



SEASEARCH

Marine Nature Conservation Review



Seasearch is run by the Marine Conservation Society on behalf of the Nature Conservancy Council as part of the Marine Nature Conservation Review of Great Britain.

CANNA EXPEDITION

Morag C. Mackinnon



SS/2/1988



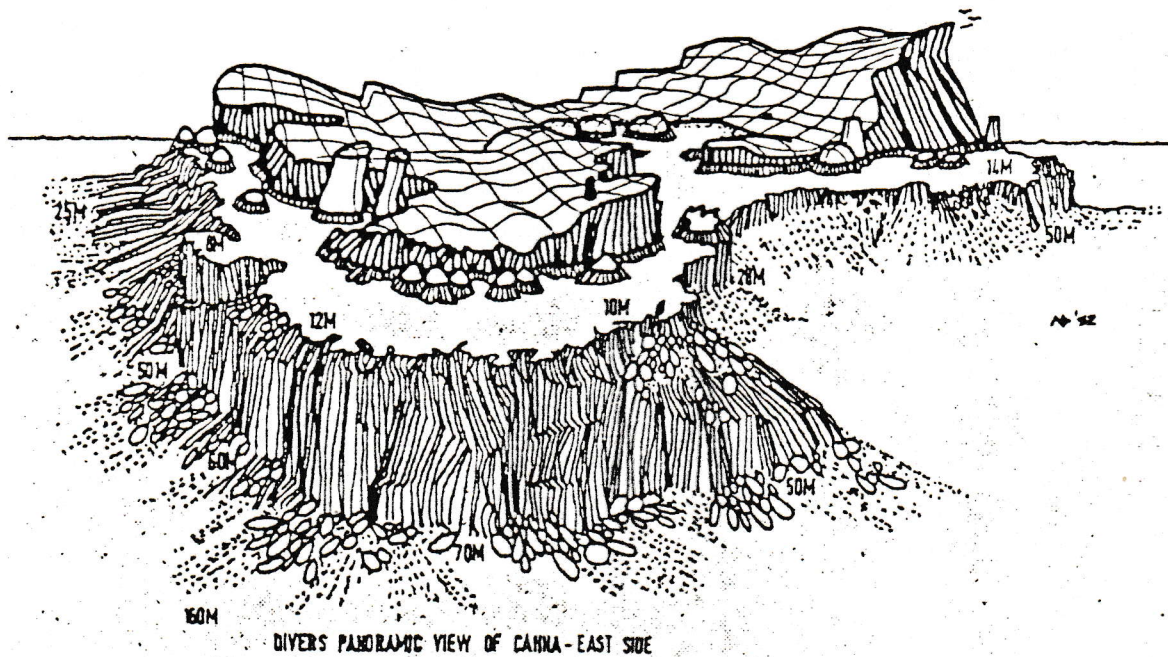
A Report to the Nature Conservancy Council
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CANNA EXPEDITION

Report by

MORAG C MACKINNON/PROJECT LEADER

Canna



CANNA EXPEDITION

SURVEY CARRIED OUT 28th/30th MAY 1988

SEASEARCH SURVEY as part of MNCR to NCC

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SEASEARCH

PREFACE TO REPORTS

SEASEARCH is a survey of the sublittoral marine habitats of Great Britain. The project is run by the Marine Conservation Society (MCS) on behalf of the Nature Conservancy Council (NCC); the governments statutory advisors on nature conservation in Great Britain.

The aims of the SEASEARCH project are:

1. To gather information on sublittoral habitats and major community types at selected areas around the coast.
2. To note the presence of any human activities and man-made impacts in the areas surveyed.
3. To note areas which appear of particular interest because of their scenic value, habitat diversity and species richness.
4. To illustrate the habitats encountered with photographs.
5. To produce a report on each area surveyed.

SEASEARCH surveys contribute to the Marine Nature Conservation Review (MNCR) of Great Britain which is being undertaken by the NCC. The MNCR will describe marine ecosystems around Great Britain from the lower limit of flowering plants, or normal tidal limits of estuaries, offshore to the 12 mile limit of territorial seas.

SEASEARCH is a 'Phase 1' survey aimed at describing the location and extent of habitats and major community types. This also provides necessary basic information to use in planning the more detailed 'Phase 2' surveys. At the same time as recording habitat types, the presence of human activities and impacts are noted thus supplying information of value to NCC for use in assessing effects of human activities on the marine environment and in providing advice. The project SEASEARCH is designed to be undertaken by volunteer divers with an interest in natural history.

Further details of SEASEARCH can be obtained by writing to:

Marine Conservation Society, 9B Gloucester Road, Ross-on-Wye, Herefordshire.

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ABSTRACT

Canna is the most westerly of the Small Isles and lies in an exposed position to the north-west of Rhum. It's very remoteness makes it fairly inaccessible to divers, and also the normal Atlantic swell and prevailing winds make investigation even more difficult. Previous surveys and diving expeditions (Dipper, 1981 and Davidson, 1982) had been concentrated at the easterly end of the island and around the harbour area, also on the south easterly side of Sanday, which is an adjoining island.

This present survey was undertaken to fill gaps in previous information and primarily to provide phase 1 type information on habitat types and dominant species related to those sites. It was also intended to further the Seasearch methodology on identifying cliff habitats.

Due to unusual strong easterly winds, it was possible to dive on north side of Canna on the first day, and improved conditions allowed diving the south side and the outlying rocks and islands including Oigh Sgeir on the following day. Deteriorating conditions made it impossible to dive the south-west side of Rhum on the third and final day, and as an alternative we managed to dive four sites on Eigg not previously recorded.

The dive sites on the north side of Canna, particularly at the eastern end which were very exposed, had much mobile sand, gravel, cobbles and pebbles. These sites were approximately 200 - 300 m. offshore and there was no opportunity to investigate the terrain nearer the shore.

The southern aspect of Canna seemed to indicate bedrock dropping 5 - 10 m. before becoming a gradual boulder slope interspersed with coarse sand patches. Sand patches everywhere seemed prone to wave ripple.

The outlying rocks to the south-east of Canna provided the most spectacular habitats. Alcyonium digitatum covered basaltic columns which formed vertical walls, up to 5 metres high, at a depths of 20 - 25m.

Eigg provided two contrasting habitats within the Bay of Laig, rock and boulder ridge, to the north and fine sand substrate to the south side of the bay. The two sites dived on the north-eastern side of Eigg showed some interesting comparison of boulder and fine sand/mud slopes.

2. INTRODUCTION

2.1 Background to the Survey

The Nature Conservancy Council have funded the Marine Conservation Society to co-ordinate and manage a project called "Seasearch" which is a phase 1 survey of the sublittoral environment of the U.K. The objectives for this survey of Canna were to gather habitat information on areas not previously recorded by NCC staff on a previous survey, complete the data forms for incorporation into the MNCR data-base, and to prepare this report summarising the results of the survey work.

2.2 Location

Canna, Rhum, Eigg and Muck are known as the Small Isles and lie North of Mull and the Ardnamurchan peninsula, west of Mallaig and south of Skye. Canna, with Sanday joined to its south-eastern end by a drying reef and a footbridge is the most westerly of these islands separated from Rhum by the Sound of Canna which is 1.75 miles wide.

2.3 Geology

Canna - Tertiary basaltic lavas, mostly horizontal, make up most of the geological successions apart from the interbedded agglomerates and tuffs. There are some doleritic sills emphasising the trap landscape on the hill slopes such as at Compass Hill. No sedimentary rocks are present and it is thought that the basement to the principally alkali basaltic flows is Pre-Cambrian, since there are coarse conglomerates containing pebbles of gneiss, schist and Torridonian sandstone. These clasts are both acid and ultrabasic. Pillow lavas are present in western Canna. Basaltic columns are to be found at Compass Hill and the outlying islands making up Oigh Sgeir (or Hyskeir, on some maps and charts) are predominantly columnar.

Eigg - Basaltic lavas overlay exposed Mesozoic rocks in thick successions forming high plateaux to either side of a fault valley. The typically Hebridean trap landscape is bounded by precipitous cliffs, particularly in the north-eastern corner of the island. Here Cretaceous sandstones, limestones and shales of the Middle Jurassic erode to facilitate landslipping. The uniform size and rounded form of the sand grains from weathered Jurassic sandstone form the "singing sands" of Camas Sgiotaig in northern Eigg, at Laig Bay. North of Kildonan village, there are shales outcropping on the foreshore, and in these Jurassic stratas, Hugh Miller, the eminent geologist, found fossil reptile bones and teeth, together with pterodactyl and dinosaur remains. The ridge forming An Sgurr is unique, and the smooth columnar pitchstone and associated felsite sheets rising to 394 metres dominate the skyline.

2.4 Bathymetry and hydrography

Canna is the most westerly of the Small Isles and to both north and south of the elongated island the seabed is of gradually sloping cobbles and mobile coarse sands giving way to muds. Only at the eastern end does the flat underwater plateau drop sharply to form steep underwater terrain, although the basaltic columns and underwater cliffs of Oigh Sgeir at the outlying southeastern end are dramatic.

Each of the Small Isles is separated from the others by deep water sounds of between 50 to 100 metres.

The currents in this area do not exceed 4.08 knots and the tidal range is 3.7 metres.

2.5 Previous Sublittoral studies

NCC have carried out a sublittoral survey of Canna, (Dipper, 1981- Sublittoral Survey in the Small Isles, Inner Hebrides), but the activities of this survey were restricted to the eastern end of Canna and Sanday. Sime and Earll have dived around the north and there has been one dive recorded by Dipper and Maggs on the extreme west side. Since the entrance to Canna Harbour provides considerable shelter, the areas round the eastern end are more frequently dived, and Ridley, (1985 - Dive north-west Scotland) quotes several round Canna. Maurice Davidson, a keen amateur, has written a report and provided an excellent sketch of the general view of the sublittoral of the eastern harbour approach.

3. AIMS

The aims of this survey were to

- 1) Collect further information on the sites to complete the phase 1 survey of Canna providing an overall description of topography, habitat and community type.
- 2) Continue developing the seasearch project manual for habitat and bottom types of nearshore sublittoral areas. In particular this expedition aimed to describe "cliff" types.

4. METHODS

4.1 Survey Organisation

Survey Team The team was chosen from experienced divers who were keen amateur marine biologists and MCS members. Rohan Holt and Lois Calder have degrees in marine biology. Crawford Grier is a professional photographer and is also on the technical staff at SMBA, Dunstaffnage. Sue Hiscock is a member of the NCC, MNCR team and provided diving survey support.

Survey Vessel used was the 75ft M.V. "Jane R".

4.2 Site Selection

Although our remit was to try and dive sites at Canna, not covered by the previous NCC expedition, (Dipper, 1981), it was hoped that other sites in the Small Isles might be possible.

Day 1. We left Oban with imminent gale force 7 warnings. The only place that diving was possible that day was to the north of Canna. The swell was too great to allow launching the inflatable, or to approach the coast too closely, so we did five spot dives spaced out along the northern coast. Dive sites were chosen opposite land features, such as promontories, in the hope that there might be some interesting geological feature underwater. The chart and the echo sounder were uniform in their diagnosis of a fairly even horizontal bed of small boulders, cobbles and coarse mobile sand.

Day 2 - The weather had moderated and the weather cleared to give us an excellent day of diving on the southern side of Canna and its outlying rocks to the east.

Day 3- was curtailed by time and tide to get back to Oban, and diving in the Small Isles had to be finished by midday. It had been hoped to dive the south-west side of Rhum, but again this was not possible due to sea conditions. We detoured to Eigg, where the Bay of Laig provided two contrasting dives and two final dives on the north end of the island filled gaps in previous studies. (Dipper, 1981)

4.3 Recording and Sampling

The diving team was split into pairs, with Mary Childs carrying out a Coastwatch survey and providing boat cover assistance when required. Teams were asked to limit their dives to 20 mins. and 30 m.

Seasearch forms had been supplied, along with sketches of cliff formations and notes on key habitat descriptive words prepared by MCS. Some MNCR forms were filled in, though these have not formed part of the raw data, additional detail from them has been used and found helpful. Little sampling was carried out as general species lists were not required.

4.4 Photography

Personal underwater camera equipment of various types was used with mostly Fuji 100 asa colour slide film being used. Seven team members had underwater cameras and underwater video was also used.

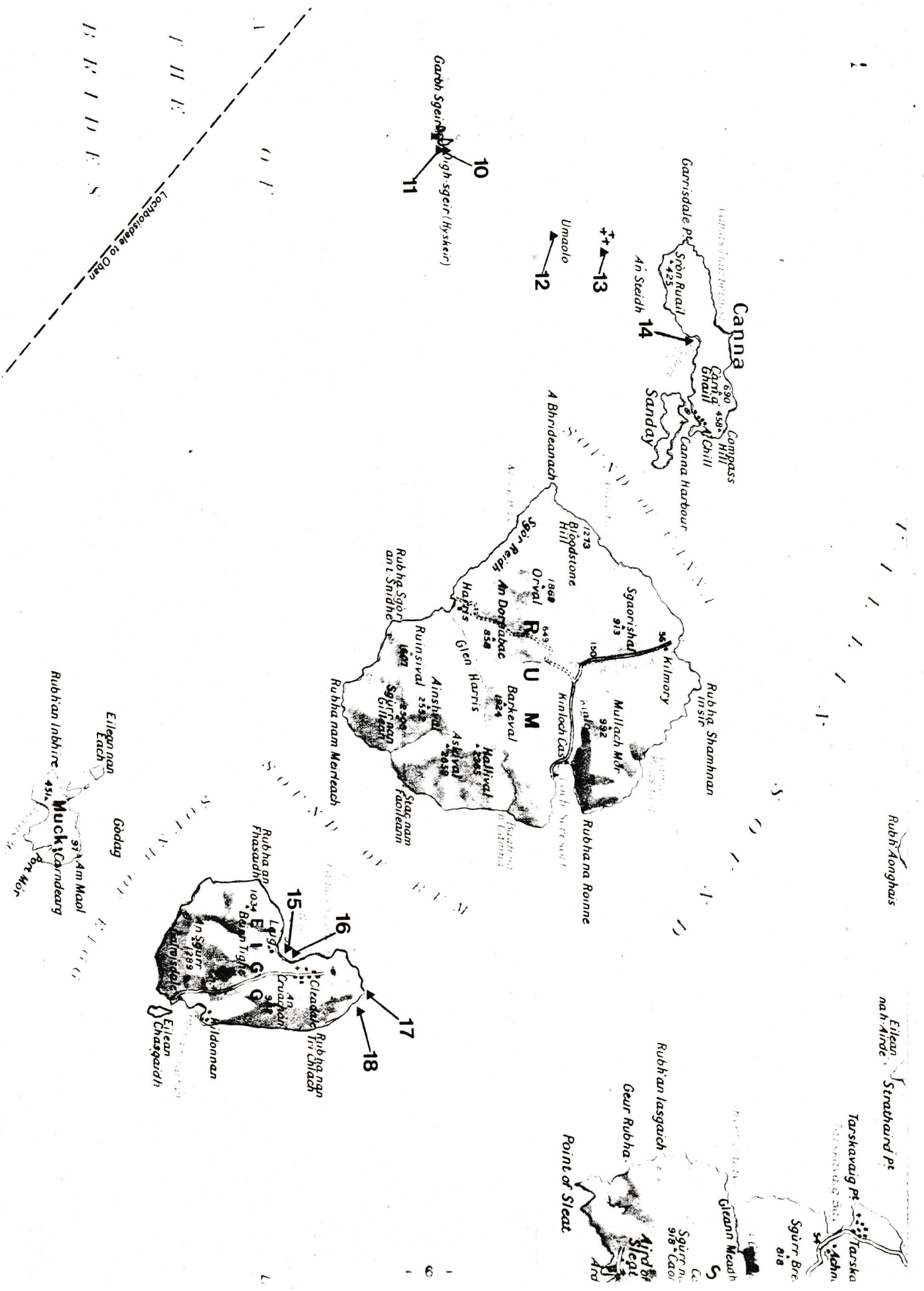
4.5 Seasearch - Cliffs details

Bob Earll, MCS, had provided sketches of the type of cliff surfaces likely to be encountered and these were circulated to recorders and they were encouraged to comment and add to this document. See Appendix 5.

5. RESULTS

5.1 Site Location and Maps

Dive Site No. and Name	Lat Long	Date	Divers
CANNA			
1 Sgeir nan Sgarbh	57°03.10'N 6°36.50'W	28.5.88	SH + JM
2 Midway Sites 1 & 3	57°03.90'N 6°35.00'W	28.5.88	MM + CG
3 Camas Tharbernish	57°03.80'N 6°34.50'W	28.5.88	RH + LC
4 Ruudha Langan-innis	57°04.41'N 6°33.50'W	28.5.88	SP + JW
5 Bod an Stoi	57°04.44'N 6°25.75'W	28.5.88	JW + RS
6 Tallabric	57°02.50'N 6°50.00'W	29.5.88	JW + RS
7 Na Garraidhean	57°03.00'N 6°31.25'W	29.5.88	SP + JW
8 W. Haslam Is	57°03.05'N 6°32.10'W	29.5.88	RH + LC
9 Rubha Sgorr nam Ban-naomha	57°02.50'N 6°34.00'W	29.5.88	SH + JM
10 Oigh Sgeir	56°58.53'N 6°40.21'W	29.5.88	RH, LC, SH
11 Oigh Sgeir	56°58.53'N 6°40.21'W	29.5.88	CG + JM
12 Humla Rock	57°00.50'N 6°36.84'W	29.5.88	JW + RS
13 Jemima Rock	57°01.50'N 6°36.30'W	29.5.88	SP + JW
14 Tarbert Bay	57°03.20'N 6°32.50'W	29.5.88	RH + SH
EIGG			
15 Bay of Laig	56°55.16'N 6°10.25'W	30.5.88	SH + JM
16 Bay of Laig	56°55.30'N 6°09.95'W	30.5.88	RH + LC
17 Talm	56°56.80'N 6°07.80'W	30.5.88	JW, RS, CG
18 S of Sgurr Sgailleach	56°56.50'N 6°07.10'W	30.5.88	SP + JW



B R I D G E S

I I I I

S O U T H I S L A N D

S O U T H I S L A N D

Garbh Sgeir
10
11
High sgeir (Hyskeir)

Umalo
12
13
14

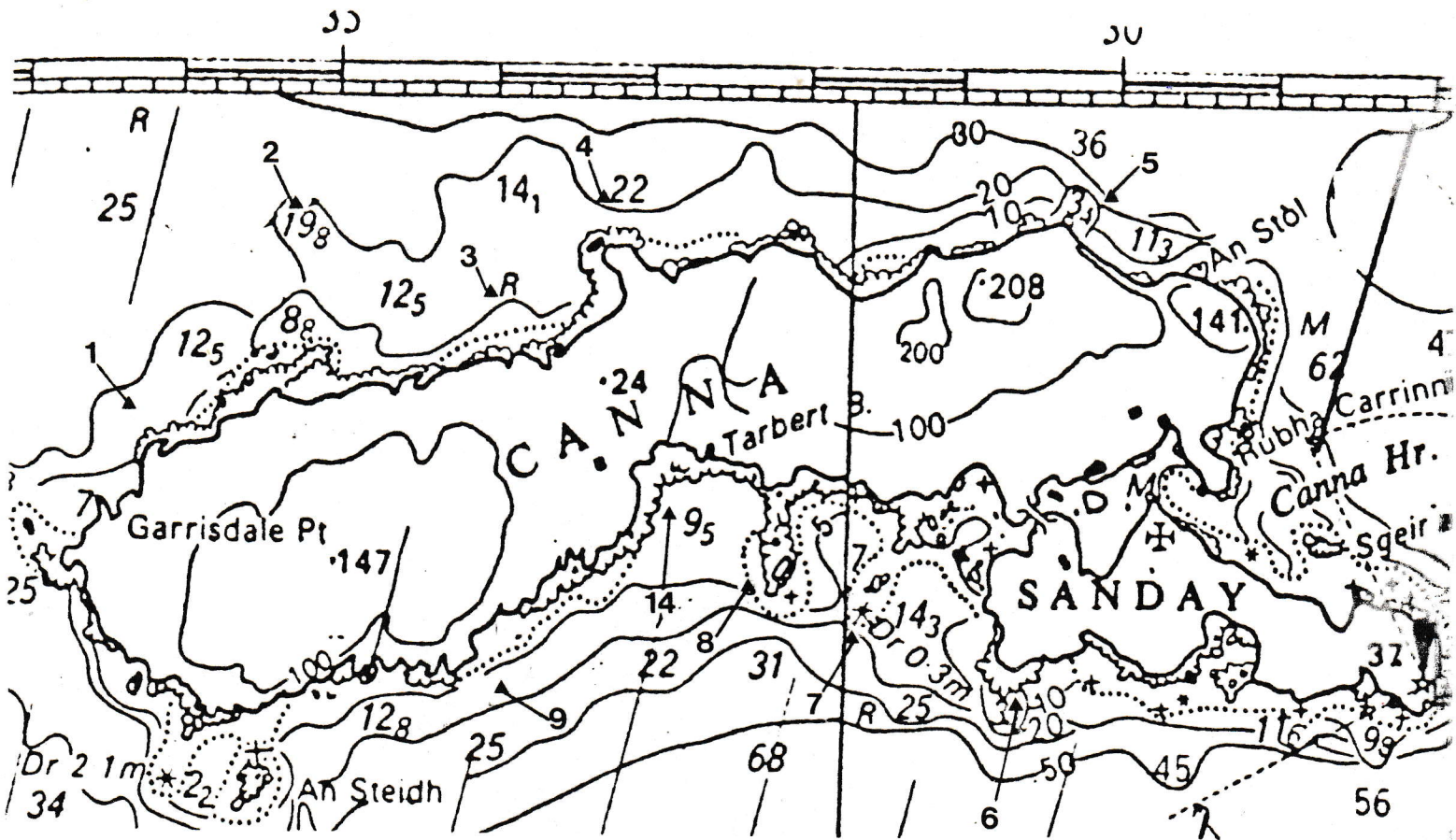
15
16
17
18

Rubh Aonghais

Eilean Strathairn Pt.

Tarskavaig Pt.

Point of Sleat



5.2 Introduction

During the weekend 18 sites were surveyed as detailed on the preceding list of sites, co-ordinates and maps. Species that were noted have been listed under Appendix 3, but this is by no means an exhaustive list, since this aspect was not one of the primary aims of the survey. Photographs (Appendix 4) have been selected and listed according to site, and copies have been taken for team members where required. Where NCC film was supplied, the original slide is the property of NCC. The major habitat types surveyed and the communities found are described below.

5.3.1 - CANNA -

Habitats and communities on cliffs and bedrock

Infralittoral vertical bedrock was found at sites 7 and 13, where there was dense kelp forest of Laminaria hyperborea down to 13 - 14 metres with Alcyonium digitatum dominating and Caryophyllia smithii present at site 7.

5.3.2 Habitats and communities on boulders

Infralittoral boulder slopes Site 1 on the north side of Canna had dense kelp forest to 14 m. with associated red Algae, and below 14 to 19 m. the kelp was much more sparse. On the south side of the island, at site 6, dense kelp forest on rough bedrock and boulder slope went down to 17 m. and there after was sparse to 20 m.

Circalittoral boulder slopes having coarse sand between boulders. Site 1 had boulders scattered about at 24 m. and these had encrusting algae, barnacles, a few urchins, Holothuria and one crayfish and Alcyonium digitatum. Other boulders on the north side of Canna were similar.

On the south side of Canna and Sanday, 8,9,10,11,12, and 13, Alcyonium digitatum was dominant from 19 m. to 24 m. with virtually no specimens to be seen below that depth. Hydroids, sponges, Holothuria forskali, Antedon bifida, Antedon petasus, Ophiocoma nigra, Echinus esculentus, Porania pulvillus, Asterias rubens, Marthasterias glacialis, Luidia ciliaris, Caryophyllia smithii, Ascidia mentula, Cliona intestinalis, Clavellina lepadiformis, Nemertesia antennina Eledone cirrhosa, Sabella Pavonina, also Pecten maximus and Pomatoceros sp.

5.3.3 Habitats and communities on cobbles and pebbles.

On the north side of Canna the swell resulted in a very mobile substrate with some sparse Laminaria saccharina on cobbles, a few urchins and occasional Urticina felina between the cobbles. Some red algal growths on the pebbles, Balanus crenatus, Echinus esculentus noted.

5.3.4 Habitats and communities on sand and gravel, with a few boulders

On the north side of Canna the coarse sand/shell gravel sediments had ripples up to 1m apart and 150mm high. Little fauna was noted at the western end, but Corymorpha nutans and Lanice conchilega were present at the eastern end. Pecten maximus, Peachia cylindrica, Echinus esculentus, Atelecyclus rotundatus, Ophiura albida, Cerianthus lloydii and Asterius rubens were also recorded. Dragonets were noted as common at this most easterly of the northern sites. On the south side of the island Lanice conchilega site 7, Neopentadactyla mixta and Chaetopterus variopedatus also at site 9 which also showed signs of wave ripples.

Habitats and Communities on Fine Sand

At Site 14, in Tarbert Bay, on the south side of Canna there were noticeable sand ripples at 13 metres. Ensis siliqua, (large specimens); Echinocardium cordata, and a burrowing brittle star -Amphiura brachiata were noted species. Corytes cassivalanus, Liocarcinus depurator, Astropecten irregularis, Pagurus bernhardus, and Lanice conchilega were also present.

5.4.1 - Oigh Sgeir and the Outliers

Circalittoral vertical bedrock was found only at Site 10 where columnar basalt below 20 metres provided a habitat for dense cover of Alcyonium digitatum living on the outer edges of the columns, other niches being taken by a variety of sponges, Caryophyllia smithii, Corynactis viridis, Sagartia elegans and bryozoans. Holothuria forskali was common at the base of, and on the cliff. At the mouth of a cave, basaltic columns were again dominated by Alcyonium digitatum and large Ascidia mentula, with abundant coralline Algae encrusting the columns.

5.4.2 Habitats and communities on boulder slopes

Flustra foliacea was noted at Sites 11 and 13. Diazona violacea was noted at site 13, along with Janolus cristata Polycera quadrilineata and Pawsonia saxicola.

5.5.1 Eigg

Habitats and communities on boulders

At site 16, Bay of Laig, Laminaria hyperborea dominated the shallower boulders, with L. saccharina, predominant nearer the shore. There was a good representation of red Algae over the whole site, and Balanus balanoides, Echinus esculentus, Pawsonia saxicola, Marthasterias glacialis and Urticina felina were also recorded. The boulders were covered with encrusting pink aglae at site 15 in the Bay of Laig, and supported some Cliona celata. The infralittoral at the north end of Eigg was a moderately dense kelp forest to 11m. Echinus esculentus, Caryophyllia smithii, Ophiura texturata, and Antedon bifida were noted as being present at this site.

5.5.3- Habitats and communities on coarse sand.

At site 15, in Laig Bay, Eigg, Lanice conchilega, Chaetopterus variopedatus, Cerianthus lloydii, and

5.5.3-Habitats and communities on sand/mud sediments

At site 18 the steep slope supported a good diversity of species. Cerianthus lloydii, Virgularia mirabilis and Pennatula phosphorea were common. Goneplax rhomboides, Nephrops norvegicus were noted at 25 metres.

6. DISCUSSION AND CONCLUSION

a. The north side of Canna, consisting of shallow shelving mobile substrate with some bedrock showed very little diversity of habitat and little diversity of species also. Because of the very mobile form of the shell sand which was formed in several areas into ripples most of the species found in this area were associated with vertical crevices in the bedrock. There was considerable movement due to swell and wave action even at 24 m., probably fairly normal on this exposed side of Canna. It would have been interesting to examine the area nearer the shore in order to discover whether the habitats there supported greater diversity.

Dipper (1981) and Davidson(1982) have reported a very prolific and interesting marine life at the south-eastern end of Canna. From the results of this survey it would appear that there is a reasonable diversity on the southern side of Canna, and a rather poor diversity on the northern side. The abundance of life though was typical of west of Scotland exposed sites of this nature. Two species that one would have expected to be recorded but were not seen at any of the sites dived were Metridium senile and Alcyonium glomeratum. Swiftia pallida was not recorded either. Arthropod whips were recorded at several of the Canna sites, though not at Eigg.

b. Humla Rock and Oigh Sgeir, lie along a chain of islands stretching out from the south western corner of Canna about 8 km. They were dived on their less exposed easterly side and Oigh Sgeir in particular provided a very dramatic and scenic site with abundant and diverse life. The basalt which formed the cliff and cave features at Oigh Sgeir probably formed the tops of the rocks at Humla. Alcyonium digitatum was reported to be very dense. Holothuria forsakali was present here and there were a great diversity of sponges reported from Oigh Sgeir. Due to the extreme exposure there was no opportunity to dive on the western side of these outliers, but the indications are that, like the eastern end of Canna, the western end justifies further examination. A minke whale surfaced briefly while we were off Humla Rocks.

c. Eigg. The Bay of Laig was interesting from the diversity of species recorded in this more sheltered area. Corymorpha nutans occurred in large numbers here. Many arthropods were noted and it was thought that given more time at this site many more species would have been recorded. Luidia sarsi, seldom recorded, was found at this site. At the north end of the island Pennatula phosphorea were found along with Virgularia mirabilis and possibly juvenile forms of Pennatula were found at much shallower depths.

The recording of cliff types was not particularly satisfactory since there were few cliff types to record, however very good drawings of basaltic columns were produced, vertical cliff with horizontal crevices, and cliff with ledges were well described when found. The drawings from the Seasearch "cliffs" were found to be helpful in describing rocky habitats. The variation in wave and ripple patterns can be seen in the raw data from sites 1, 4, 7, 9 and 14. They varied from 1m to 100mm from crest to crest and troughs up to 200mm were recorded, generally found on coarse shell sand.

7. ACKNOWLEDGEMENTS

Thanks are due to Eric and Jane Reid and the crew of the "Jane R" for their co-operation in making this survey a success and to Sue Hiscock of the NCC for the invaluable help and encouragement given during the survey; and also in coming up to Glasgow to talk to us beforehand about Seasearch.

Dr Bob Earll of M.C.S. is due thanks for help and advice as well as co-ordinating the financial support with NCC to whom we are indebted.

Dr Shelagh Smith's critical reading of this script was much appreciated and I would like to thank all members of the team for their hard work, in particular Rohan Holt for taking on the duties of Dive Officer and Joyce Wilson for bringing first aid kit and dive flags.

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Site 1 - North side Canna, Sgeir nan Sgarbh

This site had a limited diversity of life and seemed fairly typical for an exposed site of this nature.

250 m. offshore, at the 24 m. depth was composed of mobile shell gravel with a few boulders. As a result of the swell, the sand was formed into waves 100mm. high, 0.7m. apart. The boulders, on this most westerly and exposed site of the northern coast, were covered with encrusting algae, barnacles and Alcyonium digitatum. A few urchins were also noted. One crawfish was seen between boulders and also noted was a holothurian, possibly, Neopentadactyla mixta. The terrain changed at 22 metres from boulders to exposed bedrock which had a smooth and even surface with areas of cobbles and pebbles, below which the seabed was generally horizontal, supporting some algal growth, occasional kelp fronds and urchins. A few ophuroids and top shells noted at 19 m. depth. The bedrock sloped gently upwards from 21 m. with sparse kelp plants to 14 m. where the kelp forest was firmly established.

Site 2 - North side Canna, East of Sgeir nan Sgarbh

An exposed site seemed to offer little choice of habitat and diversity was low.

At 15 m. depth smooth bedrock with vertical or slightly inclined crevices, 100mm. wide, covered with encrusting Algae, emerged from a seabed of coarse sand and cobbles. There were a few large smooth boulders with a little algal growth and barnacles. Occasional bare-stiped kelp plants were attached to the cobbles and the cobbles and coarse sand were very mobile in the big swell, apparent even at 18 m. The seabed undulated between 15m. to 18 m. in depth. A few large urchins, a number of small Asterias rubens, and occasional Urticina eques noted between cobbles. The areas of coarse sand supported no obvious species.

A large shoal of gadoid fish were noted in midwater.

Site 3 - Camas Tharbernish

Very mobile site, exposed to weather, currents and swells.

Flat coarse sand plain at 15m. - 16 m. with many shell fragments, pebbles and small cobbles on, and beneath, the surface. The cobbles supported Laminaria saccharina with several red algal species attached. Desmarestia aculeata was also present. Red algal growths attached to small flat rounded pebbles included Nitophyllum punctatum, Dilsea carnosus, Ceramium rubrum, Calophyllis laciniata, Polysiphonia sp. Plocamium cartilagineum, Delesseria sanguinea, Phycodrys rubens, Rhodomela sp. and Phyllophora crispa. Fauna was limited and only Coryphella lineata, Ophiura texturata, Gibbula magus, Corymorpha nutans, (two only); and a single Sabella pavonina were noted.

Site 4 - Rudha Langan-innis

This flat site exposed to weather and wave surge provided little in habitat and had a low diversity of fauna.

At 24m. depth there were well sorted shell sand and gravel sediment waves running north-south with crests 1 metre apart. Troughs had pebbles up to 40mm. in diameter. There were occasional small boulders and cobbles with solitary kelp fronds on the boulders. Barnacles were common on rocks and there were small Alcyonium digitatum up to 50mm. high attached to larger boulders. Nemertesia antennina, Sagartia elegans and Urticina eques were noted as well as the occasional urchin. There were no obvious species on the sand but occasional Corymorpha nutans in the gravel.

Site 5 - Bod an Stoi

A typical exposed mobile site with no diversity of habitat.

A horizontal bed of rounded fine sand formed waves about 0.5m. apart, with empty shells and occasional small cobbles also present. Laniche conchilega and Corymorpha nutans were common as was Atelecyclus rotundatus. Cerianthus lloydii, Asterias rubens, Echinus esculentus, Ophiura albida, Peachia cylindrica, were also present. Dragonets were common and one small angler fish was seen. There were a few Pecten maximus and an unidentified holothurian, a few unidentified hydroids and some red algae. A few kelp fronds were noted at this depth and only the occasional small boulder.

Site 6 - Tallabric

The bedrock sloped down at approximately 30° and gave good holdfast for kelp and the usual associated hydroids and sponges one would associate with a kelp zone in a fairly exposed site such as this, but nothing exceptionally interesting was noted.

This rocky point at the south-west side of Sanday descended underwater as a rough bedrock slope densely covered with kelp to 15m. - 18m. where the terrain changed to a small boulder slope continuing down to at least 25m. The spaces between bedrock outcrops were filled with coarse sand and shell fragments. Below 20m. there was a light covering of sediment. The dominant species on the boulder slope from 20m. - 25m. was Alcyonium digitatum. Encrusting sponges, hydroids, Holothurian forskali, Antedon bifida, and Echinus esculentus were also present.

Site 7 - South side of Canna - Na Garraidhean

This site facing south west was exposed to swell and moderate currents, as well as the prevailing winds, and seemed fairly typical of a rocky exposed shore.

From this rock which dries (0.3m) to 14m. depth the cliff face was almost vertical, with occasional horizontal crevices 1m. deep by 0.2m. wide. Kelp, Laminaria hyperborea and Alcyonium digitatum with some Caryophyllia smithii were the dominant species on the cliff face, with Holothuria forskali in the crevices, also bryzoans. At the foot of the cliff there was coarse shell sand formed into current wave ripples, 0.8m. from crest to crest and 0.2m. high. Here there was no obvious sign of fauna. Further out from the base of the cliff, bedrock showed through, with shellsand patches to 18m. then small to large boulders sloped gradually to 21m. depth. Here, there was sparse Laminaria saccharina, rare Caryophyllia smithii and Pomatoceros sp., some bryzoans, a 300mm. Holothuria forskali, Marthasterias glacialis. Thereafter there was almost horizontal shingle and coarse shellsand, with a few Lanice conchilega. Outcrops of bedrock showed through, supporting some sparse kelp. It was noted that apart from some sand gobies there were few fish to be seen.

Site 8 - South side of Canna -W. side of Haslam Is.

This moderately exposed site facing south west may get some shelter from the west side of the bay and had a fairly abundant marine life though not particularly diverse, probably typical of a cobble and boulder slope.

At 30m. depth there was a gradual slope towards the shore composed of large cobbles, small boulders with coarse sand in between. Echinoderms were prevalent here with large Echinus esculentus, Porania pulvillus and Asterias rubens, and Nemertesia antennina being the dominant hydroid. Luidia ciliaris, Marthasterias glacialis, and occasional Ophiothrix nigra were also present. There were small specimens of Polymastia boletiformis also present on the gradual slope as well as Balanus crenatus on the the boulders and Laniche conchilega in the coarse sand. At about 17 metres depth, the slope steepened to a 45oangle with small and large boulders forming habitats for all the previously mentioned dominant species plus the tunicates, Ascidia mentula and Cliona intestinalis. This slope was followed up to 13m. Other species noted were Eledone cirrhosa, Caryophyllia smithii, Limacia clavigera, Antedon petasus, Pecten maximus, Pomatoceros sp. and Sabella pavonina.

Site 9 - South side of Canna - Rubha Sgorr nam Ban-naomha

No great diversity of life found at this site, where the seabed was mainly shellsand, with broken mearl, with a few boulders on a fairly horizontal if uneven bed. The mobile sand formed waves 350mm apart and about 100mm. high. Fauna in the sediment at 24m. included Neopentadactyla mixta, Lanice conchilega, also Chaetopterus variopedatus. Boulders were covered with encrusting Algae and a few barnacles. Some chitons were found under the boulders. Nemertesia antennina and other hydroids were found on sediment and boulders. Alcyonium digitatum and Echinus esculentus were also present.

Site 10 - Canna outliers - Oigh Sgeir

This very spectacular and interesting site with basalt columns offered a good variety of habitat with very diverse and abundant life. Being 8km. out at the end of a chain of rocky islets south-west of Canna this site is extremely exposed, even if sheltered from the prevailing winds.

From 26m. to 24 m. depth the gradual slope of the seabed was composed of large and small rocks or boulders, which were possibly the tops of basalt columns, tightly packed together with coarse sand/shell fragments in between them. This zone was dominated by Alcyonium digitatum. From 24m. to 20m. the slope became very steep, almost vertical, being the faces of basaltic columns. The columns were covered with Alcyonium digitata with many Holothuria forskali noted around the base. Also noted were Sagartia elegans, Caryophyllia smithii, Corynactus viridis and many bryzoan species. At the top of this underwater cliff the dominant species was Laminaria hyperborea and a diversity of red Algae; becoming more dense with decreasing depth. The cliff top was traversed around a point where the vertical wall continued back to form a cave. The bottom slope leading to the cave was quite bare apart from coralline Algae. The cave had a floor of broken basaltic columns, spectacular basaltic columnar walls and the ceiling was the undersides of basaltic columns. The cave walls were dominated by Alcyonium digitatum and large Ascidium mentula. There was much decaying Laminaria stipes on the floor of the cave and it appeared as though there was little water movement through the cave.

Site 11 - Oigh Sgeir

This exposed site, being on the easterly side of the Islands which form the Oigh Sgeir, may get some shelter from the prevailing south-westerlies but shows considerable diversity and abundance set in one of the most spectacular dive sites.

The shallow water above 15m. depth, (at which there were the tightly packed tops of basaltic columns), supported a kelp forest. Boulders down to 20m. were covered in Halichondria panicea with a good cover also of Chondrus crispus. Holothuria forskali were common on the boulders with some Botryllus schlosseri, Luidia ciliaris and Antedon bifida. Below 15m. there were large boulders with small clusters of barnacles, encrusting Algae, and small colonies of Flustra foliacea between the boulders. Hydroid Nemertesia aentenina, Clavelina lepadiformis, boring sponges, nudibranch egg whorls and topshells were also seen.

Site 11(cont'd.)

Alcyonium digitatum was dominant at all depths, but more so in the shallower water. Sea gooseberries and small jellyfish were common in the water column.

Site 12 - S.W. Canna outliers - Humla Rock

The bedrock, at this very exposed site, had very flat angular surfaces, possibly tops of basaltic columns, and sloped gently from the surface to 15m. This area was dominated by dense kelp forest heavily grazed by urchins. Below the kelp there was a diverse and abundant circalittoral zone which appeared to be significantly reduced and impoverished below 23m. depth.

Lithothamnion sp encrusted the rock. From 5m. to 21m. depth the bedrock was more irregular, still with angular surfaces and no significant deposits and few small red algae. The dominant species in this zone was Alcyonium digitatum and a range of echinoderms were present including Asterias rubens, Marthasterias glacialis, Porania pulvillus, Holothuria forskali. Caryophyllia smithii grouped in small rings spaced 50mm - 100mm. apart were very common. There were a few sponges including Cliona celata.

Site 13 - S.W. Canna outliers - Jemima Rocks

This exposed site had good diversity of life, but nothing outstanding. A moderate westerly tidal current was noted and swell was noticeable at all depths.

The cliff fell steeply to 13m. with a ledge at 1m. and again at 9m. depth. From 13m. to 21m. depth the bedrock gradually sloped with some fissures, and at 21 metres to 27m. and beyond, the bottom was composed of poorly sorted large boulders, forming a gradual slope formed of bedrock with cracks and crevices.

The steep cliff was dominated by Laminaria hyperborea and abundant Alcyonium digitatum. Echinus esculentus was present, also Myxilla incrustans. The kelp continued down the slope but became sparser with depth to about 18m. Red Algae, hydroids, Clavelina lepadiformis, Diazona violacea were observed. On the boulders there was encrusting Lithothamnion and other red seaweeds. Caryophyllia smithii and Flustra foliacea were present on the boulders, with Pawsonia saxicola in crevices. Janolus cristata and Polycera quadrilineata were recorded.

Site 14 - South side of Canna - Tarbert Bay

At this sheltered site a fine sandy substrate at 13 metres formed the bottom with wave ripples across the bay. The slope was very gentle - almost horizontal. There was loose algae over most of the area giving a 10 - 30% cover, including Laminaria saccharina and fragments of red Algae. The dominant species was large specimens of Ensis siliqua, and also noted were the burrowing brittlestar Amphiura brachiata, Lanice conchilega, Astropecten irregularis, Liocarcinus depurator, Pagurus bernhardus, Echinocardium cordatum, Corystes cassivelaunus. There was debris from fishing boat nets such as Nephrops claw and Funiculina "pens"

Site 15 - N.W. Eigg - Bay of Laig, south side of the bay.

This side of the bay would be sheltered from the prevailing south-westerlies. The horizontal bed at 15m. was of coarse/medium sand with the occasional boulder covered with pink encrusting algae and some Cliona celata. A variety of red Algae was evident. The substrate supported a good variety of life on the surface and it is probable that further investigation would produce many more species than was initially evident. Noted at this site were Cerianthus lloydii, Clavelina lepadiformis, and Corymorpha nutans in large numbers. Nemertesia antennina, Chaetopterus variopedatus, Lanice conchilega, Sagartia sp, Gibbula magus, Coryste cassivelaunus. Luidia sarsii was also recorded.

Site 16 - N.W. Eigg - Bay of Laig, North side of the bay

At 14m. depth, the seabed was composed of large and small boulders with coarse sand and shell, cobbles and pebbles in between. A ridge approximately 20m. wide and 2m. high ran parallel to the shore and was composed of large and very large boulders with some coarse sand and shells, cobbles and pebbles. Beyond the ridge, nearer the shore, the terrain was similar to the far side of the ridge but with larger pockets of coarse sand with shells. There was Laminaria hyperborea over the whole site with L. saccharina on the shallower boulders. There was much red algal growth on stipes and rocks. Echinus esculentus (2 per m.2), Marthasterias glacialis, and small Asterias rubens were present, also Balanus balanoides on rocks. Usual fauna associated with kelp present plus holothurians between boulders and cobbles, especially - Pawsonia saxicola. Also noted Membranipora membranacea, Obelia geniculata, Mya truncata, Heliccion pellucidum, Gibbula magus, Halichondria panicea, Macropidia sp, Dilsea carnosus, Phyllophora pseudoceranoides, Desmarestia sp, Urticina felina, Plocamium cartagineum, Delesseria sanguinea, Calophyllis laciniata.

Site 17 - North Eigg - Talm

A typical kelp/boulder habitat with a gradual slope from 9m. to 13m. with large kelp covered boulders on medium sand/mud. At 11m. the boulders were smaller and there was a greater area of sand/mud with small cobbles also present. At 12m. to 13m. cobbles in sand/mud predominated with ripples about 0.6mm. apart. Alcyonium digitatum was present on boulders, with Echinus esculentus, Luidia ciliaris, Ophiura texturata, Antedon bifida, Caryophyllia smithii, Clavelina lepadiformis, Lanice conchilega, and Ophiuro albida. Hydriods and dragonets were recorded

Site 18 - North Eigg - South os Sgurr Sgaileach

There was soft silty sand forming a moderately steep slope from 9m. to at least 26m. Fauna was predominantly Cerianthus lloydii, Virgula mirabilis with Pennatula phosphorea at greater depths. Possibly juvenile Pennatula phosphorea were noted at the shallower depths. Goneplax rhomboides and Nephrops norvegicus noted at 25 metres, also two angler fish. Other species noted Labidoplax digitata, Solaster endeca, Asterias rubens and Cancer pagurus.

APPENDIX 2

Code	Species	N. Canna	S. Canna	SE Rocks	Eigg
PORIFERA					
C 035	Scypha ciliata			x	
C 213	Tethya aurantium			x	
C 258	Polymastia boletiformis			x	
C 302	Cliona celata		x	x	x
C 354	Axinella infundibuliformis			x	
C 423	Raspailia sp.			x	
C 484	Halichondra panicea		x	x	x
C 645	Myxilla incrustans			x	
C 775	Hemimycale columella			x	
	Sponge unident.		x		
HYDROZOA					
D 121	Corymorpha nutans	x			x
D 144	Tubularia indivisa	x			
D 526	Halecium halecinum			x	
D 585	Kirchenpaueria pinnata				x
D 597	Nemertesia antennina	x	x	x	x
D 599	Nemertesia ramosa		x	x	
D 728	Obelia sp.		x		x
ANTHOZOA					
D1024	Alcyonium digitatum	x	x	x	x
D1056	Virgularia mirabilis				x
D1067	Pennatula phosphorea				x
D1075	Cerianthus lloydii				x
D1158	Anemonia viridis			x	
D1168	Urticina felina	x	x	x	x
D1169	Urticina eques	x			
D1231	Sagartia elegans	x		x	x
D1319	Peachia cylindrica				x
D1357	Corynactis viridis			x	
D1370	Caryophyllia smithii		x	x	x
ANNELIDA					
P1375	Chaetopterus variopedatus			x	x
P1576	Arenicola marina				x
P2031	Lanice conchilega	x	x	x	x
P2227	Myxicola infundibulum				
P2261	Sabella pavonina	x	x		
P2302	Pomatoceros sp.	x	x	x	
P2346	Protula tubularia			x	

Code	Species	N. Canna	S. Canna	SE Rocks	Eigg
ARTHROPODA					
R 021	Cirripedia		X	X	
R 108	Balanus balanoides				X
R 110	Balanus crenatus	X		X	
	Amphipod whips	X	X	X	
S2331	Crangon crangon				X
S2365	Nephrops norvegicus				X
S2414	Palinurus elephase	X			
S2465	Pagurus bernhardus		X		
S2484	Galathea sp.	X			
S2543	Ebalia sp.		X		
S2582	Macropodiasp.				X
S2620	Corystes cassivelaunus		X		X
S2626	Atelecyclus rotundatus	X			
S2646	Cancer pagurus				X
S2669	Liocarcinus depurator		X		X
S2672	Liocarcinus puber			X	
S2714	Goneplax rhomboides				X
MOLLUSCA					
W 50	Chiton (unidentified)				
W 139	Helcion pellucidum				X
W 189	Gibbula magus	X			X
W 200	Calliostoma zizyphinum		X	X	
W 700	Aporrhais pespelecani				X
W 844	Buccinum undatum				X
W1267	Dendronotus frondosus	X		X	
W1358	Limacia clavigera		X		
W1363	Polycera quadrilineata			X	
W1431	Janolus cristatus			X	
W1452	Coryphella lineata	X			
W1809	Pecten maximus	X	X		
W2027	Ensis siliqua		X		X
W2227	Mya truncata				
W2522	Eledone cirrhosa		X		
BRYZOA					
Y 0	Bryozoa indet. (encrusting)	X			
Y 137	Alcyonidium diaphanum		X		
Y 664	Membranipora membranacea				X
Y 694	Flustra foliacea			X	
Y 869	Bugula sp			X	

Code	Species	N.Canna	S.Canna	SE Rocks	Eigg
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ECHINODERMATA

ZB 11	<i>Antedon bifida</i>		x	x	x
ZB 12	<i>A. petasus</i>		x		
ZB 41	<i>Astropecten irregularis</i>			x	x
ZB 67	<i>Luidia ciliaris</i>		x		x
ZB 68	<i>Luidia sarsi</i>				x
ZB 101	<i>Porania pulvillus</i>			x	
ZB 149	<i>Crossaster papposus</i>		x		
ZB 164	<i>Henricia</i> sp		x		
ZB 190	<i>Asterias rubens</i>	x	x	x	x
ZB 200	<i>Marthasterias glacialis</i>		x	x	
ZB 235	<i>Ophiothrix fragilis</i>		x		
ZB 242	<i>Ophiocomina nigra</i>		x		
ZB 285	<i>Amphiura brachiata</i>		x		x
ZB 313	<i>Ophiura albida</i>		x		x
ZB 315	<i>Ophiura ophiura</i>		x		
ZB 362	<i>Echinus esculentus</i>	x	x	x	x
ZB 407	<i>Echinocardium cordatum</i>		x		
ZB 474	<i>Pawsonia saxicola</i>			x	x
ZB 452	<i>Holothuria forskali</i>		x	x	
ZB 503	<i>Neopentadactyla mixta</i>	x	x		
ZB 533	<i>Labidoplax digitata</i>				x

CHORDATA

ZD 6	<i>Clavelina lepadiformis</i>		x	x	x
ZD 33	<i>Polyclinum</i> sp.			x	
ZD 117	<i>Ciona intestinalis</i>				
ZD 123	<i>Diazona violacea</i>			x	
ZD 150	<i>Ascidia mentula</i>			x	
ZD 209	<i>Botryllus schlosseri</i>				

PISCES

ZG 136	<i>Lophius piscatorius</i>				x
ZG 150	Gadidae	x			
ZG 700	<i>Callionymus lyra</i>	x			x
ZG 727	<i>Gobiusculus flavescens</i>		x		

CETACEA

ZK 131	<i>Balaenoptera acuturstrata</i>				surfaced beside boat nr Humla Rock
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Code	Species	N. Canna	S. Canna	SE Rocks	Eigg
ALGAE					
ZM 256	<i>Dilsea carnosa</i>	x	x		x
ZM 323	<i>Calophyllis laciniata</i>	x	x	x	x
ZM 384	Corallinaceae indet. (encr.)	x	x	x	
ZM 461	<i>Lithothamnion glaciale</i>				
ZM 584	<i>Phyllophora crispa</i>	x			
ZM 586	<i>Phyllophora pseudoceranoides</i>				x
ZM 588	<i>Phyllophora traillii</i>		x		
ZM 611	<i>Chondrus crispus</i>				
ZM 631	<i>Plocamium cartilagineum</i>	x			x
ZM 692	<i>Rhodophyllis</i> sp.			x	
ZM 752	<i>Lomentaria clavellosa</i>		x		
ZM 823	<i>Ceramium rubrum</i>	x			
ZM 950	<i>Cryptopleura ramosa</i>	x			
ZM 955	<i>Delesseria sanguinea</i>	x	x	x	x
ZM 985	<i>Hypoglossum hypoglossoides</i>		x		
ZM1002	<i>Nitophyllum punctatum</i>	x	x		
ZM1012	<i>Phycodrys rubens</i>	x	x	x	
ZM1050	<i>Brongniartella byssoides</i>	x	x		
ZM1097	<i>Odonthalia dentata</i>	x			
ZM1101	<i>Polysiphonia</i> sp.	x	x		
ZM1137	<i>Pterosiphonia parasitica</i>	x			
ZM1144	<i>Rhodomela</i> sp.				
ZR 158	<i>Pseudolithoderma extensum</i>		x	x	x
ZR 389	<i>Cutleria multifida</i>	x	x		
ZR 457	<i>Dictyota dichotoma</i>	x	x	x	
ZR 497	<i>Desmarestia aculeata</i>				x
ZR 632	<i>Laminaria digitata</i>				
ZR 633	<i>L. hyperborea</i>	x	x	x	x
ZR 636	<i>L. saccharina</i>	x			
ZR 716	<i>Haidrys siliquosa</i>		x		

APPENDIX 3

TABLE OF HABITATS AND COMMUNITIES

	N.Canna	S.Canna	SE Rocks	Eigg
Infralittoral cliff		7	11,13	
Circalittoral cliff			10,11	
Infralittoral bedrock/boulders	1,2,3	6,7	10,12,13	16,17
Circalittoral bedrock/boulders	2	6,7,8,9	10,11, 12,13	
Cobbles & Pebbles with sand/gravel	1,2,3,4	7,9		16,17
Coarse/medium sand	2			15,17
Sand/mud	5	14		18
Human Impacts - Boats emptying nets		14		

APPENDIX 4

Slide No	Site No	Description	Photographer
1	1	Encrusting algae & barnacles on scoured boulder	S Hiscock
2	"	Crayfish & encr. algae on boulder	"
3	"	Biota on cobbles	"
4	"	Kelp & foliose algae on bedrock	"
5	"	Foliose algae on bedrock	"
6	4	Sand ripples	J. Wilson
7	"	Sand bottom and ripples	"
8	"	Alcyonium on boulders	"
9	"	Large Cobbles on sand	"
10	"	Squid eggs on kelp stipe	"
11	"	Kelp and encrusting algae	"
12	"	Kelp	"
13	"	Kelp forest on bedrock	"
14	5	Sand/mud botton with Corymorpha	R Sykes
15	"	Corymorpha nutans	"
16	6	Eubranchus farrani on boulder	"
17	"	Hydroids, encrusting algae	"
18	"	Caryophyllia smithii	"
19	"	Antedon bifida	J. Woodward
20	"	Alcyonium on boulder	"
21	"	Biota on rock	"
22	"	Hydroids and Antedon bifida	"
23	"	Alcyonium and Forskali	"
24	7	Forskali on boulders	J Wilson
25	"	General view of boulder slope	"
26	8	Sagartiogeton?	R Holt
27	"	Limacia clavigera	"
28	"	Urticina felina	"
29	"	Eledone	"
30	"	Clavelina lepadiformis	"
31	"	Barnacle & hydroid	"
32	9	Boulders and sand/gravel	S Hiscock
33	"	Halidrys siliquosa and boulders	"
34	"	Biota on boulders	"

Outliers			
35	10	Biota on Boulders at 23m	S. Hiscock
36	"	ditto	"
37	"	RH & LC at 20 metres	"
38	"	Alcyonium on basalt columns at entrance to cave	"
39	"	As above from 12 m to 7m bedrock	"
40	"	Alcyonium on columns near entrance	"
41	"	Basalt debris at entrance with encrusting algae	"
42	"	Cave floor with dead L.Hhperborea and bacteria at 10m	"
43	"	Columnar basalt on cave walls with sparse biota	"
44		Biota on boulder	"
45		Amphipod whips etc	"
46		Nudibranch eggs and other biota	"
47		Corynactus and other biota	"
48		Tritonia hombergi	"
49		Entelurus aequorius	"
50		Haliclona viscosa	"
51		Ascidia mentula	"
52	11	Aplidium punctatum	R Holt
53	"	Axinella infundibiliformis	"
54	"	Janolus cristata	"
55	"	Aplidium proliferum	"
56	"	Sagartia elegans	"
57	"	Alcyonium sp	"
58	"	Tethia aurantium	"
59	"	Coryphella pedata	"
60	12	Clavelina lepadiformis	R Sykes
61	"	Hydroid and Doto coronata	"
62	"	Onchidoris luteocincta	"
63	"	Facelina sp	"
64	"	Eubranchus farrani	"
65	"	Biot on rocks & boulders	J Woodward
66	"	Caryophyllia smithii	"
67	"	Marthasteria & Alcyonium	"
68	"	Biota on boulder	"
69	13	Biota on bedrock	J Wilson
70	"	Biota on boulders	"
71	"	ditto	"
72	"	ditto	"
73	"	Cobbles on sand	"

Eigg			
74	15	Biota and siphons	S Hiscock
75	"	Astopecten	"
76	"	Ophia albida	"
77	"	Corystes	"
78	"	Corystes burying itself	"
79	"	Corymorpha nutans	"
80	"	Peachia cylindrica	"
81	"	Luida sarsi	"
82	"	Hydroids	"
83	18	Sand/Mud and Virgularia	J Wilson
84	"	Biota on Sand/mud	"
85	"	Angler fish	"

Appendix 5

Seasearch Forms

SITE NAME: _____ SITE NO: _____
 DATE OF SURVEY: _____ * Delete where not applicable
 TIME OF DIVE: Start: _____ End: _____ Duration: _____
 DEPTH RANGE: _____ m below sea level/chart datum*

OS GRID REFERENCE

--	--	--	--	--	--	--	--

 to

--	--	--	--	--	--	--	--

OR LATITUDE/LONGITUDE

	°	'N		°	'W/E*
--	---	----	--	---	-------

	°	'N		°	'W/E*
--	---	----	--	---	-------

NAME OF RECORDER: _____
 RECORDERS ADDRESS: _____
 AND/OR NAME OF EXPEDITION: _____
 WHY WAS THIS SITE SELECTED? _____

DESCRIBE THE OBJECTIVES OF THE DIVE _____

WERE THESE OBJECTIVES MET? _____

SITE LOCATION MAP(S) (Photocopy of OS map or chart and/or sketch of site marking dive location. Sketch any transit lines used for location.)

Please tick if other information was collected at this site and note from where this information can be retrieved. Please attach copies of information.

Species lists _____ Specimens (identified) _____
 Samples (not identified) _____ Photographs _____

Tick here if the form is completed by the recorder
 by the project leader

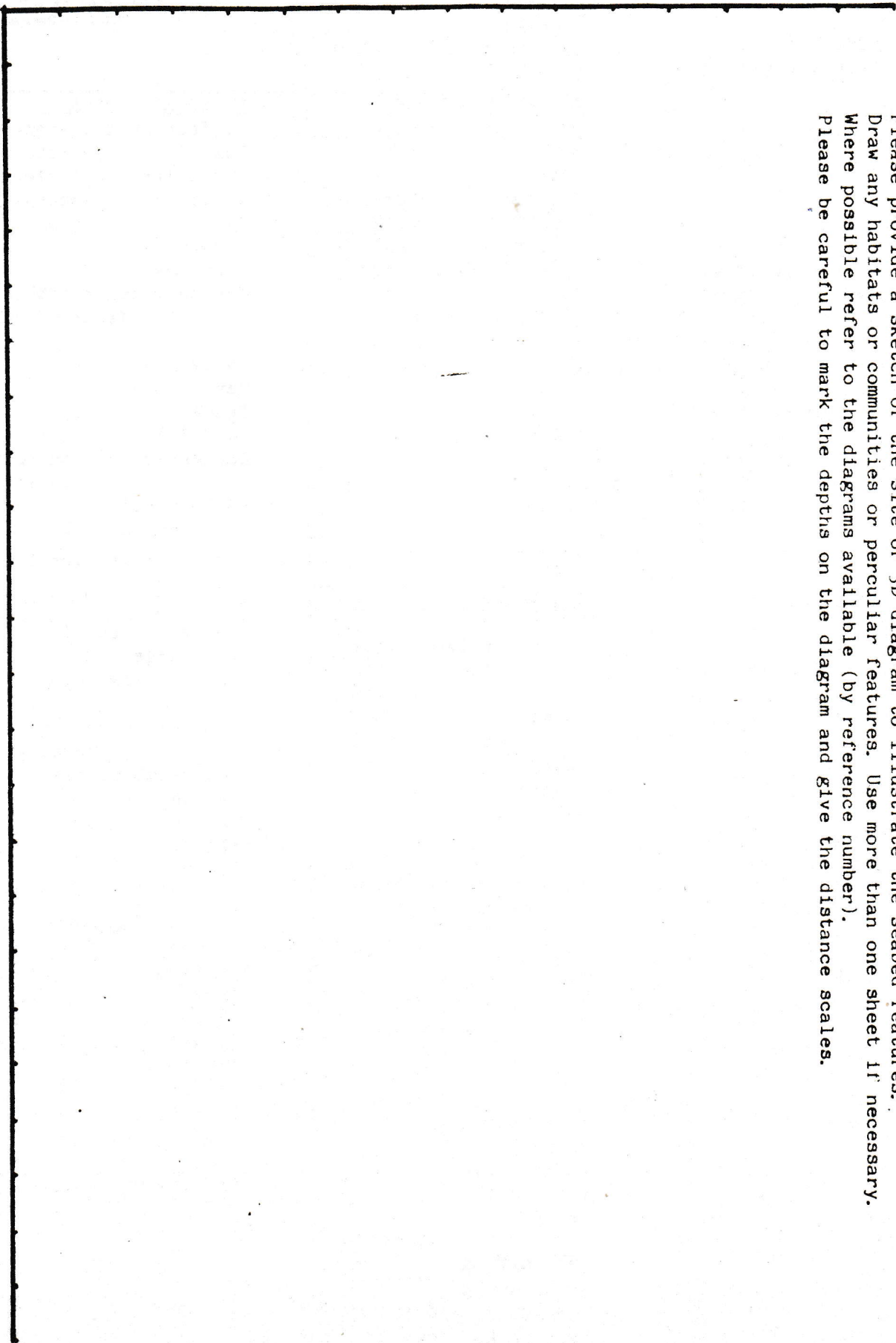
Expedition _____

Site Name _____ Grid Ref. or Lat/Long _____ Site Number _____

Site Description Describe the main seabed features encountered on your dive. Use the key words and checklists provided. Refer to the diagrams and pictures in the habitat manual for cross reference, and also to the Sketch Sheet. First describe the topography (dive profile) then the main habitats, (rock, sediment, plants), and then the main community types in that order. Note the visually dominant species/community types. Use extra sheets if necessary.

YOUR ASSESSMENT OF THE SITE: Please give your assessment of the site. Were any of the features of the site especially interesting. Was the underwater scenery uninteresting, typical, or spectacular? Was there a variety of habitats or was it dominated by one habitat. Were the marine life diverse and interesting or nothing unusual? Were there any marked features of human impact at the site?

Project Leader comments



SKETCH SHEET

Please provide a sketch of the site or 3D diagram to illustrate the seabed features. Draw any habitats or communities or peculiar features. Use more than one sheet if necessary. Where possible refer to the diagrams available (by reference number). Please be careful to mark the depths on the diagram and give the distance scales.

Site Number _____

SITUATION

Open coast
 Straits/Sound/Narrows
 Shallow Rapids
 Marine inlets
 Lagoon
 Other

OFFSHORE FEATURES

Islands/islets/rocks
 Reefs
 Breakwater
 Shoal/sandbank
 Other

WAVE EXPOSURE

Ext. exposed (prev. wind/
 swell onshore, deep water)
 Very exposed (prev.
 wind & swell onshore)
 Exposed
 (prev. wind onshore)
 Mod. exposed
 (onshore wind frequent)
 Sheltered
 (strong wind rare)
 Very sheltered
 (fetch <20km)
 Ext. sheltered
 (fetch <3km)

Max. TIDAL STREAM STRENGTH

Very strong (>6 K)
 Strong (3-6 K)
 Mod. strong (1-3 K)
 Weak (<1 K)
 Very weak (neg.)
 Uncertain

ROCK TYPE

Hard
 Igneous
 Chert/Flint
 Slate
 Sand/Mudstone
 Medium
 Limestone
 Friable
 Shale/Slate
 Soft
 Sand/Mudstone
 Chalk
 V. soft
 Clay
 Other
 Not known

STRATIFICATION

Thermocline
 Halocline
 Not stratified
 Not known

SALINTY

Normal (always >30‰)

--

SHORE BACKING

Low cliff (<10m)
 Moderate cliff(10-50m)
 High cliff (50-100m)
 V.high cliff (>100m)
 Woodland
 Grassland
 Shgle/cble/bllder ridge

EXTENT OF RECORD

Whole area surveyed
 Biological subzone
 Depth band
 Restricted feature
BIOLOGICAL SUBZONE
 Sublittoral fringe
 Infralittoral upper
 lower
 Circalittoral upper
 lower

DEPTH BCD

0-5m
 5-10m
 10-20m
 20-30m
 30-50m
 >50m

SUBSTRATUM

Bedrock
 Boulder v.lge >1m
 lge 0.5-1m
 sml 25-50cm
 Cobble lge 128-250mm
 sml 64-128mm
 Slate 64-256mm
 Pebble 4-64mm
 Gravel stone
 shell
 dead maerl
 Sand coarse 0.5-2mm
 medium
 fine
 Mud
 Shells (empty)
 Artificial wreck
 metal
 concrete
 wood
 plastic
 Tree/Branch
 Algae
 Maerl (live)
 Water column
 Other

Total 100

INCLINATION

Overhanging
 Vertical (80-100°)
 Very steep (40-80°)
 Upward facing(0-40°)
 Underboulder

Total 100

Cliffs**SEASearch**
Marine Nature Conservation Review**FEATURES - ROCK** 1-5

Surface relief(even-rugged)
 Texture (smooth-pitted)
 Stability (stable-mobile)
 Scour (none-scoured)
 Silt (none-silted)
 Fissures >10mm
 Crevices <10mm
 Boulder, cobble, pebble shape
 (rounded-angular)

Gully

Cave

Tunnel

Rockmill

Boulder/cobble on rock
on sediment

Boulder holes

Sediment on rock

Surface silt/floculent

Other

MODIFIERS

Freshwater runoff
 Wave surge
 Tidal stream accelerated
 decelerated
 Inclination vertical
 overhang
 Substratum mobile
 Grazing
 Shading
 Pollution
 Other

ASPECT

North
 Northeast
 East
 Southeast
 South
 Southwest
 West
 Northwest

Horizontal UW Visibility

Appendix 6

Extracts from NCC-CST Report

Sublittoral Survey of the Small Isles, Inner Hebrides

Frances Dipper March 1981

Sublittoral survey of the Small Isles, Inner Hebrides:
Rhum, Canna, Eigg and Muck.

NCC, CST expedition in collaboration
with the Underwater Conservation Society

Sept 6 to Sept 20 1980

by

Frances Dipper

SURVEY TEAM

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TABLE 1	Summary of dive sites
TABLE 2	Sublittoral site number, name, location and site features
TABLE 3	Comparison of species present at sites with bedrock extending below 20m
FIGURE 1	Sublittoral sites

APPENDIX I List of all species of animals and algae observed and collected

APPENDIX II SRS record of white holothurian

APPENDIX III Faunal check list and habitat recording sheet

APPENDIX IV (separate cover) Raw data sheets

APPENDIX V (separate cover) List of all colour slides taken

1. INTRODUCTION

1.1 Aims of survey

The main aims of the survey were to describe the sublittoral habitats and communities of plants and animals present around Rhum and where possible around the neighbouring islands of Canna, Eigg and Muck. The survey forms part of a wider NCC marine investigation throughout the Inner and Outer Hebrides run in collaboration with the Underwater Conservation Society. The site information collected during this and other similar surveys will eventually be used in the classification and evaluation of the shallow sublittoral habitats of Britain for a Marine Nature Conservation Review. While on location the team made a tape recording of aspects of the survey work which was presented by Roger Mitchell in the BBC radio programme, 'The Seaside in Autumn' as part of a series by Don Mosey, BBC Manchester.

1.2 Location and area

Rhum, Canna, Eigg and Muck known collectively as the Small Isles (from the name of their Parish) lie between the Islands of Coll and Skye, ten to twenty five miles out from the Scottish west coast town of Mallaig. Access is by Caledonian MacBrayne passenger ferry and all equipment must be loaded onto the ferry and then off via a launch acting as tender.

1.3 Previous marine studies

The only previously recorded study of marine survey around these islands is a short report by three members of the Glasgow University Exploration Society who dived two inshore sites in Loch Scresort, Rhum (Harvey et al 1974). Other records are received from time to time from amateur divers taking part in the Underwater Conservation Society recording projects whilst on diving holidays.

1.4 Other studies

During this survey the opportunity was also taken to record seabirds from the ferries and diving boats and to investigate a few intertidal sites. The results will be reported separately.

2. ENVIRONMENTAL CONDITIONS

2.1 Bathymetry and seabed characteristics

Considerable differences in extent and type of rock slope are apparent between the different islands and between East and West coasts. These differences are probably due both to geology and to differences in exposure to wave action. Deep water is present close inshore around all the islands.

On the East coast of Rhum very short, silt covered bedrock slopes give way to sand close inshore as shallow as 5m. In the North-East on headland sites the rock slope is extended by boulder scree to about 10m. Sediments close inshore are predominantly sand shelving steeping away and becoming muddier with depth. Some deep offshore rocky reefs are present just north of Loch Scresort. Off the exposed West coast of Rhum the rock slope extends further offshore and is generally a steep bedrock slope to about

10m followed by shelving bedrock, boulder and pebble slopes to beyond 20m.

Extensive bedrock and boulder slopes are also present off the west of Canna, the West and South of Eigg and the North of Muck and give way to clean sand or gravel at about 20m. Steep and vertical bedrock cliffs extending to at least 30m are present around the South and East coast of Canna/Sanday and the North of Muck. The clarity of the water was greatest off the west end of Canna and off Eigg and Muck.

2.2 Exposure to wave action

Loch Scresort on the East coast of Rhum is the only sheltered inlet of any size in these islands and even this is exposed to wave action when the wind is in the east. The prevailing winds however, are westerly and the West coasts of the islands are very exposed to wave action and considerable Atlantic Swell is usually present even in calm weather.

2.3 Exposure to tidal streams

Strong tidal streams are absent in most of the area. Some flow is apparent off the east coasts of Rhum and Canna but is only significant offshore beyond the rock-sediment interface. However, the west coast of Muck is exposed to strong tidal streams.

3. METHODS

3.1 Survey

The expedition was based on Rhum where accommodation was available in "Kinloch Castle". The only suitable launching site for boats is the slipway at the head of Loch Scresort and all sublittoral sites were reached by sea from this point. Most of the sublittoral survey work was carried out from an inflatable necessitating long journeys to the more distant sites, often in adverse weather conditions. The islands of Canna and Muck were visited using the ferry boat "the Rhouma" on her off duty days. Eigg was visited by inflatable on an exceptionally calm day. Sites were selected by inspection of maps and charts to include locations exposed to different strengths of wave action and tidal streams. However, access to the south and west sides of Rhum proved extremely difficult due to the prevailing winds and access to the other islands was also restricted by the weather.

Field records of species and habitats were made underwater on formica writing boards and later transferred to standard check lists and habitat recording sheets (Appendix III). Species that could not be identified in the field were collected for subsequent identification and as voucher specimens. Nudibranch molluscs, hydroids and algae were particularly well investigated in this way since team members specialised in these particular groups. Habitats and species were also recorded by underwater photography. The data collected is of necessity mainly qualitative due to the very short time available

for observations underwater. However, unqualified presence/absence records provide less useful information for the comparison of sites and so subjective estimates of abundance were made as in previous surveys using the following notations: dominant, abundant, common, frequent, occasional and rare (Dipper and Mitchell 1980).

3.2 Interpretation of Results

Sublittoral sites were numbered in the order in which they were visited and are summarised in Table 1. A description of the main features of each site was prepared from the habitat recording sheets and is given in Table 2. An appendix (I) was prepared from the species check lists showing species present at each site and the distribution and habitat preferences of each individual species. Species identified from specimens and photographs were added to these lists. All records were used to describe the general populations and communities present. All depths are given relative to Chart Datum.

4. RESULTS

4.1 Introduction

All the sublittoral sites studied are shown in Figure 1 and are listed with a description of the main site features in Table 2. The main results of the survey are summarised in Appendix I as an annotated species list and plant and animal communities are described below. The term 'community' is used here in the loose sense as defined in Hiscock & Mitchell (1980) to include any group of organisms present in a particular habitat. Raw data sheets are bound in a separate Appendix IV.

4.2 Description of sublittoral plant and animal communities

At the majority of sites investigated, infralittoral and circalittoral zones could not be clearly distinguished since the rock slope did not extend much beyond 15m and there were few rich animal dominated communities.

4.2.1 Shallow bedrock and boulders off the east coast of Rhum

The short bedrock and boulder slopes of the east coast of Rhum were generally silt covered. A Laminaria hyperborea forest was dominant extending to about 10m when rock was still present at this depth and with heavy epiphytic growths of red algae, Crisiidae, Botryllus schlosseri, Scrupocellaria reptans, Obelia dichotoma and Halichondria panicea. The rock was generally heavily grazed by Echinus resulting in sparse foliaceous algae such as Callophyllis laciniata, Phycodrys rubens and Pterosiphonia parasitica. There was extensive cover of lithothamnium and other encrusting algae including Aglaozonia and Acrosorium reptans. In the fairly narrow depth range between the bottom of the kelp forest and the lower limit of the algae, encrusting algae occurred with filamentous species such as Trilliella and Compsothamnion spp. Varieties of Sargassum elegans and

Tealia felina were common on bedrock ledges and Caryophyllia smithi was frequent on the sediment covered rocks. Pomatoceros triqueter was frequent especially on boulders and pebbles. Occasional sponges, hydroids, (especially Abietinaria abietina); Alcyonium digitatum and Antedon bifida were present. Barnacles were common at some sites.

4.2.2 Wave exposed rock

The more extensive wave exposed bedrock and boulder slopes of the west coasts of Rhum, Canna and Eigg were dominated by thick L. hyperborea forest to about 10m often with plants extending to more than 20m. Much of the rock was again heavily grazed by Echinus, but the clearer water and more extensive rock surfaces resulted in a wider variety of foliaceous algae including Kallymenia reniformis and Bonnemaisonia asparagoides. The encrusting alga Cruoria pellita formed large patches in shallow water. Characteristic species found below the kelp forest included Phyllophora crispa, Dictyota dichotoma, and abundant B. asparagoides at site 35. There was extensive rock cover of orange encrusting bryozoa (particularly Parasmittina trispinosa) and Pomatoceros triqueter. The fauna was otherwise mainly restricted to crevices and kelp holdfasts. However large patches of Haliclona sp were characteristically found on the vertical sides of rocks and other sponges such as Pachymatisma johnstonia and Cliona celata were frequent. At some sites barnacles were abundant both on the rock and on kelp stipes. Deeper boulders and pebbles supported the hydroids Nemertesia spp., Abietinaria spp., and Hydrallmania falcata. Antedon bifida was also common at some sites.

4.2.3 Animal dominated tide exposed rock

Communities characteristic of strong tidal streams were only found at one site (34) off the west coast of Muck, and here distinct infralittoral and circalittoral zones could be distinguished although the former was not fully investigated. The circalittoral below about 23m was dominated by a bed of Ophiocomina nigra on pebbles covered with Securiflustra securifrons overlying coarse sand. Above this depth a boulder plain was dominated by thick erect bryozoa/hydrozoa particularly S. securifrons, and by Alcyonium digitatum. Above 20m a lower infralittoral zone was dominated by foliaceous red algae.

4.2.4 Steep bedrock and offshore reefs

Animal dominated communities were also found on offshore reefs below 30m at site 16/18. These reefs supported a rich community of filter feeding hydroids and anthozoans characterised in particular by large numbers of Caryophyllia smithi on the sediment covered rock and by Swifteia pallida, occasional Axinella infundibuliformis, Nemertesia spp. Thecocarpus myriophyllum and other hydroids. These reefs are probably only exposed to moderate tidal streams and are sheltered from wave action by their depth. A similar type of community was found on steep bedrock below about 20m off Muck (site 35) where again C. smithi and S. pallida were abundant along with a variety of hydroids and sponges.

The vertical bedrock cliffs off the south and east coasts of Sanday and Canna also supported rich animal growths below about 15m. Above this a wide variety of algae including several interesting species such as Rhodophyllis sp. and Compsothamnion spp. was found. Although Caryophyllia smithi was common at these sites, no Swiftea was present, and the rock was dominated by a thick undergrowth of bryozoa at the more wave exposed sites and by a wide variety of sponges and hydroids. Corynactis viridis was abundant and of particular interest was the presence of large numbers of the holothurians Holothuria forskali (site 10) and Parastichopus tremulans (site 9).

4.2.5 Sediment communities

Zostera beds

Sparse beds of Zostera marina occurred in clean sand close inshore along the east coast of Rhum and in Eigg harbour. Occasional Chaetopterus variopedatus, Lanice conchilega and Cerianthus lloydi were found among the Zostera and Lacuna vineta was common on the blades but on the whole, the beds were poor in other species. Characteristic algae included Bonnemaisonia hamifera, Lomentaria clavellosa and Antithamnion plumula. Pebbles supported several encrusting and filamentous species.

Muddy sand

Much of the sediment below about 10m off the east coast of Rhum and in Loch Scresort was of muddy sand. This was not very rich in species. Cancer pagurus was common in large excavations; Pecten maximus was frequent but not found in large numbers. Chaetopterus variopedatus, Arenicola marina and Macropipus depurator were also characteristic, as were Laminaria saccharina and Gracilaria verrucosa attached to stones. Where some current was present the hydroids Nemertesia spp., Halecium spp. and Thecocarpus myriophyllum were present attached to stones.

Muddy shell sand at the base of vertical cliffs within Canna harbour supported dense beds of Cerianthus lloydi and at deeper depths in much finer mud, beds of Sagartiogeton lacerata and Nephrops norvegicus.

Deep water sediments

Fine mud at depths greater than about 30m off the east coast of Rhum supported species such as the sea pens Pennatula phosphorea and Funiculina quadrangularis and the crustaceans Goneplax rhomboides and Nephrops norvegicus. No dense beds of Virgularia mirabilis were present as are found in the sheltered east coast lochs of the Uists.

Gravel

Clean sand and gravel off the north coast of Canna (site 12) supported an infauna that included Neopentadactyla mixta, Peachia hastata and venerid bivalves. Ciocalypa penicillus was present in shell gravel off the west coast of Eigg (site 25).

TABLE 1

Site No.	Site Name	Grid Ref.	Date	Divers
1	Creag na h-lolaire	NG 410025	7.9.80	RE, CM
2	Rubha Camas Pliasgaig	NG 399035	"	FD, BP
3	Loch Scresort North	NM 420997	"	BP
4	Loch Scresort South	NM 419990	"	FD, CM
5	Sgeir á Mhaim-ard	NM 414938	8.9.80	BP, RE
6	Dibidil	NM 395923	"	CM, FD
7	North of Welshman's Rock	NM 420957	"	CM, FD
8	Bàgh na h-Uamha	NM 425975	"	BP, RE
(9	Sanday. Sgeir á Phuirt	NG 286046	9.9.80	CM, FD
(-	"	NG 286046	16.9.80	BP, FD
10	Sanday. Dùn Mór	NG 279036	9.9.80	BP, RE
11	Canna. Dùn Channa	NG 204047	"	CM, FD
12	Canna. An t-Each Stack	NG 277065	"	BP, RE
13	Papadil	NM 362916	11.9.80	BP, RE
14	Welshmans Rock	NM 420947	"	FD, CM
15	N of Rubha na Roinne In	NG 420015	"	FD, CM
16	N of Rubha na Roinne Out	NG 423015	"	BP, RE
17	Kinloch Pier	NM 409992	12.9.80	CM
18	N of Rubha na Roinne(Again)	NG 423015	"	BP, RE
19	A'Mharagach	NG 337036	13.9.80	BP, FD
20	Kilmory	NG 354045	"	BP, CM
21	Rubha Shambnam Insir	NG 377050	"	CM
22	Eigg. Eilean Chathastail	NM 491830	14.9.80	FD, GB
23	Eigg. Galmisdale	NM 486838	"	BP, CM
		to 485835	-	-
24	Eigg. Dubh Sgeir	NM 450835	"	GB, FD
25	Eigg. Rubha an Fhasaidh	NM 438875	"	BP, CM
26	Sanday. Lighthouse	NG 294041	16.9.80	GB, CM
27	Canna. Rubha Carr-innis	NG 280051	"	BP, FD
28	Canna. An Coroghon(Castle)	NG 281055	"	GB, CM
29	Samhnan Insir	NG 380048	17.9.80	GB, FD
30	Bàgh Rubha Mhoil Ruaidh	NG 390039	"	BP, CM
31	Camas Pliasgaig	NG 398030	"	GB, FD
32	A'Bhrideanach W/side	NM 291994	18.9.80	BP, CM
33	Bloodstone Hill	NG 303005	"	GB, FD
34	Muck. Eagomol	NM 388812	19.9.80	GB, FD
35	Muck. Godag	NM 418818	"	BP, CM

Antedon bifida frequent and Trailliella common on boulders and pebbles. Tealia felina common on bedrock especially in sand filled crevices. A variety of small and encrusting algae on pebbles.

/5-17m/

33. Bloodstone Hill NG 303005

Plain of scattered small boulders with clean very coarse sand inbetween (16.5m), giving way at 18.5m to a boulder plain with little sediment. Small L. hyperborea occasional on boulders, many with stipes encrusted by Balanus crenatus. Moderate growth of foliaceous algae especially Phyllophora crispa although Echinus fairly common. Tops of boulders in boulder plain dominated by Traillia, Bonnemaisonia asparagoides and Phycodrys rubens; sides by Parasmittina trispinosa and Pomatoceros triqueter. Not much lithothamnion. Antedon bifida common especially below 17m.

/16.5 to 18.5m/

32. A' Bhrideanach West side Rhum NM 291994

Broken bedrock plain with some boulders on the bedrock and some thin ridges of clean shell gravel at 20m. Alcyonium digitatum and erect hydrozoa including Nemertesia sp. Abietinaria sp. and Hydrallmania falcata common; Echinus and barnacles common. Corynactis viridis present in small patches. Algae sparse, less than 5% cover.

/19-20m/

CANNA

11. Du'n Channa NG 204047

Slope of very broken bedrock and very large boulders with steep sided gullies giving way at 8m to hard smooth bedrock with overlying boulders. Boulders became smaller and more scattered with depth until at 18m the substratum was predominantly clean sand and pebbles. Above 8m a mature L. hyperborea forest was present with very tall plants and a rich flora of foliaceous algae in spite of large numbers of Echinus. Fauna sparse throughout and mainly on vertical surfaces. Large patches of Haliclona sp. occasional and Actinothoe sphyrodeta and Caryophyllia smithi frequent. Pomatoceros triqueter common on boulders and encrusting bryozoa and Cucumaria saxicola frequent under boulders. Some areas of small boulders and stones in the kelp forest probably scoured in winter, were dominated by Desmarestia aculeata. Grazing action of Echinus appears greatest below 8m with kelp stipes mainly bare. Scinaia turgida frequent on pebbles below 17m. No silt in the water or on the rocks.

/3-18m/

12. An t-Each Stack NG 277075

Scattered islands of bedrock and boulder surrounded by clean sand with an overlay of small black pebbles mostly less than 1" diameter. Occasional L. hyperborea plants on the bedrock and boulders and L. saccharina on pebbles, with no algae below 16m. Scinaia turgida on pebbles. Epifauna sparse with occasional hydroids, Caryophyllia smithi, crustacea and Polycarpa pomaria; barnacles common. Infauna of sand included Neopentadactyla sp. Peachia hastata and Venerid bivalves. Echinus were apparently feeding on barnacles.

/9-18m/

28. An Coroghon (castle) NG 281055

Short bedrock cliff from CD to 2.5m dominated by a wave exposed L. hyperborea forest followed by a bedrock and boulder slope to about 13.5m. The boulder slope between about 6 to 12m was heavily covered with silt, and dominated by the broad bladed form of L. hyperborea found in sheltered situations. Below 13.5m the substratum was a mixture of sandy mud and stones giving way to a steep mud slope at 18m. A variety of attached foliaceous algae were common on rock and stipes and occasional Gracilaria verrucosa and L. saccharina were attached to pebbles on the sediment slope. Rock fauna was sparse with occasional hydroids, Sagartia elegans (common above 2.5m), Balanus sp. and Echinus. Cerianthus lloydi was abundant and Sagartiogeton lacerata common in the sediment.

/+1.5 to 13.5m/

27. Rubha Carr-innis NG 280051

Steep bedrock cliff from CD to about 9m with large angular boulders scattered at the base. No thick kelp forest but scattered large plants of Sacchoriza polyschides. Foliaceous algae in scattered patches, mainly Delesseria sanguinea and Phycodrys rubens. Rock cover mainly silt, lithothamnion and abundant Caryophyllia smithi. Scyphistomae of Aurelia common under overhangs. A sediment plain below the rock had a distinct boundary at a depth of 13.5m. Above this depth muddy shell sand was dominated by Cerianthus lloydi. Below this depth the sediment was much finer mud, Cerianthus lloydi was only occasional and Sagartiogeton lacerata and Nephrops norvegicus were common.

/6-15m/

SANDAY

9. Sgeir a' Phuirt NG 286046

Almost vertical bedrock cliff with ledges and crevices from CD to 13m followed

by a bedrock slope to 18m and a steeply sloping muddy sand plain at the base. The bedrock slope was overlain in many places by sediment and large boulders were scattered at the base of the cliff and on the rock slope. Bedrock was dominated by a thick L. hyperborea forest to 8m the fronds heavily encrusted with Membranipora membranacea, Scropocellaria sp. and Tubularia larynx (occasional). Epiphytic algae especially Phycodrys rubens and the sponge Halichondria panicea were common stipe epiphytes. Beneath the kelp the rock cover was mainly 'lithothamnion', Caryophyllia smithi, patches of Alcyonium digitatum, Sagartia elegans and foliaceous algae, particularly large Rhodophyllis divaricata on vertical rock. The rock slope below 13m was characterised by sponges and hydroids especially Cliona celata, Myxilla incrustans, Pachmatisma johnstonia, Polymastia sp., Suberites sp., Raspailia/Stelligera and Nemertesia spp. Cerianthus lloydi was frequent in the sediment overlying the rock and very abundant in the sediment plain. Metridium senile was common on isolated boulders at the base of the rock slope. Several specimens of the rarely recorded holothurian Parastichopus tremulus were found on the cliff face and the rock slope. This site was extremely rich in species.

/+2 to 18m/

26. Lighthouse NG 294041

Gentle boulder slope with pebbles inbetween from 6m to 15m followed by a short bedrock slope leading onto a clean sand plain at 17m. Boulders dominated by L. hyperborea forest interspersed with L. saccharina attached to pebbles. Dense foliaceous algae under kelp forest since Echinus few in numbers. Kelp park to 13m, silt on rock below this. Bedrock slope cover mainly lithothamnion, Trailiella, Caryophyllia smithi and Antedon bifida. Cerianthus lloydi frequent and Lanice conchilega occasional in the sand.

/6m to 17m/

10. Dun Mor NG 279036

Vertical bedrock cliff examined from 16-29m but extending both above and below this. Flats, slopes, overhangs, crevices and some boulder scree present providing a variety of microhabitats. L. hyperborea present to 16m, red algae to 19m and lithothamnion to 24m. Erect bryozoa especially Securiflustra securifrons, Cellaria sp. and Crisiidae abundant; erect hydroids especially Tubularia indivisa common. Alcyonium digitatum common in patches; Caryophyllia smithi and Corynactis viridis abundant. At the deeper depths the sponges Cliona celata, Axinella infundibuliformis, Myxilla incrustans and Pachymatisma johnstonia were also present. The holothurian Holothuria forskali was common and two Palinurus vulgaris were recorded.

/16-29m/

FIGURE 1
SUBLITTORAL SITES

