schlosseri 2, 4, 5, 6, 7, 9, 11, 12, 13, 14, 15, 16, 17.
Probably at all sites: on kelp stipes and fronds.

Ciona intestinalis 1, 2, 4, 5, 9, 12, 14, 16, 17.

Clavelina lepadiformis 1, 2, 4, 5, 12. Small aggregations and individuals only.

Corella parallelogramma 1, 2, 7, 8, 9, 12, 14, 15, 16. Common.

Diazona violacea 5, 7, 12, 14, 16. On steep rock faces in exposed conditions.

Didemnidae 1, 2, 4, 5, 7. On kelp.

Diplosoma listerianum 5. On kelp.
Distaplia rosa 11.
?Lissoclinum argyllense 12.
Molgula spp. 9, 11, 12.
'Polyclinidae' 7, 9, 11, 12, 15. On kelp.
Sidnyum ?elegans 7, 14.

4.3.17 Pisces Most fish seen by the divers were distinctive enough to be readily identified underwater or from photographs. The frequency of Scyliorhynchus at most sites was high, but is probably a seasonally variable phenomenon (MLB and KGV personal records). Thorogobius epihippiatus occurred more frequently than expected and, given its shy temperament, is probably under-recorded. Pholis gunnellis, Lophias piscatorius, Pomatoschistus pictus, Myoxocephalus scorpius and Labrus mixtus are all commonly seen by divers in this area.

Agonos cataphractus 11. One specimen.
Callionymus lyra 11. Female: on sand among weed.
Ciliata mustela 1a. One specimen.
Conger conger 6. One small specimen.
Crenilabrus melops 1, 2.
Ctenolabrus rupestris 1, 2, 5, 7, 9, 13, 16, 17. Common among rocks.
Cyclopterus lumous 3, 16. Small specimens in kelp.
Diplecogaster bimaculata 1b.
small gadids: probably juvenile Pollachius 1, 2, 5, 15.
Gobiusculus flavescens 1, 9, 11. Common in kelp: probably under-reported.
Labrus bergylta 1a, 2, 4. Among rocks, boulders and in wreck.
Labrus mixtus 1a, 5, 14, 15, 16, 17. Mostly females: one male at site
1a. Typically found at bottom of cliffs just off sediment
bottom.
Lophius piscatorius 1, 2, 7, 12.
Molva molva 1, 7, 14, 17.
Myoxocephalus scorpius 2, 8. Frequent on soft sediments.
Pholis gunnellis 1, 2, 7, 9, 10, 17. Frequent among weedy rocks.
Pleuronectes platessa 8, 11, 12.
Pollachius pollachius 1, 2, 3, 4.
Pomatoschistus pictus 1, 2, 3, 9. Common on sand.
Scyliorhinus canicula 1, 2, 6, 7, 8, 10, 13, 16. Egg cases at 9 and 12.
Spinachia spinachia 1a, 2. Frequent in kelp.
Syngnathus sp. 1a.

Taurulus bubalis 4, 9.

Thorogobius epihippiatus 1a, 2, 6. In rocky crevices.

Trisopterus minutus 1, 5, 12, 13.

4.3.18 Mammalia Seals were seen in the water near most sites, but were most abundant near the islands to the west of Luing. All appeared to be grey seals (Halichoerus grypus) though both grey and common seals have been reported from Luing (see Berry, 1983). Small groups (6 to 10) could often be seen hauled out of the water on sheltered, sunny rocks. Judging by the white coats of the juveniles, these groups consisted of both young and adult seals. Sea otters were often seen swimming and diving among kelp in shallow water: Cuan Sound (site 10) seemed to be an especially favoured haunt of otters.

5. CONCLUDING REMARKS

5.1 Use of photography on the survey

One of the aims of the present survey was to use photography as a marine survey tool. In all, some 1500 pictures were taken with several different photographic systems. The emphasis on photography proved advantageous in some ways and a handicap in others. The concentration of many expedition members on photography inevitably meant that less time than usual was spent on collection. This is reflected in some of the relatively short species lists that resulted from the expedition. There is clearly much scope for intensive collecting work to be done in the area: many unusual species have already been found and doubtless many more remain to be described. The photographs that resulted from the expedition have, however, contributed a great deal to the value of the survey. In the first place, they give a clear picture of the nature of the underwater habitats and communities encountered. Specimens could be identified from photographs and, in many cases, species of interest have been found as accidental inclusions in pictures taken of other animals, though unrecorded on the dive itself. Photographs also proved useful in determining the local distribution of common species. After a few dives, species like Asterias or Antedon were so common as to become virtually "invisible" to divers. Photographs, however, provided proof of their presence at a site, and frequently estimates of their relative frequency could be made from pictures. Most of the expedition photographs have not yet been examined in any great detail, but will doubtless yield information

further to that included in this report.

5.2 Conservation aspects

The two surveys previously conducted of the marine life of the Lorne area (Smith 1984; Picton et al. 1982) are in full agreement that the Firth of Lorne is an area unusually rich in diversity of marine fauna. Several unusual species and associations have been found in the area, and more doubtless remain to be discovered. One authority (B. Picton, personal communication) believes that more than one new species will be found in the Lorne area. One reason for the observed and expected variety of marine life is probably the mosaic of very different environmental conditions which can be found within a small geographical area, some of which have been described in this report. Another contributing factor may be the 'boundary' nature of the Firth of Lorne: it lies near the distribution boundaries of many species typical of both northern and southern faunas. The fact that it is presently relatively free from most kinds of pollution may also contribute to the number and variety of marine animals in the region. It is clear that further surveys will be necessary before the full diversity of the life in the seas of this part of Scotland can be appreciated, and in view of the unusual species so far found in the area, such surveys should have a high priority. In summary, a quotation from S. Smith (1984) is particularly appropriate: "It is suggested that Luing, Seil and the outer islands should be regarded as one unit of the highest conservation value, of a quality suitable for consideration as a Marine Reserve."

5.3 Acknowledgements

All the members of the survey team worked long and hard towards the success of the expedition. Ken Vaughan took total charge of all equipment and camera maintenance, and also took most of the wide-angle habitat photographs, as well as doing all the on-site film processing. Tony Hunt and Steve Redfern kept scrupulously careful dive records, and Alan Brittain did much useful background research on the geology of the area. The great majority of the specimen identification was done by Norma Brandt, Dick Manuel and, in particular, Dr Shelagh Smith. We are all very grateful to the skipper of the MV Paula, Bruce Howard, who not only dived with us but took underwater photographs and in other ways entered into the spirit of the expedition. Frances Dipper, Bernard Picton and Dick Manuel identified many of the survey photographs, and we are also grateful to those experts who identified pictures through the M.C.S. Photographic Project.

Finally, we thank those bodies who provided the necessary financial support for the expedition: the Nature Conservancy Council, the Silver Jubilee Fund of the British Sub-Aqua Club, and Seahire (Underwater Photographic Equipment Hire). It would have been impossible for the survey to have been done without their assistance.

6. REFERENCES

- Anderton, R., & Bowes, D. R. 1983. Precambrian and Palaeozoic rocks of the Inner Hebrides. Proc. Roy. Soc. Edinburgh 83B:31-45
- Berry, R. J. 1983. Evolution of animals and plants in the Inner Hebrides. Proc. Roy. Soc. Edinburgh 83B:433-447.
- Donaldson, C. H. 1983. Tertiary igneous activity in the Inner Hebrides. Proc. Roy. Soc. Edinburgh 83B: 65-81.
- Hudson, 1983. Mesozoic sedimentation and sedimentary rocks in the Inner Hebrides. Proc. Roy. Soc. Edinburgh 83B:47-63.
- Mitchell, R., Earll, R. C., & Dipper, F. A. 1983. Shallow sublittoral ecosystems in the Inner Hebrides. Proc. Roy. Soc. Edinburgh 83B: 161-184.
- Peacock, J. D. 1983. Quaternary geology of the Inner Hebrides. Proc. Roy. Soc. Edinburgh 83B: 83-89.
- Picton, B. E., Howson, C. M., Connor, D. W., & Williams, A. 1982. Sublittoral Survey of Scarba, Lunga and the Garvellachs. Report to the Nature Conservancy Council.
- Smith, S. 1984. The shores of Luing and the Garvellachs. Report to the Nature Conservancy Council.

The following selection of photographs does not necessarily represent the best of the pictures taken on the expedition, nor does it include pictures of the most interesting species seen. Rather, the pictures were chosen to give some idea of the different sites visited, and the variety of habitats and substrates seen. The quality of the following prints is considerably inferior to the quality of the transparencies from which they were taken: much information is available from the transparencies which is not apparent from the prints. Nevertheless, they do give some idea of some of the uses of photography on a marine survey.

Plate 1

Site 1a: 7 m. In the sheltered bays to the north and south of the slate jetty Echinus are abundant, and there is little other life on the silty rocks.

Plate 2

Site 7: 10 m. Octopus were frequently seen: mostly hidden in tangled weed in shallow water.

Plate 3

Site 1a: 10 m. The slates at the end of the jetty are less silty. The rocks form crevices which are used by small animals as shelter, and also provide substrate for other animals (in this case, mainly hydroids and ascidians).

Plate 4

Site 14: 22 m. A steep drop on Culanach cliff with many different species, including Antedon, Terebratulina, Henricia, Filograna, Securiflustra, Caryophyllia, several sponges, hydroids, and ascidians (the photograph is more easily analyzed as a transparency than as a print).



Plate 5

Site 2: 20 m. The shell-silt bottom of Loch Melfort at the foot of the rocky slope of Eilean Coltair. Included in the picture are Antedon, Liocarcinus, Cancer, and Marthasterias.

Plate 6

Site 1b: 20 m. The shell-silt bottom of Loch Shuna, with Inachus camouflaged by sponge growth and a clinging brittle star.

Plate 7

Site 9: 12 m. Stipe of Laminaria completely covered with Antedon bifida. Similar Antedon 'turf' was occasionally seen on horizontal rock surfaces here and at site 16.

Plate 8

Site 5: 18 m. Large Sabella growing on an undercut cliff, with stems bearing much encrusting growth. Sabella of comparable size or density were not seen at any other site.

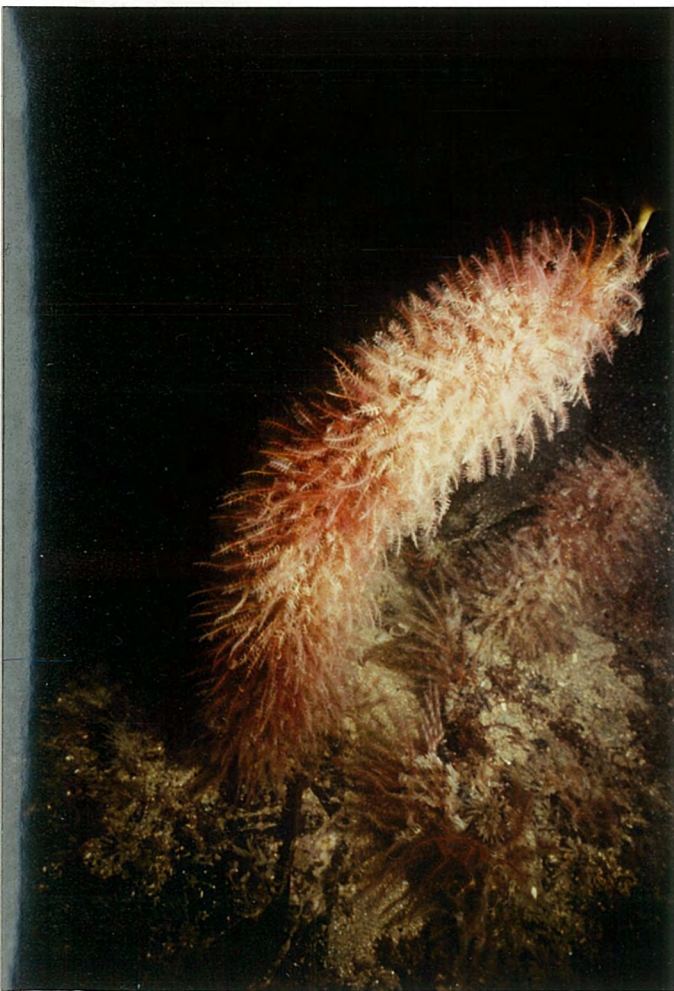


Plate 9

Site 16: 15 m. Sheer rock face thickly covered with Sargartia and Metridium (the latter with tentacles retracted). Occasional sponges and Alcyonium share the rock face.

Plate 10

Site 10: 15 m. Tumbled boulders on the floor of Cuan Sound. The growth of Tubularia and encrusting sponge is very typical of this area.

Plate 11

Site 9: 18 m. Silty, steep, bare rock face with little life (compare Plate 9). Caryophylla are common, but other life is sparse: Alcyonium, Echinus, Terebratulina, some encrusting sponges and solitary ascidians are the most conspicuous.

Plate 12

Site 15: 15 m. Boulder on the floor of Torsa Sound. The Tubularia-sponge association typical of Cuan Sound (see Plate 10) appears absent, but hydroids (especially Abietinaria) are abundant.



APPENDIX I

Nature Conservancy Council and Underwater Conservation Society

SUBLITTORAL HABITAT RECORDING SHEET

Recorder's Name Address Phone Date of observation	Site Name Area/nearest town Country OS Grid Ref. Sheet number Lat/Long Duration of study
--	---

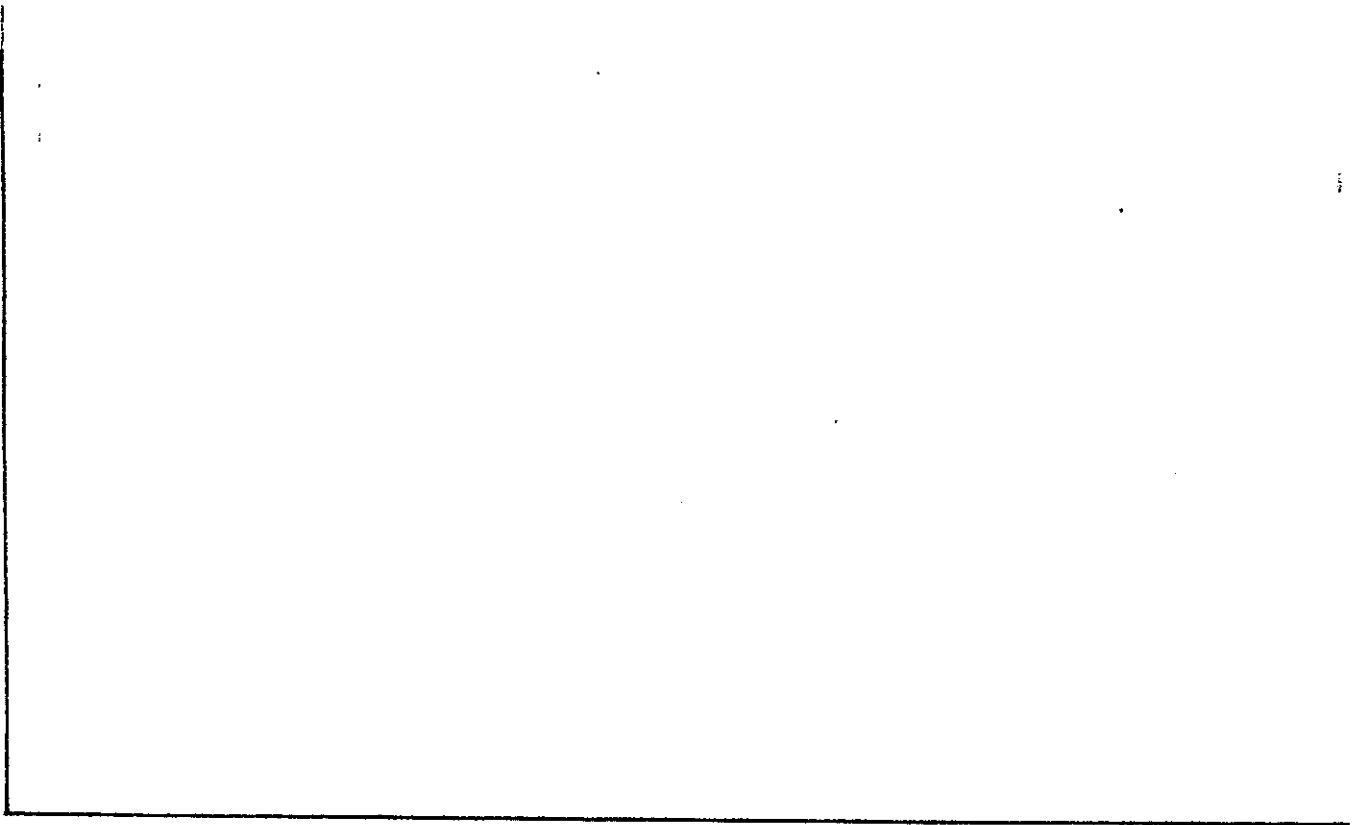
INSTRUCTIONS: Tick and score as appropriate using the following notations; 1 = <10%
 2 = 10% to 30%, 3 = 30%+

DEPTHS STUDIED corrected to Chart Datum:

0-5m	5-10m	10-15m	15-20m	20-30m	30+m
------	-------	--------	--------	--------	------

AREA OF SURVEY	COMMENTS	FEATURES - ROCK	COMMENTS
Extensive(site)		Gullies (size)	
Small(station)		Cliffs (size)	
Shore dive		Caves (size)	
Boat dive		Crevices (size)	
EXPOSURE TO WAVE ACTION		Wreck	
Very sheltered		Other	
Sheltered		Rock type (eg calcareous)	
Mod. exposed		FEATURES - SOFT SEDIMENT	
Exposed		Of one uniform type	
Very exposed		A mixture (eg sand & mud)	
EXPOSURE TO TIDAL CURRENTS		Burrows	
None		Mounds or worm casts	
Some, noticeable		Crab excavations	
Strong		Shell remains	
VISIBILITY(in metres)		'Worked' surface with obvious species	
SEA BED TYPE (score as indicated above)		Other comments	
Bedrock		Describe the site briefly. What features stand out in your mind about the site?	
Boulder (50 cm+)			
Boulder (15-50 cm)			
Cobbles (5-15 cm)			
Pebble (2.5-5 cm)			
Gravel			
Coarse sand			
Medium fine sand			
Muddy sand			
Mud			
COVER - PLANT (score as indicated above)			
Kelp			
Foliaceous red			
Foliaceous green			
Foliaceous brown			
Calcareous encrusting reds			
Diatom			
COVER - ANIMAL (score as indicated above)			
Dominant species			
Hydroid 'turf'			
Bryozoan 'turf'			
Ascidian 'turf'			
Other			
Echinus - numbers seen in 10 minutes			
COVER - INANIMATE			
Mud on rock: None			
Some			
100%			
'Bare' rock			
'Bare' sediment plain			
Shell remains			
Human debris			

Draw an aerial view - map of the site. Give distances in metres & the direction of North



Draw a cross section (transect) of the site. Give distances in metres and depth in metres corrected to Chart Datum.

Indicate on the profile:
Main study depth
Max. depth kelp forest
Max. depth kelp plants
Max. depth of any algae
Depth rock-sediment boundary ..

Depth (Metres)

Distance (metres)

Other comments (on species, facilities etc.)

Does anything make this site like or unlike other sites you have visited in this or other areas?

APPENDIX II

INNER HEBRIDES AND SUMMER ISLES SUBLITTORAL SURVEY 1981

Faunal check list

For each site, record approx. abundance of each species and notes on habitat and depth. Add additional species to appropriate groups or attach a separate note.

SITE NAME:.....DEPTH:.....m. below CD

DATE:.....RECORDERS NAME:.....

Species	Notes	Species	Notes
PORIFERA		Sagartia elegans var venusta	
Axinella infundibuliformis		S. elegans miniata	
Axinella sp		S. elegans nivea	
Amphilectus fucorum		S. elegans rossa	
Cliona celata		Sagartia troglodytes	
Dysidea fragilis		Sagartiogeton lacerata	
Halichondria panicea		Swifteia pallida	
Hemiphyllia columella		Tealia felina	
Hymeniacidon perleve		T. eques	
Haliclona sp		Virgularia mirabilis	
Clathrina coriacea			
Leucosolenia botryoides			
Myxilla incrustans			
Pachymatisma johnstonia		ANNELIDA	
Polymastia mammillaris		Arenicola marina	
Polymastia boletiformis		Bispara volutacornis	
Scypha ciliatum		Chaetopterus variopedatus	
Scypha compressa		Eulalia viridis	
Suberites carnosus		Filograna implexa	
Suberites domuncula		Hydroides norvegicus	
Stelligera stuposa		Lanice conchilega	
Raspailia hispida		Myxicola infundibulum	
		Pomatoceros triqueter	
		Sabella pavonina	
		Spirorbis sp	
		Serpula vermicularis	
		Terebellidae	
HYDROZOA			
Aglaeophenia sp		CRUSTACEA - CIRRIPIEDIA	
Abietinaria abietina		Balanus balanus	
A. filiculina		B. crenatus	
Amphisbetia operculata		Elminius modestus	
Halecium halecinum		Verruca stroemia	
H. beanii		CRUSTACEA - DECAPODA	
Hydrallmania falcata		Cancer pagurus	
Hydroclitina echinata		Carcinus maenas	
Kirchenpaueria pinnata		Caprellidae	
Negertesia ramosa		Galathea strigosa	
N. antennina		Galathea sp	
Obelia geniculata		Goneplax rhomboides	
Plumularia setacea		Homarus vulgaris	
Sertularia argentea		Hyas araneus	
Sertularella polyzonias		H. coarctatus	
Tubularia indivisa		Inachus dorsettensis	
T. larynx		Inachus phalangium(dorynchus)	
		Jassidae(tubes)	
ANTHOZOA		Liocarcinus puber	
Alcyonium digitatum		L. depurator	
Anemonia sulcata		Liocarcinus sp	
Actinothoe sphyrodeta		Macropodia sp	
Aurelia aurita		Munida banffica	
Cereus pedunculatus		Nephrops norvegicus	
Cerianthus lloydi		Palinurus elephas	
Caryophyllia smithi			
Corynactis viridis			
Hormathia coronata			
Metridium senile		MOLLUSCA	
Peachia hastata		Acmaea sp	
Pematula phosphorea		Anomiidae	

<u>Species</u>	<u>Notes</u>
MOLLUSCA CONT.	
<i>Buccinum undatum</i>	
<i>Chlamys</i> sp	
<i>Calliostoma ziziphinum</i>	
<i>Gibbula cineraria</i>	
<i>G. umbilicalis</i>	
<i>G. magus</i>	
<i>Hiatella arctica</i>	
<i>Lacuna vincta</i>	
<i>Mytilus edulis</i>	
<i>Modiolus modiolus</i>	
<i>Mya arenaria</i>	
<i>M. truncata</i>	
<i>Musculus marmoratus</i>	
<i>Nassarius</i> sp	
<i>Patella</i> sp	
<i>Patina pellucida</i>	
<i>Pecten maximus</i>	
<i>Trivia arctica</i>	
<i>T. monacha</i>	
<i>Turritella communis</i>	

BRYOZOA .

<i>Acyonidium gelatinosum</i>	
<i>Bugula</i> sp	
<i>Cellaria</i> sp	
'Crisiidae'	
<i>Electra pilosa</i>	
<i>Flustra foliacea</i>	
<i>Parasmittina trispinosa</i>	
<i>Porella compressa</i>	
<i>Membranipora membranacea</i>	
<i>Scrupocellaria reptans</i>	
<i>S. scruposa</i>	
<i>Securiflustra securifrons</i>	
Encrusting bryozoa	

ECHINODERMATA

<i>Asterina gibbosa</i>	
<i>Asterias rubens</i>	
<i>Antedon bifida</i>	
<i>Astropecten irregularis</i>	
<i>Crossaster papposus</i>	
<i>Cucumaria saxicola</i>	
<i>Cucumaria</i> sp	
<i>Echinus esculentus</i>	
<i>Echinocardium cordatum</i>	
<i>Henricia</i> sp	
<i>Holothuria forskali</i>	
<i>Luidia ciliaris</i>	
<i>Marthasterias glacialis</i>	
<i>Neopentadactyla mixta</i>	
<i>Ophiothrix fragilis</i>	
<i>Ophiocomina nigra</i>	
<i>Ophiura albida</i>	
<i>Ophiura</i> sp	
<i>Ophionholis</i> sp	
<i>Porania pulvillus</i>	
<i>Parastichopus tremulus</i>	

<u>Species</u>	<u>Notes</u>
ECHINODERMATA CONT.	
<i>Solaster endeca</i>	
<i>Psammechinus miliaris</i>	

ASCIDIACEA

<i>Asciidiella aspersa</i>	
<i>A. scabra</i>	
<i>Ascidia mentula</i>	
<i>A. virginea</i>	
<i>Botryllus schlosseri</i>	
<i>Botrylloides leachi</i>	
<i>Ciona intestinalis</i>	
<i>Clavelina lepadiformis</i>	
<i>Dendrodoa grossularia</i>	
<i>Diazona violacea</i>	
<i>Diplosoma listerianum</i>	
Didemnidae	
<i>Molgula manhattensis</i>	
<i>Polyclinum aurantium</i>	
'Polyclinidae'	
<i>Polycarpa pomaria</i>	

PISCES

ADDITIONAL SPECIES AND NOTES

APPENDIX III

BCS SUBLITTORAL HABITAT RECORD SHEET

TEST VERSION

SIDE 1 - FEATURES RECORDED ON LAND

JUNE 1983

SITE NAME, LOCATION (SURVEY AREA) AND NUMBER

SUBSIDIARY HABITAT OR STATION (IF ANY).....

ORDNANCE SURVEY GRID REFERENCE.....

Letters	Numbers E-W	Numbers N-S

LATITUDE-LONGITUDE (OFFSHORE AREAS).....

--	--	--

DATE OF SURVEY.....

Day	Month	Year

NAME, ADDRESS, TEL. NO. OF RECORDER.....

<u>Coastal type</u>	<u>Rock type</u>	<u>Exposure to wave action</u>
Open coast-rock.....	1 <input type="checkbox"/> Hard igneous/metamorphic.....	18 <input type="checkbox"/> Very exposed..... 25 <input type="checkbox"/>
Open coast-sediment.....	2 <input type="checkbox"/> Calcareous.....	19 <input type="checkbox"/> Exposed..... 26 <input type="checkbox"/>
Open sea (more than 1km off).....	3 <input type="checkbox"/> Hard sandstone/mudstone.....	20 <input type="checkbox"/> Semi-exposed..... 27 <input type="checkbox"/>
Headland on open coast.....	4 <input type="checkbox"/> Soft sandstone/mudstone.....	21 <input type="checkbox"/> Sheltered..... 28 <input type="checkbox"/>
Open bay on open coast.....	5 <input type="checkbox"/> Hard slate/shales.....	22 <input type="checkbox"/> Very sheltered..... 29 <input type="checkbox"/>
Enclosed bay on open coast.....	6 <input type="checkbox"/> Friable slate/shales.....	23 <input type="checkbox"/> Extremely sheltered..... 30 <input type="checkbox"/>
Spit/bar.....	7 <input type="checkbox"/> Other (name).....	24 <input type="checkbox"/> <u>Exposure to tidal streams</u>
Offshore small island.....	8 <input type="checkbox"/>	Very exposed (6k+)..... 31 <input type="checkbox"/>
Offshore rock.....	9 <input type="checkbox"/>	Exposed (3-6k)..... 32 <input type="checkbox"/>
Submerged rock.....	10 <input type="checkbox"/>	Semi-exposed (1-3k)..... 33 <input type="checkbox"/>
Sound/narrows.....	11 <input type="checkbox"/>	Sheltered (<1k)..... 34 <input type="checkbox"/>
Shallow rapids.....	12 <input type="checkbox"/>	Very sheltered (sea lochs, bays).... 35 <input type="checkbox"/>
Sea loch.....	13 <input type="checkbox"/>	<u>SUPPLEMENTARY NOTES</u>
Estuary.....	14 <input type="checkbox"/>	NNR, LNR, SSI, MNR near..... 36 <input type="checkbox"/>
Harbour.....	15 <input type="checkbox"/>	Sewage/industrial outfall near..... 37 <input type="checkbox"/>
Sea cave.....	16 <input type="checkbox"/>	Other supplementary notes below..... 38 <input type="checkbox"/>
Other (name).....	17 <input type="checkbox"/>	

LOCATION SKETCH

(Give a plan with scale for exact location and route of dive, sketch of transit marks, etc.)

DCS SUBLITTORAL HABITAT RECORD SHEET
SIDE 2 - FEATURES RECORDED UNDERWATER

TEST VERSION
JUNE 1983

TIME OF DIVE.....INOUT

ACTUAL DEPTH.....METRES

DEPTH BELOW CHART DATUM.....METRES

SUBZONE(S) AT SITE

Sublittoral fringe.....	40
Upper infralittoral.....	41
Lower infralittoral.....	42
Upper circalittoral.....	43
Lower circalittoral.....	44
Other (name).....	45

SUBSTRATA PRESENT

(Score 1=rare, 2=secondary, 3=predominant)

Bedrock.....	46
Boulders (50cm+).....	47
Boulders (15cm+).....	48
Pebbles (2.5cm+).....	49
Clean gravel.....	50
Muddy gravel.....	51
Maerl.....	52
Coarse sand.....	52
Fine clean sand.....	54
Muddy sand.....	55
Sandy mud.....	56
Mud.....	57
Mixed sediments.....	58
Other (name).....	59

ROCK TYPE PRESENT

Hard.....	60
Hard, fissured.....	61
Calcareous.....	62
Friable.....	63
Other (name).....	64

BOTTOM FEATURES (HARD

SUBSTRATA) (Score 1-3)

Outcrop (rock-surrounded sediment).....	65
Steep rock, unbroken.....	66
Steep rock, broken.....	67
Slope/plain, unbroken.....	68
Slope/plain, broken.....	69
Cliff.....	70
Pier pile.....	71
Wreck.....	72
Crevices.....	73
Open gullies (<75°).....	74
Steep-sided gullies (75°+).....	75
Overhangs (100-135°).....	76
Steep overhangs/cave roofs (135°+).....	77
Potholes.....	78
Rock mills.....	79
Caves.....	80
Scree.....	81
Stable boulder slope.....	82
Mobile cobbles.....	83
Scoured rock.....	84
Sand on rocks.....	85
Flocculent silt on rocks.....	86
Thick silt on rocks.....	87
Other features (name).....	88

ABUNDANCE OF ECHINUS ON ROCK

1+/m ²	89
1-9/10m ²	90
<1/10m ²	91
Few seen.....	92
None seen.....	93

ABUNDANCE OF MAIN GROUPS ON ROCK

(Score 1-3)

	Score	Species
Kelps.....	95	
Foliose algae.....	96	
Encrusting algae.....	97	
Porifera.....	98	
Hydrozoa.....	99	
Anthozoa.....	100	
Polychaeta.....	101	
Gastropoda.....	102	
Bivalvia.....	103	
Decapoda.....	104	
Barnacles.....	105	
Bryozoa-erect.....	106	
Bryozoa-encrusting.....	107	
Asteroidea.....	108	
Echinoidea.....	109	
Ophiuroidea.....	110	
Holothuroidea.....	111	
Ascidacea.....	112	
Fish.....	113	
Other (name).....	114	

ABUNDANCE OF MAIN GROUPS ON

SEDIMENTS (Score 1-3)

Bare sediment.....	115	
Zostera marina.....	116	
Attached foliose algae.....	117	
Unattached foliose algae.....	118	
Chorda filum.....	119	
Burrows.....	120	
Mounds.....	121	
Ripples.....	122	
Bivalve siphons.....	123	
Ophiurid arms.....	124	
Other (name).....	125	

PROFILE/COMMUNITY SKETCH ETC.

(Draw a profile and/or sketch of the main community.)

APPENDIX IV

NATURE CONSERVANCY COUNCIL SCIENTIFIC SUBLITTORAL SURVEY & ALGAE check list 1982

DATE No. of: Depth m. below CD

Site.....Recorders Name.....

CHLOROPHYTA

Bryopsis plumosa

Cladophora sp.

Codium sp.

Enteromorpha sp.

Ulva sp.

PHAEOPHYTA

Alaria esculenta

Asperococcus turneri

Chorda filum

Colpomenia sinuosa

Cutleria multifida

Desmarestia aculeata

D. ligulata

D. viridis

Dictyopteris membranacea

Dictyota dichotoma

Furcellaria lumbricalis

Holidrys siliquosa

Himantalia elongata

Laminaria digitata

L. hyperborea

L. saccharina

Pseudolithoderma extensum

Sacchoriza polyschides

Spermatochnus paradoxus

Sporochnus pedunculatus

RHODOPHYTA

Acrosorium reptans

Acrosorium uncinatum

Ahnfeltia plicata

Antithamnion plumula

Apoglossum ruscifolium

Asparagopsis armata

Audouinella floridula

Bonnemaisonia asparagoides

Bonnemaisonia hamifera

B. hamifera (Trailliella)

Brongniartella byssoides

Calliblepharis ciliata

Callithamnion sp.

Callophyllis laciniata

Ceramium rubrum

Chondrus crispus

Chylocladia verticillata

Corallina officinalis

Cordylecladia erecta

Cruoria sp.

Cryptopleura ramosa

Cystoclonium purpureum

Delesseria sanguinea

Dilsea carnosa

Furcellaria lumbricalis

Gigartina stellata

Gracilaria verrucosa

Griffithsia corallinoides

G. flosculosa

Halarachnion ligulatum

Heterosiphonia plumosa

Heterosiphonia plumosa
Hypoglossum woodwardii
Kallymenia reniformis
Lomentaria articulata
L. clavellosa
L. orcadensis
Membranoptera alata
Meredithia microphylla
Myriogramme bonnemaisonii
Nitophylum punctatum
Odonthalia dentata
Palmaria palmata
Phycodrys rubens
Phyllophora crispa
P. pseudoceranooides
Phyllophora sp.
Plocamium cartilagineum
Plumaria elegans
Polyides rotundus
Polyneura gmelinii
Polysiphonia sp.
Porphyra sp.
Pterosiphonia parasitica
Ptilota plumosa
Rhodomela confervoides
Rhodophyllis divaricata
Rhodophyllis sp.
Rhodymenia pseudopalmata
Schottera nicaeensis
Scinaia turgida
'Lithothamnia'
'Maerl'

GENERAL COMMENTS ON ALGAL POPULATIONS AND OTHER SPECIES