NATURE CONSERVANCY COUNCIL

SEASEARCH

Marine Nature Conservation Review

MARINE CONSERVATION SOCIETY

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

LOCH BROOM & LITTLE LOCH BROOM

Susan Gubbay & Julia Nunn

MARINE CONSERVATION SOCIETY

SS/3/88

A Report to the Nature Conservancy Council
from Marine Biological Consultants Ltd.,
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SEASEARCH SURVEY OF LOCH BROOM & LITTLE LOCH BROOM

Susan Gubbay & Julia Nunn

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December 1988

SS/3/88

ABSTRACT

SEASEARCH survey techniques were used to collect information on the main habitat and community types in Loch Broom, Little Loch Broom and part of the approaches to Loch Broom. A total of 62 sites were investigated enabling a series of maps to be produced showing the overall distribution of the major sublittoral habitats and communities in the survey area. Twenty-five different habitat types were identified and each of these is described in some detail in the report. The extent of human impact on the area has also been described.

PREFACE

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, 9 Gloucester Road, Ross-on-Wye, Herefordshire, HR9 5BU.

ACKNOWLEDGEMENTS

Many thanks to all members of the survey team for their hard work during the trip and for keeping up their enthusiasm despite the number of "muddy" dives we undertook. Thanks also to Mr & Mrs Parry of the Ardness Salmon Fishery for their hospitality and for permission to launch our boats from their land. Mr Sid Hinds kindly lent us a inflatable boat for the expedition and we would like to thank him for helping the survey in this way. We are also grateful to the Ardmair Sailing Club for allowing us to launch boats from their land.

The report was completed following useful discussions with Bob Earll of the Marine Conservation Society and we would like to thank him for his help.

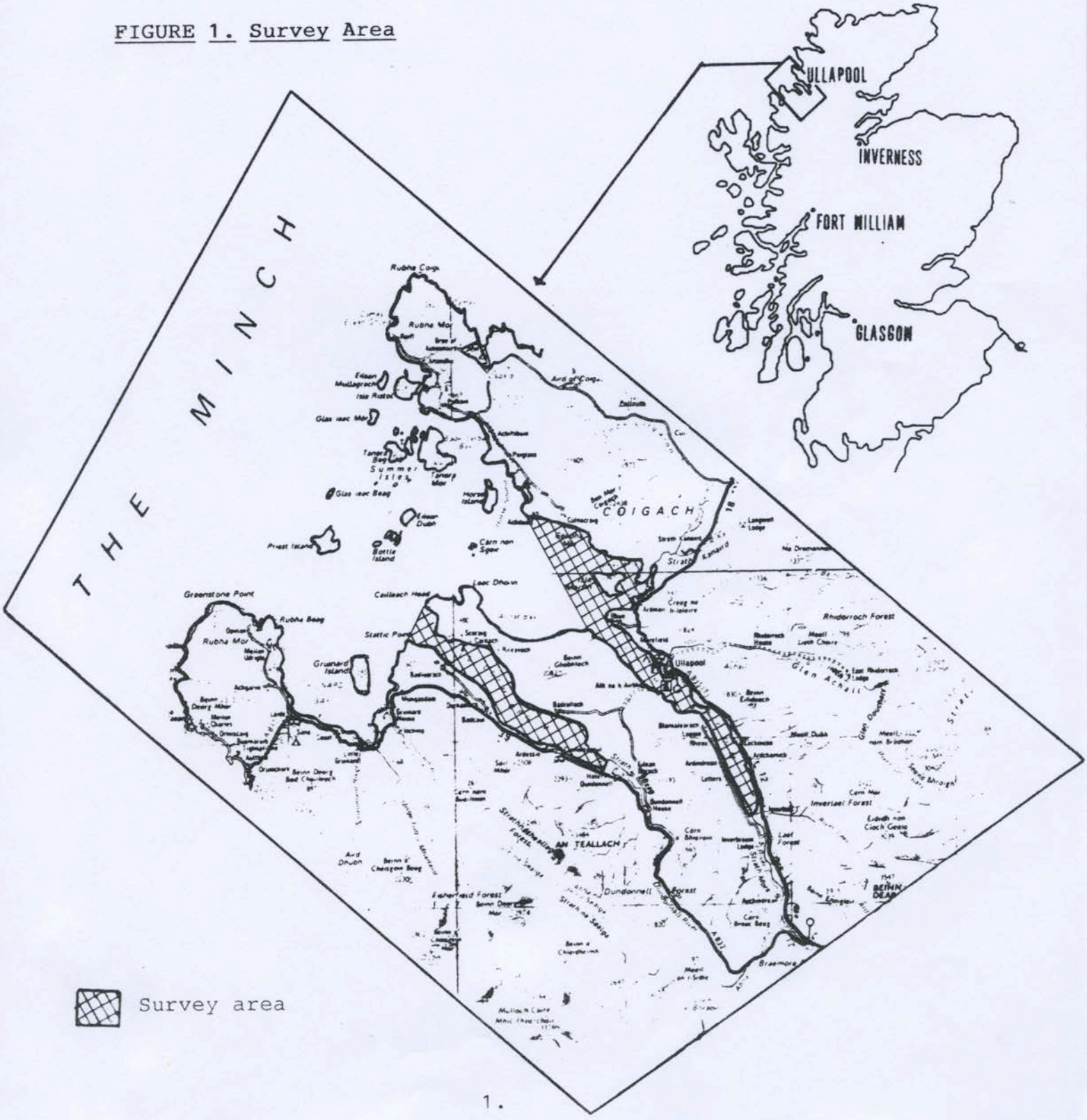
Finally many thanks to the Nature Conservancy Council who supported the expedition with a grant for the project and also by loaning equipment to the survey team.

CONTENTS

1. INTRODUCTION

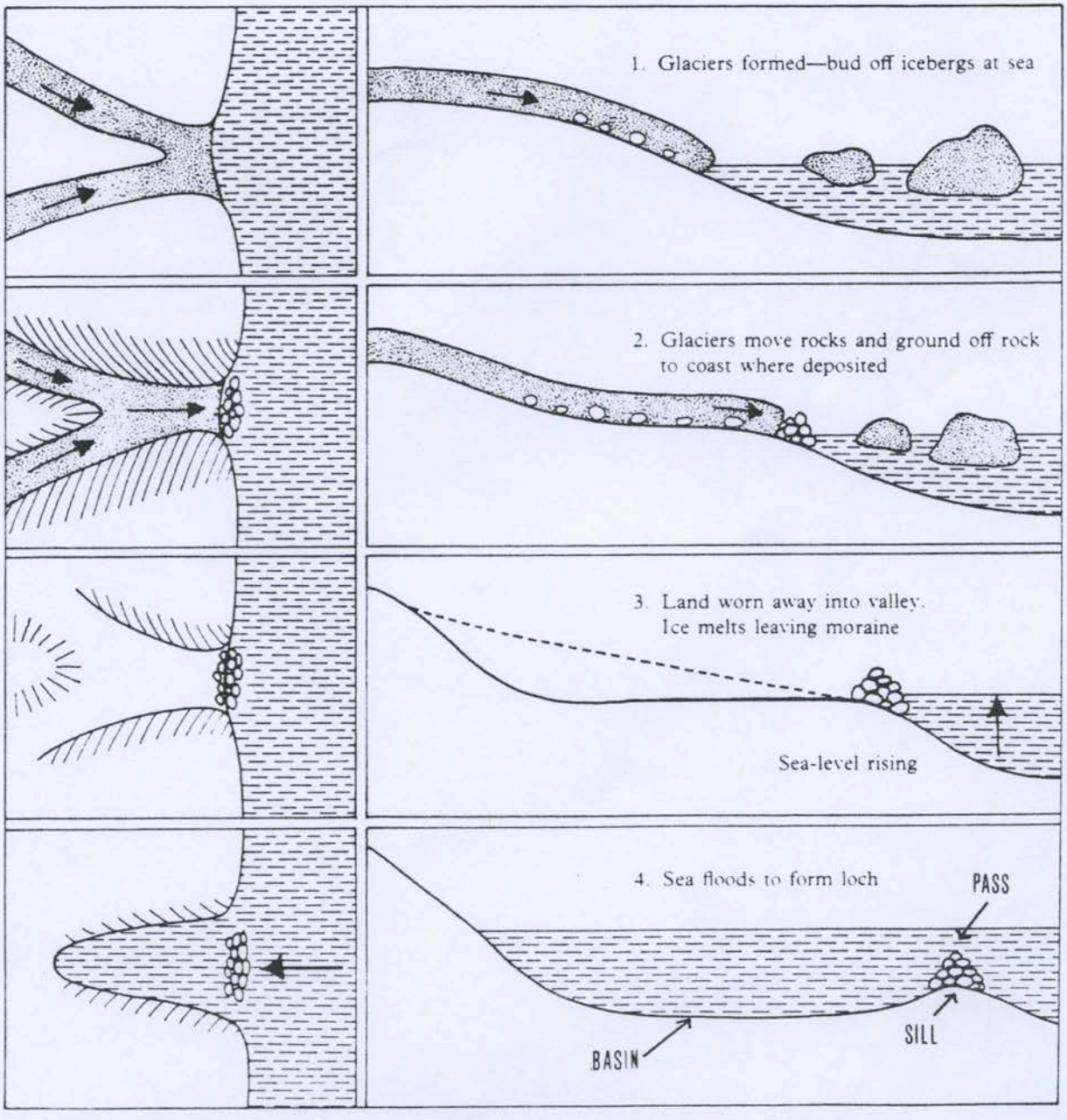
The aim of this SEASEARCH expedition was to describe the major habitat and community types in Loch Broom and Little Loch Broom, two sea lochs on the north-west coast of Scotland. The approaches to Loch Broom were also to be investigated if time allowed and this was achieved for the area between Rubha Cadail and Rubha Dubh Ard. The limits of the survey area are shown in Figure 1.

FIGURE 1. Survey Area



Sea lochs are one of the most conspicuous large-scale coastal features on the west coast of Scotland. Their formation, present topography and bathymetry have all been significantly influenced by glaciation during the last ice age, and the characteristic features of such activity are clearly apparent in many of the sea lochs. The general direction of ice movement was outwards from the central highlands with a resultant scouring of valleys leading to the sea on the west coast. The effect of glaciation in such situations results in the formation of deep 'basins', with 'passes' and 'sills' as material collected by the glaciers is deposited (Fig.2).

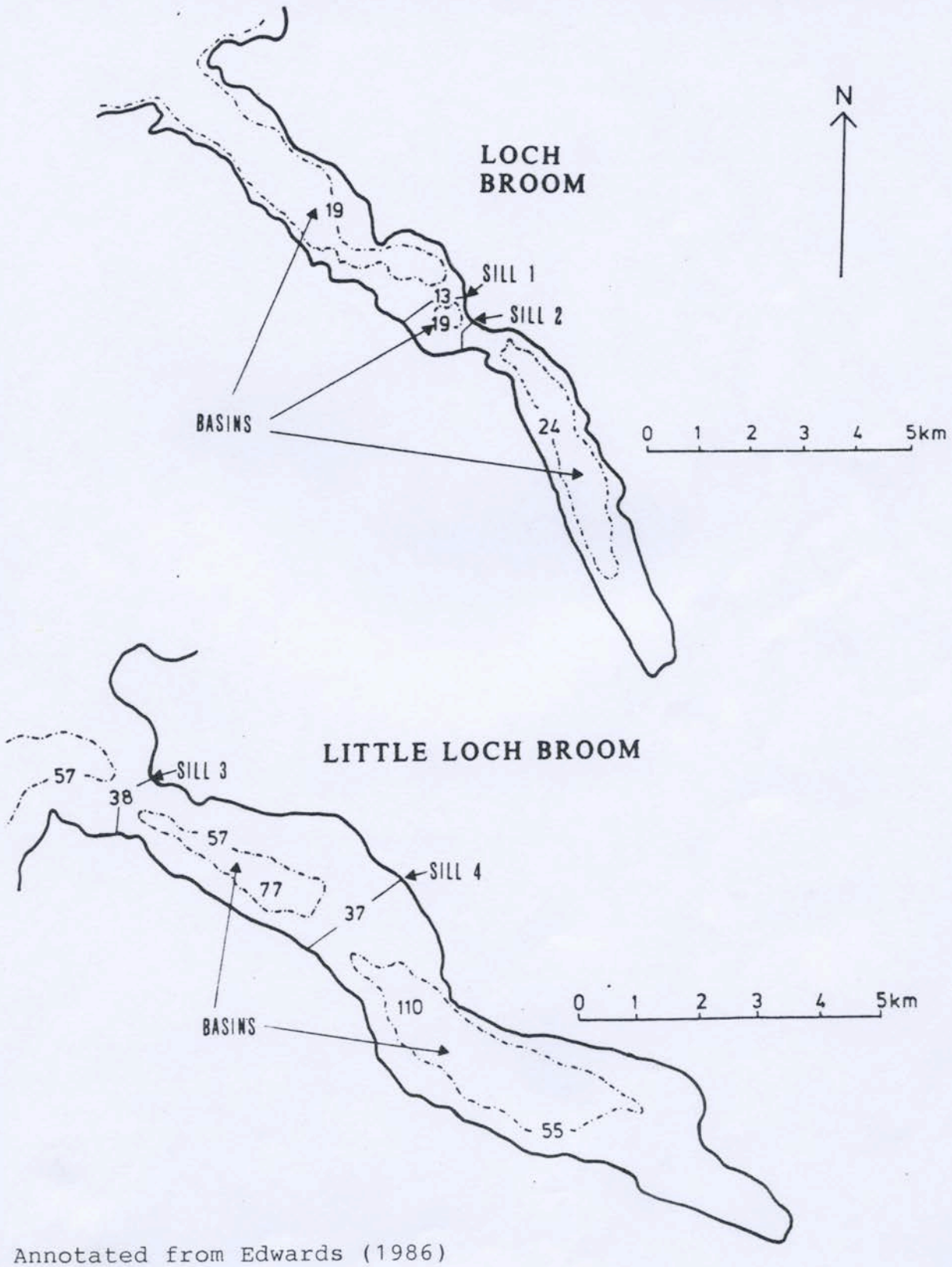
FIGURE 2. Sea loch features formed by glaciation



from Wood (1988)

These large-scale features are present in both Loch Broom and Little Loch Broom and are a key to understanding the distribution of habitat types in the two lochs (Fig. 3).

FIGURE 3. Large scale features in Loch Broom & Little Loch Broom



Annotated from Edwards (1986)

The geology of an area also influences the broad distribution of habitats and communities. Rock type and geological activity, such as folding or faulting, not only influence what is found within a particular sea loch, but also help to explain differences between sea lochs. The predominant rock type in the study area is Torridonian sandstone although the head of Loch Broom is composed of quartzite. In addition, faulting of the rock in the central part of Loch Broom has resulted in a slightly more complicated geology (Fig.4). A number of other characteristics of the two sea lochs have been reported in a survey of sea lochs by Edwards (1986) and are summarised in Table 1. Particularly notable is the quantity of freshwater run-off from the surrounding mountains and this resulted in pockets of freshwater overlying seawater at many of the dive sites, especially at the head of the lochs, although a distinct halocline was only observed at one site.

FIGURE 4. Geology of the Loch Broom area

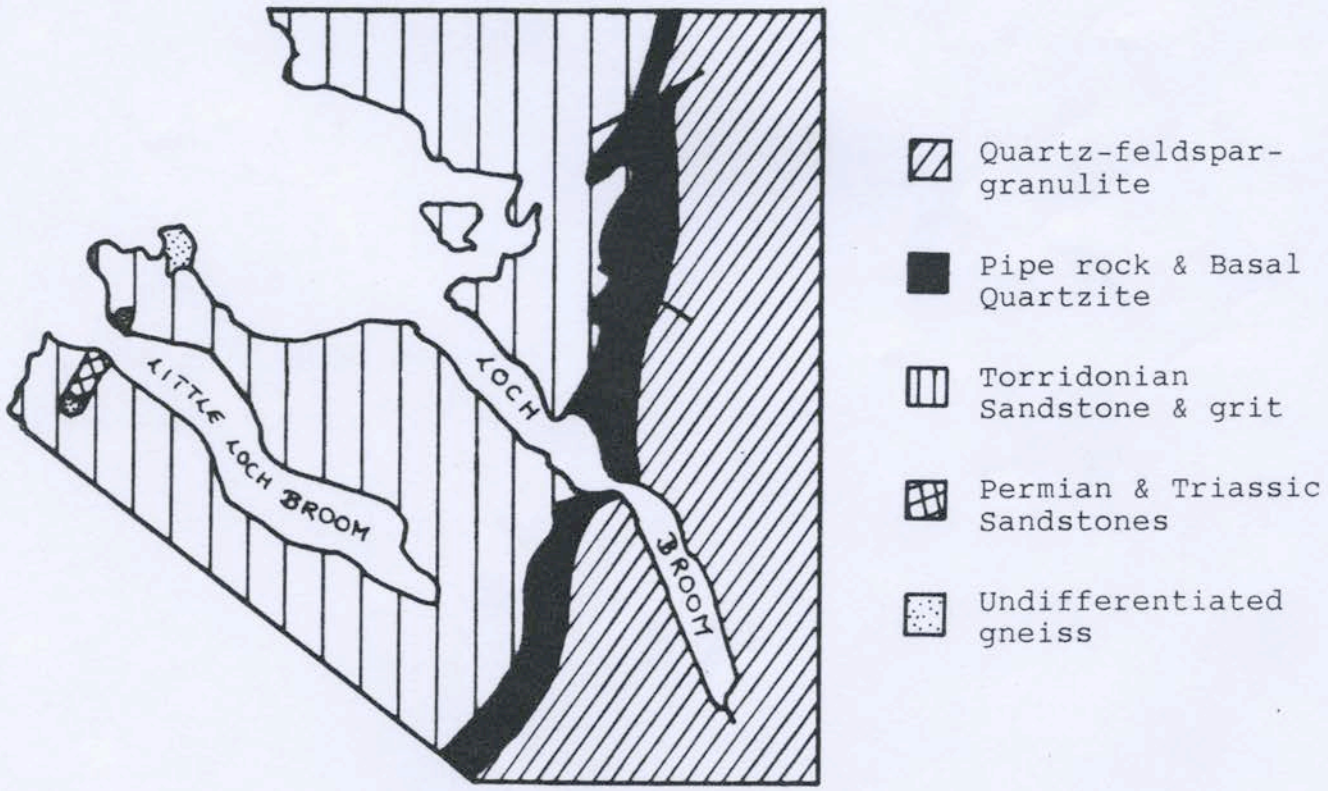


TABLE 1

PHYSICAL CHARACTERISTICS OF LOCH BROOM & LITTLE LOCH BROOM

	LOCH BROOM	LITTLE LOCH BROOM
O.S. Grid Reference	NH 080960	NG 980960
Chart number	2500	2500
Loch length (km)	14.7	12.7
Tidal range (m)	4.5	4.5
Maximum depth (m)	87	110
HW area (sq.km)	17.6	20.9
LW area (sq.km)	16.8	20.4
LW vol. (million m^3)	458.6	851.6
Watershed (sq.km)	353	167
Annual rainfall (mm)	1750	1750
Runoff (M m^3/yr)	529.2	249.9

<u>Sill Data</u>

	LOCH BROOM		LITTLE LOCH BROOM	
Sill number (see Fig 3)	1	2	3	4
Length (m)	410	1050	760	990
HW width (m)	1360	600	1160	1940
LW width (m)	1340	580	1140	1920
Depth (m)	13	16	38	37
Mean depth (m)	10	9	24	26
Current (cm/s)	8	19	14	5
Basin depth (m)	27	51	77	110

(from Edwards, 1986)

Little published information was available on the marine habitats and communities in Loch Broom and Little Loch Broom prior to this expedition. Similarly, there does not appear to be any report of its marine nature conservation importance, although a number of sea lochs on the west coast have been shown to contain unusual habitats and communities. The Nature Conservancy Councils criteria for identifying sites of nature conservation importance includes "typical" examples of various habitat types; this survey should help to build up a picture of what this means for a sea loch. Published information which was available and referred to prior to the expedition included Barber et al (1978) and the North Sheet Geological Survey Ten Mile Map for geology and Edwards (1986) for the broad characteristics of the two sea lochs. Other sources of information were a dive site guide by Ridley (1985) which contains brief descriptions of the sublittoral habitats at a number of locations in the survey area. Useful background information on Little Loch Broom was also made available by Gil & Betty Green who have been diving in the area for some years and have a collection of slides showing some of the habitat types.

2. EXPEDITION AIMS

The aim of the expedition was to identify the major habitat and community types within the two sea lochs and give an overall description of their distribution in relation to the topography of the survey area. The results had to be detailed enough to enable NCC staff to identify potential sites of marine nature conservation interest and sites in need of further investigation for the Marine Nature Conservation Review. A photographic record of the dive sites was also compiled for the NCC slide library and for a Seasearch Habitat Manual (Earll, 1988) being put together by MCS to be used by future SEASEARCH expeditions. Ideas on the methods to be used on SEASEARCH expeditions were also tested.

3. METHODS

SEASEARCH aims to collect information using divers. The survey was therefore carried out by sports divers, working in pairs, at locations identified by the Project Leader. All diving was done from inflatable boats and site location was greatly assisted by using an echo sounder, which was essential because of the steep depth profiles of both lochs.

Each diver was given a specific task to carry out during the expedition depending on whether they were 'Recorders' or 'Photographers'. These roles are only described briefly in this report but are defined in some detail in the draft SEASEARCH Training Manual (MCS, 1988). In the case of Recorders, diving in pairs, one was responsible for noting the various habitat and communities observed during the dive, and the other was responsible for drawing the dive profile. Acetate sheets with key words and an axis on which to draw the profile were attached to

slates and given to the divers to make the task easier. This information was then transcribed onto standard SEASEARCH forms specially designed for the survey. Samples of the acetate sheets, SEASEARCH forms, and standard symbols to be used on these forms can be seen in Appendix 1. After the first few days the two tasks of habitat recording and drawing the dive profile were no longer separated as each recorder found it easier to collect as much information as possible on both subjects then confer whilst filling in the SEASEARCH forms at the end of the day. The primary task of the Photographers was to take photographs of each of the habitat types encountered during the dive according to a standard format (frame size $1m^2$). These were then catalogued for the expedition report.

3.1. Sampling Strategy

The survey area was considered as three seperate units; Loch Broom, Little Loch Broom, and the approaches to Loch Broom, each of which needed to be investigated by the diving team. To cover as much of these areas as possible each site was only dived once. This allowed a large number of locations to be investigated, although it took more time because of the need to move sites after each dive. The dive locations were selected by the project leader with a view to being able to draw a map showing the distribution of the main habitat and community types in the survey area at the end of the expedition. Central to this was the premise that sites should only be dived if an investigation at that location would help build up an overall picture of the survey area. The emphasis was therefore on trying to locate the different habitat types and the boundaries between them. This meant that topographical features such as each basin and sill had to be investigated as well as the edges of the lochs where the most rapid changes in habitat type were likely to be observed. The reasons for selecting each site for survey are recorded on the completed SEASEARCH forms in Appendix 3. but can be summarised as falling into one of the following categories;

(1) Edges of each basin. This is where the most rapid changes in habitat type can be observed and also differences between basins. The boundary between the infralittoral and circalittoral can be recorded in these areas.

(2) The bottom of each basin. Deeper and more sheltered therefore different to the margins of the basin and possibly different between basins.

(3) Where rivers or streams enter the loch. Freshwater influence and sorting of sediments.

(4) Where surface narrows or sills were present. A different current regime to other parts of the loch.

(5) Either side of an area of narrows. The fall-off in current speed is likely to result in a different habitat type.

(6) Areas where significant currents were noted on the chart in the absence of sills.

(7) The head of each loch. A very sheltered area.

(8) Steep and more gently sloping edges of the loch basins.

(9) Obviously different features marked on the chart such as pinnacles or reefs

(10)'Bays' along the margin of the lochs which are more sheltered and therefore likely to contain different habitats. Similarly 'bluffs' which are more exposed.

(11) Different rock types therefore subject to different amounts and types of erosion.

(12) Different bottom substrate types marked on chart from those already located by diving.

(13) The different aspects of an island because they would be subject to differing amounts of wave action.

3.2. Access to sites

A number of the proposed survey sites could not be investigated because of practical limitations. The town of Ullapool, which lies on the north shore of Loch Broom, is a particularly busy port in the winter months when the Russian fishing fleet anchor in the area. The resulting vessel traffic activity in central Loch Broom and on Cadail Bank made it unsafe to dive in these areas. In addition much of the the central part of both Loch Broom and Little Loch Broom could not be surveyed because of their considerable depth which was beyond the recommended depth limit for sports diving. Nevertheless it was possible to give some indication of the habitat types likely to be found in these areas.

During the survey the inflatable boats were launched from four different locations to make access easier;

Launch point	Survey area
Ullapool council jetty	All of Loch Broom
Badluarach jetty	mouth of Little Loch Broom
Ardness Salmon fishery (private land)	central and head of Little Loch Broom
Ardmair Sailing Club	Priest Island area

4. RESULTS

The survey was carried out using methods designed to provide an overview of the habitats and communities in the area (see Section 3). The results are presented in this section for each of the three parts of the survey area (Loch Broom, Little Loch Broom, and the approaches to Loch Broom) in turn. The information is also summarised in Figs. 5-11 which should be refered to in conjunction with the key on pages 23-24 and the detailed habitat descriptions in section 4.4.

4.1. LOCH BROOM

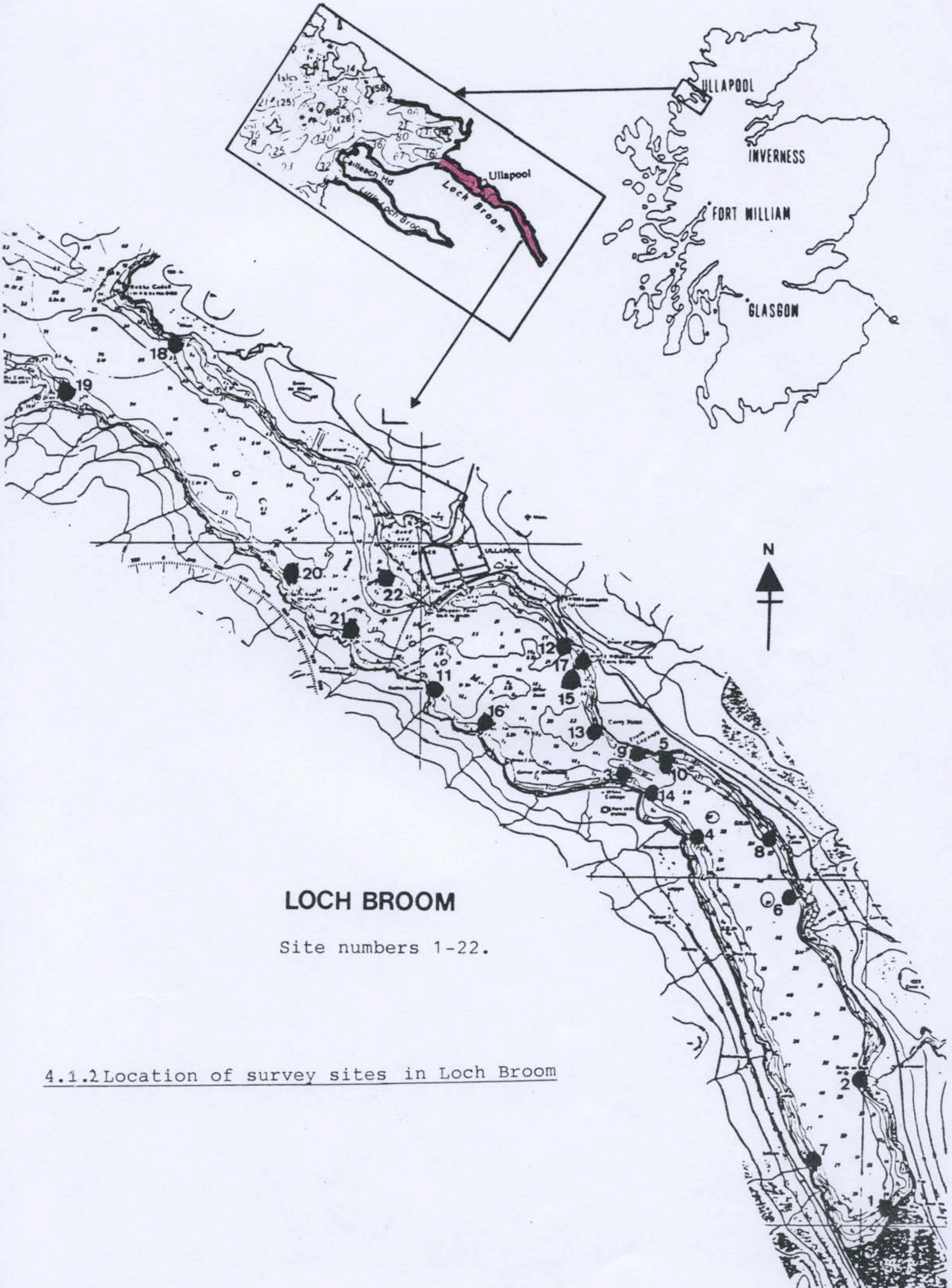
4.1.1. Details of dive sites in Loch Broom

Table 2 summarises the details of each dive site in Loch Broom. All depths have been corrected to Chart Datum.

TABLE 2

DETAILS OF DIVE SITES IN LOCH BROOM

SITE No.	SITE NAME	GRID REF.	DATE	MAX DEPTH to CD (M)	DIVERS INITIALS
1	Rubha Aird an Tuirc	NH 175867	28.9.88	+0.7	JN,GD,SG
2	Rubh an Olan	NH 170883	28.9.88	0.6	AD,BG
3	Dun Lagaidh	NH 142917	28.9.88	17.8	GG,RC
4	Blarnalearoch	NH 153911	28.9.88	18.1	TB,JR
5	Camas an Daimh	NH 148918	28.9.88	15.1	AD,BG
6	Leckmelm Farm	NH 162904	28.9.88	28.2	JN,GD,SG
7	Letters	NH 166876	28.9.88	19.9	GG,RC
8	Tigh na Coille	NH 161909	28.9.88	18.1	TB,JR
9	Struth Lagaidh	NH 145919	29.9.88	12.6	TB,GG
10	Camas an Daimh	NH 147918	29.9.88	15.5	JN,RC
11	Rubha Buidhe	NH 126923	29.9.88	9.5	JN,RC
12	North of White House	NH 137932	29.9.88	18.1	TB,GD
13	Corry Point	NH 142921	29.9.88	13.8	GD,BG
14	Dun Lagaidhe (east)	NH 148915	29.9.88	12.7	MB,SG
15	North of Corry Point	NH 139926	29.9.88	14.5	JR,AD
16	Point S. of Rubha Buidhe	NH 131923	29.9.88	5.0	JR,AD
17	Gadcaisceig	NH 139929	29.9.88	14.0	MB,SG
18	Rhue	NH 098968	30.9.88	7.1	GD,JR
19	Rubha Camas a'Mhaoraich	NH 085964	30.9.88	13.6	GG,MB
20	Buckle Patch	NH 110941	30.9.88	26.0	JN,AD
21	North of Ferry House	NH 116935	30.9.88	16.6	BG,RC
22	W.of Ullapool(Port Buoy)	NH 121941	30.9.88	1.5	TB,GD,SG



LOCH BROOM

Site numbers 1-22.

4.1.2 Location of survey sites in Loch Broom

4.1.3. General description of habitats in Loch Broom

The habitats and communities within Loch Broom are best described in three parts corresponding to the inner, central and outer areas. The inner loch was an area of little water movement, extremely sheltered from wave action and therefore dominated by fine sediments. The basin was a muddy area supporting Pennatula beds, and the steep sides of the loch graded from a muddy slope with the occasional boulder and many Munida rugosa, to a narrow infralittoral zone of boulders supporting Laminaria saccharina kelp forest (Fig.5). The deepest kelp plants were recorded at around 16m but most did not extend below 8m which was the boundary between the infralittoral and circalittoral zone. This was no doubt influenced by the peat laden runoff from the surrounding mountains which covered much of the surface of the inner loch during the survey. The freshwater did not form a distinct halocline but was visible as a surface shimmering effect and areas of mixing but it would nevertheless reduce the depth of light penetration into the loch. Between the inner and central part of the loch a sill and surface narrowing creates a pass where water movement is increased (upto 1 knot at spring tides according to the Chart). This habitats in this section were notably different with pebbles supporting L.saccharina along the margins, and Limaria hians beds amongst a pebble substrate in the middle of the narrows.

The central area of Loch Broom could not be surveyed very extensively because of vessel traffic activity in the area. Nevertheless, it was clear that the margins of this part of the loch were more sandy and usually covered with a good diatom mat (Fig.6) This was probably due to the combination of its shallow depth (30m max) when compared to the head of Loch Broom (more than 50m max) and the fact that it would experience more wave action than the inner loch. An area of boulders was identified in the vicinity of Otter Bank which was probably the edge of the second sill which occurs in the loch (see Fig.6). A third area of narrows, although not caused by a sill, divides the central and outer parts of the loch and supports a Modiolus bed amongst cobbles. This habitat was close to an area where a stream discharges into the loch causing a particularly marked halocline to form at a depth of 1.5m. The limits of the Modiolus bed could not be determined because of its position adjacent to the approaches to the port of Ullapool.

The outer part of Loch Broom (between Ullapool and the mouth of the Loch) was more open to wave action and currents. The basin was still muddy because of its great depth, but the margins tended to be sand scattered with pebbles. In the top 10m the main habitat was boulders supporting kelp forest, just as was found in the inner basin of the loch. However, the predominant kelp species was Laminaria hyperborea rather than L.saccharina. There were also areas of stepped bedrock at the entrance to the loch (Fig.7) with ledges and vertical faces which were clearly larger scale geological features and may be typical of underwater

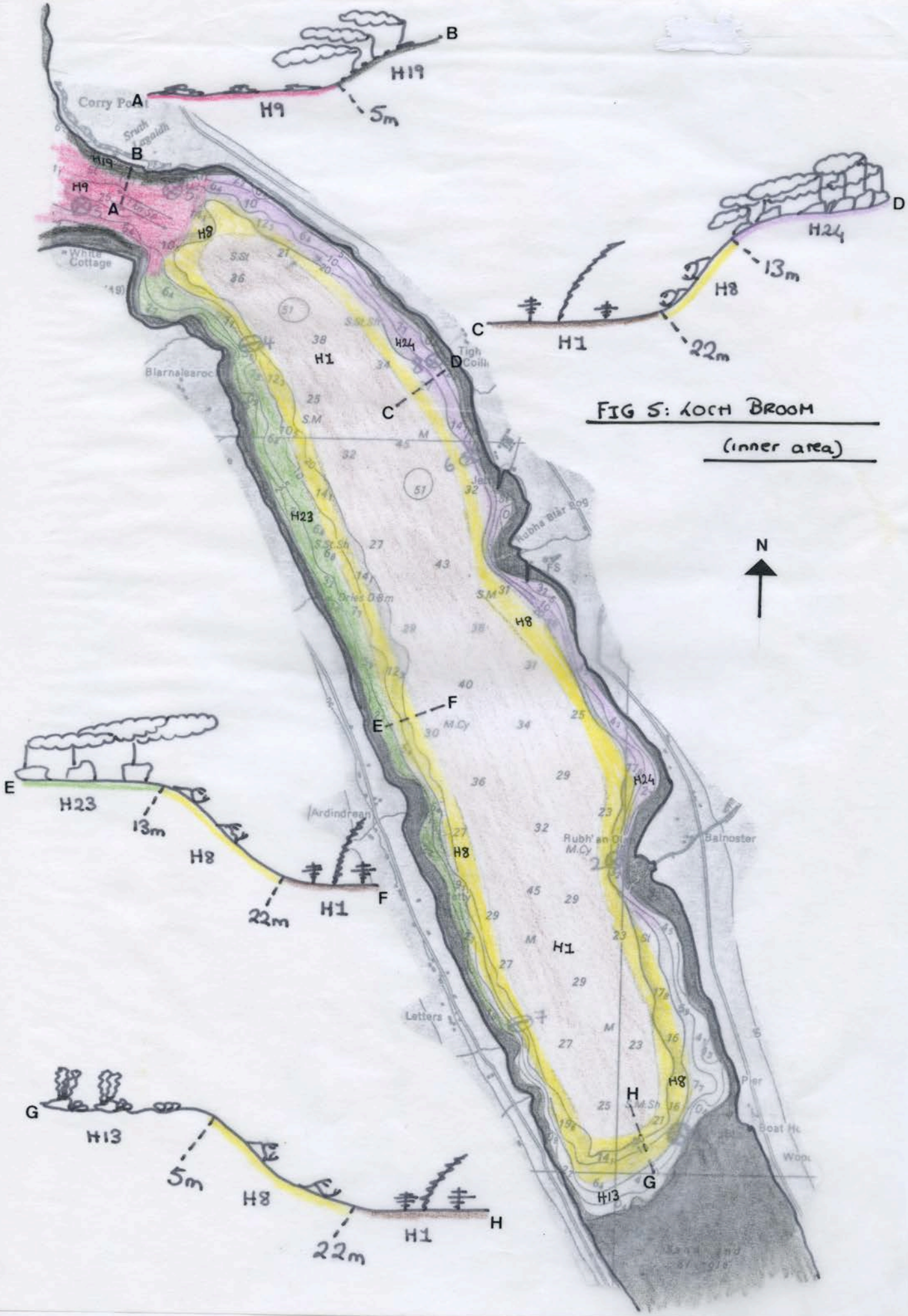


FIG 5: LOCH BROOM

(inner area)

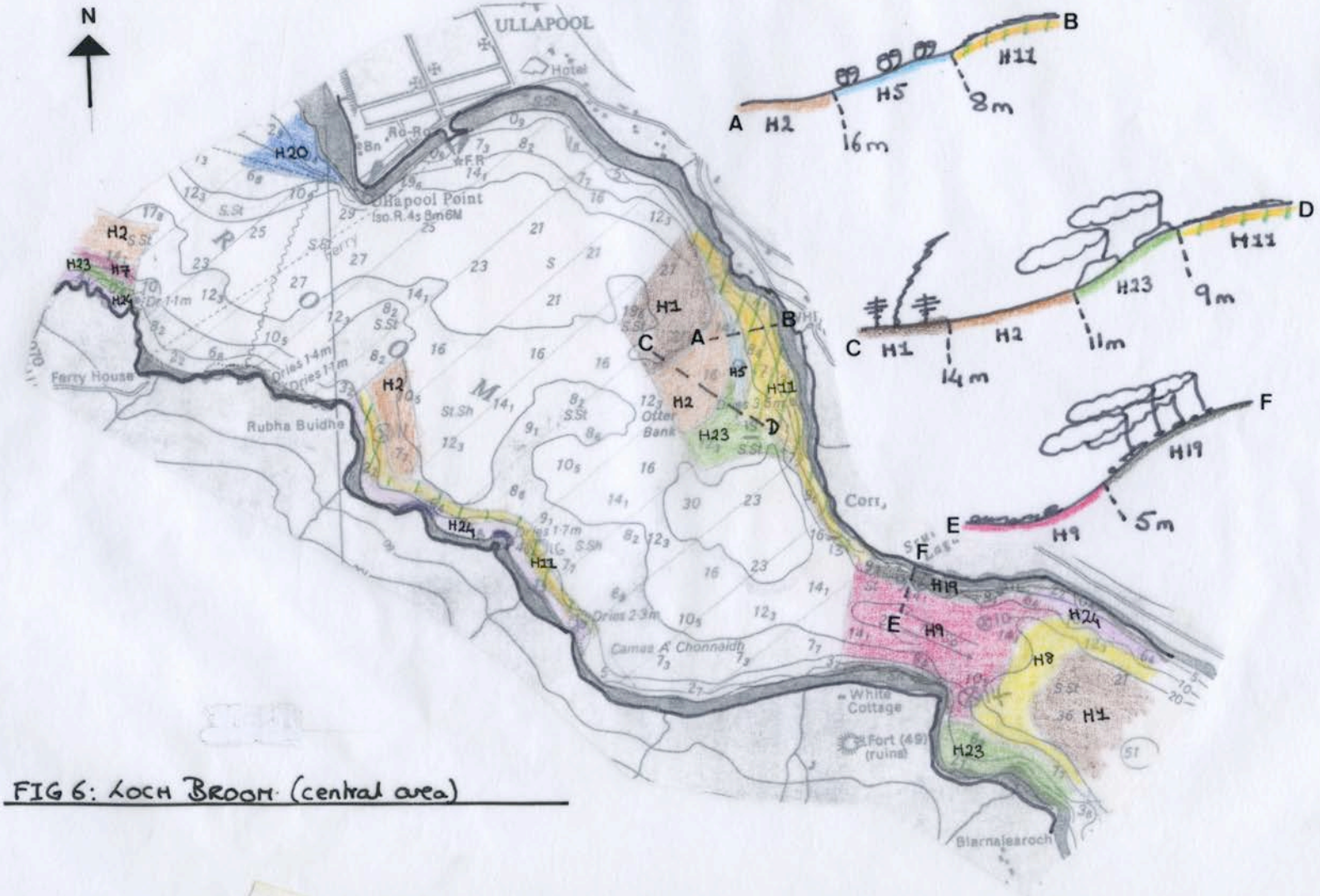


FIG 6: LOCH BROOM (central area)

exposures of Torridonian Sandstone.

The information on habitat distribution collected for Loch Broom shows a typical gradation from mud dominated habitats at the head of the loch, through to sandy areas in the central basin, sand with pebbles in the outer area and, finally, exposed bedrock at the entrance to the loch. This reflects the changing conditions from wave sheltered areas at the head of the loch to the more exposed outer section. Interruptions in this pattern can be seen where the loch narrows as the innermost sill was an area of pebbles on sand and the central sill was predominantly an area of boulders lying on sand. The major community types also showed a gradation with the infralittoral zone consisting of sparse L.saccharina kelp forest in the inner loch whereas the same boulder habitat supported L.digitata and L.hyperborea at the loch entrance. The circalittoral was dominated by M.rugosa within the loch whereas Canger pagurus was more common in the outer sandy pebble areas.

4.1.4. Habitats recorded at each dive site in Loch Broom

Table 3 summarises the habitat types recorded at each dive site in Loch Broom. Full descriptions of each of the 25 different habitat types recorded during the survey are given in section 4.4.

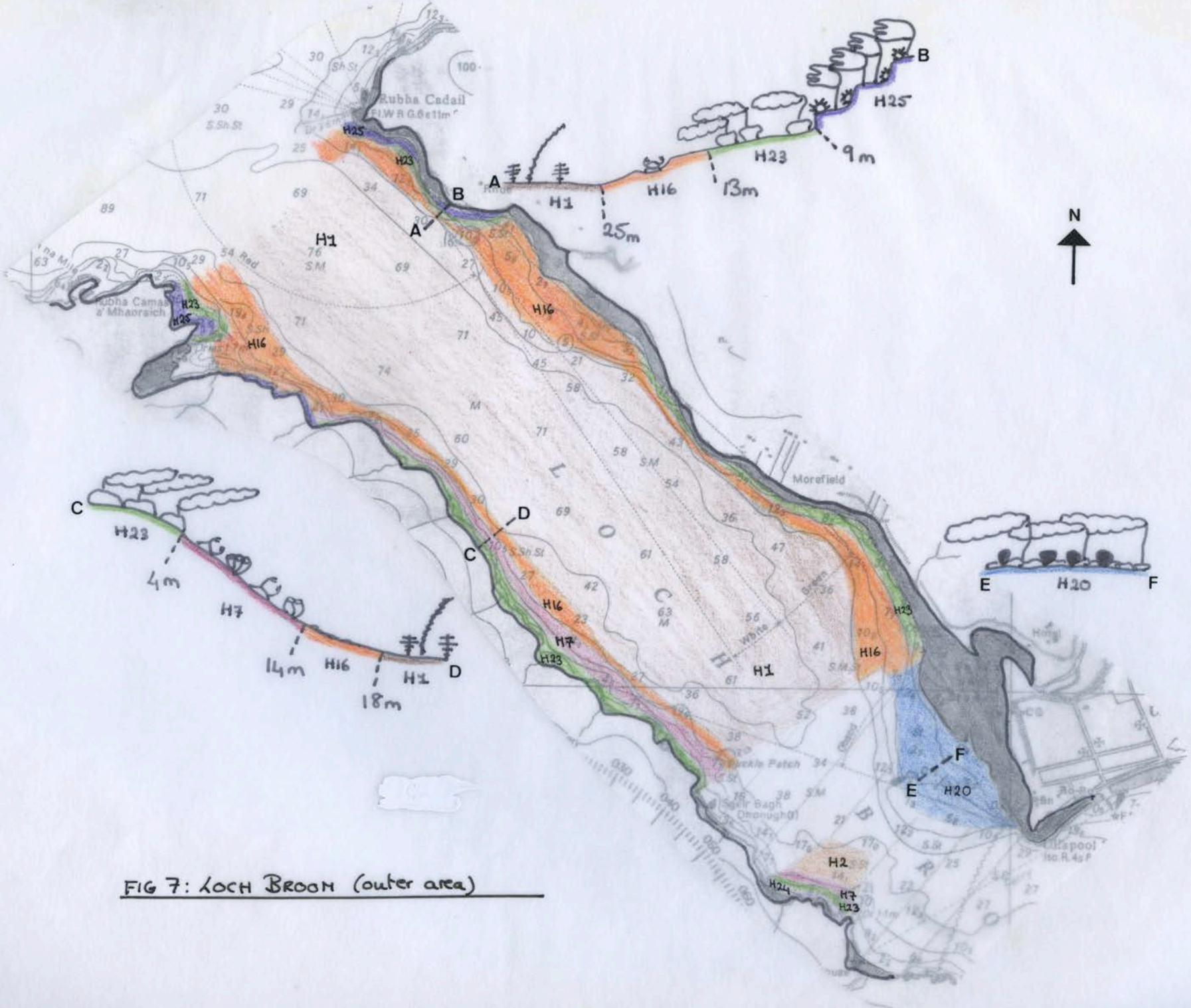


FIG 7: LOCH BROOM (outer area)

TABLE 3

HABITAT NUMBER	ZONE	HABITAT DESCRIPTION	SITES WHERE HABITAT WAS RECORDED
H1	Circalittoral	FINE STICKY MUD, USUALLY FLAT PENNATULA BEDS	12
H2	Circalittoral	FINE MUD SLOPE WITH OCCASIONAL SHELL DEBRIS	4,11,15,21
H3	Circalittoral	SILTY MUD, AEQUIPECTEN BED	-
H4	Circalittoral	MUDDY SAND WITH VIRGULARIA & SEASQUIRTS	-
H5	Circalittoral	SANDY MUD WITH SPARSE SHELL DEBRIS, CLUMPS OF ASCIDIELLA	17
H6	Circalittoral	MUDDY SLOPE WITH EXTREMELY ABUNDANT SHELL DEBRIS	-
H7	Circalittoral	MUD WITH OCCASIONAL SMALL BOULDERS OR STONES, MUNIDA AND ASCIDIELLA	21
H8	Circalittoral	MUDDY SLOPE WITH SMALL BOULDERS, MUNIDA DOMINATED	4,6,7,8
H9	Circalittoral	PEBBLE CLUMPS ON COARSE MUD, LIMA HIANS BEDS	3,5,9,10,14
H10	Circalittoral	SHELLY SAND WITH PEBBLES	-
H11	Infralittoral	SAND WITH SCATTERED SHELL DEBRIS	2,13,15,16, 17
H12	Infralittoral/ Circalittoral	CLEAN COARSE SAND WITH SCATTERED SHELL DEBRIS	-
H13	Littoral/ Infralittoral	CLEAN, RIPPLED, INTERTIDAL SAND FLAT	1
H14	Circalittoral	FIRM CLEAN SAND	-
H15	Circalittoral	SHELL SAND	-
H16	Infralittoral/ Circalittoral	SANDY SHELL GRAVEL WITH SCATTERED PEBBLES	18
H17	Infralittoral	PATCHY UNHEALTHY MAERL ON SAND, VIRGULARIA PATCHES	-
H18	Infralittoral	MAERL BEDS ON COARSE SAND	-
H19	Infralittoral	PEBBLES SUPPORTING LAMINARIA SACCHARINA	9,10
H20	Infralittoral	CLEAN COBBLE, MODIOLUS	22
H21	Infralittoral/ Circalittoral	BOULDERS INTERSPERSED WITH MAERL & COARSE SAND	-
H22	Infralittoral/ Circalittoral	BARE BOULDER SLOPE	-
H23	Infralittoral	OCCASIONAL BOULDERS INTERSPERSED WITH SAND, KELP FOREST	7,15,18,19,21
H24	Infralittoral	DENSE BOULDER BED, KELP FOREST	2,6,20,21
H25	Infralittoral	BEDROCK, KELP FOREST	16,19,20

Habitat types recorded in Loch Broom at each dive site

4.2. LITTLE LOCH BROOM

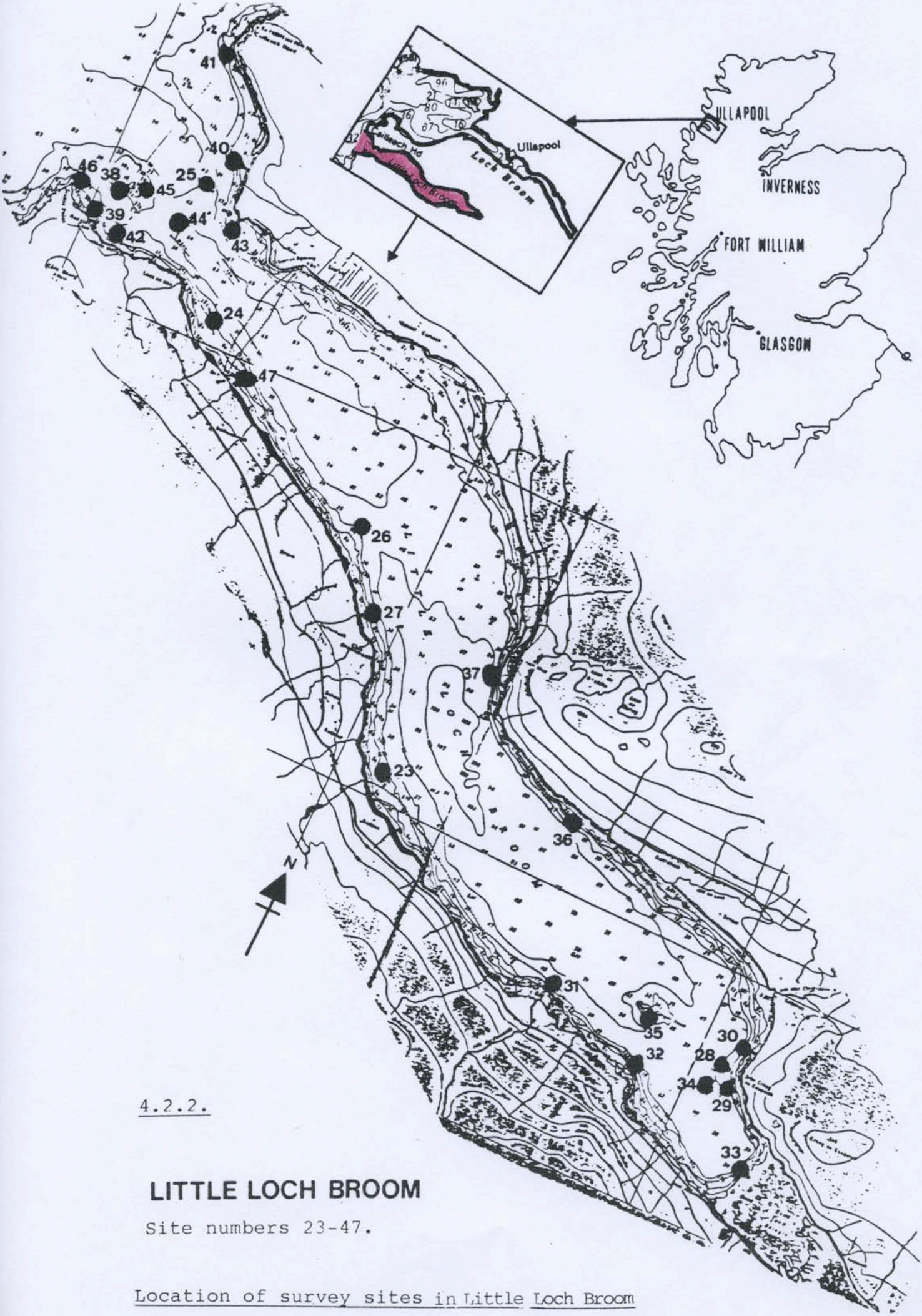
4.2.1. Details of dive sites in Little Loch Broom

Table 4 summarises the details of each dive site in Little Loch Broom. All depths have been corrected to Chart Datum.

TABLE 4

DETAILS OF DIVE SITES IN LITTLE LOCH BROOM

SITE No.	SITE NAME	GRID REF.	DATE	MAX DEPTH to CD (M)	DIVERS INITIALS
23	North of Badbea	NH 028914	1.10.88	17.7	JR,GG
24	South of Leac an Ime	NG 993953	1.10.88	23.8	RC,SG
25	N.W. of Corran Sgoraig	NG 987966	1.10.88	32.4	JN,AD
26	North of Durnamuck	NH 021940	1.10.88	31.4	MB,GD
27	N. of Carn Dhonnchaidh	NH 022929	1.10.88	19.9	TB,BG
28	Sron Creag na Ceapaich	NH 075898	2.10.88	25.3	JN,GG
29	South of Sron Creag na Ceapaich	NH 078896	2.10.88	30.3	MB,RC
30	South of Kildonan	NH 076904	2.10.88	16.1	AD,SG
31	Ardessie	NH 055900	2.10.88	26.9	JN,GG
32	Camusnagaul	NH 068893	2.10.88	25.4	MB,RC
33	Head of Loch	NH 082888	2.10.88	31.9	AD,SG
34	West of Sron Creagna Ceapaich	NH 069899	2.10.88	22.5	GD,JR
35	Conger Stack	NH 066902	2.10.88	14.1	BG,TB
36	West of Badrallach	NH 048918	2.10.88	17.4	BG,TB
37	Creag a'Chadha	NH 035930	2.10.88	10.4	GD,JR
38	Near Ardross Rock	NG 979963	3.10.88	19.8	BG,GG
39	Red Cliffs	NG 977960	3.10.88	19.5	JN.GD
40	W. of Cnoc Sgoraig	NG 988970	3.10.88	6.2	BG,GG
41	Sron a Gheodha Dubh	NG 983980	3.10.88	11.1	JN,GD
42	White cliffs	NG 980958	3.10.88	12.1	SG,JR
43	W.of Corran Sgoraig	NG 991963	3.10.88	21.7	TB,RC
44	S.W. of Ardross Rock	NG 983962	3.10.88	35.4	AD,MB
45	Ardross Rock	NG 981964	3.10.88	16.4	TB,RC
46	Stattic Point	NG 974962	3.10.88	8.9	GG,JR
47	Badluachrach Jetty	NG 996949	3.10.88	2.5	AD,MB



4.2.2.

LITTLE LOCH BROOM

Site numbers 23-47.

Location of survey sites in Little Loch Broom

4.2.3. General description of habitats in Little Loch Broom

The main large scale topographical features of Little Loch Broom are the two basins and two sills, one in the central part of the loch and the other at its entrance. The head of the loch contained very similar habitats to Loch Broom as it was predominantly muddy with the steeply sloping edges dominated by Munida which sheltered near the occasional stone or boulder. One main difference however was the presence of Conger Stack. This is a pinnacle of stepped bedrock on a ridge of land which extends in a line from the crags of Creag na Ceapaich and Sron Creag na Ceapaich on the surface (Fig.8). The ledges and vertical faces of the bedrock were of a similar scale to those seen at the entrance to Loch Broom and consisted of the same rock type (Torridonian Sandstone). Although providing a hard surface for attachment there was limited species diversity in this area probably due to the sheltered conditions. The sill which divides the two basins of the loch was not investigated due to poor weather conditions when this area was being dived therefore has been left blank in Fig.9.

The outer basin of Little Loch Broom is more sheltered that the outer area of Loch Broom as it lies behind a sill at the entrance. Consequently, the habitat types are very similar to those found at the head of both lochs; a muddy basin, supporting Pennatula beds, with steep Munida dominated muddy slopes grading to a small zone of bedrock supporting L.saccharina. The sill itself was an area of bare boulders which led down to pebbly sand outside the loch. Water currents moving in and out of the loch appeared to move along the southern margin according to the chart. This is confirmed by the habitat types on this side of the loch which were much coarser grained and included maerl beds which are characteristic of sealoch narrows. The maerl extended outside the loch covering an area between the pinnacle of Ardross Rock and the mainland; an area where water is naturally funnelled through to form a narrows (Fig. 9). In common with Loch Broom, the kelp forests around the mouth of the loch were predominantly Laminaria hyperborea rather than L.saccharina, and there was much more exposed bedrock. The stepped nature of the bedrock provided a series of ledges and vertical faces which was also seen at Conger Rock at the head of the loch.

4.2.4. Habitats recorded at each dive site in Little Loch Broom

Table 5 summarises the habitat types recorded at each dive site in Little Loch Broom. Full descriptions of each of the 25 different habitat types recorded during the survey are given in section 4.4.

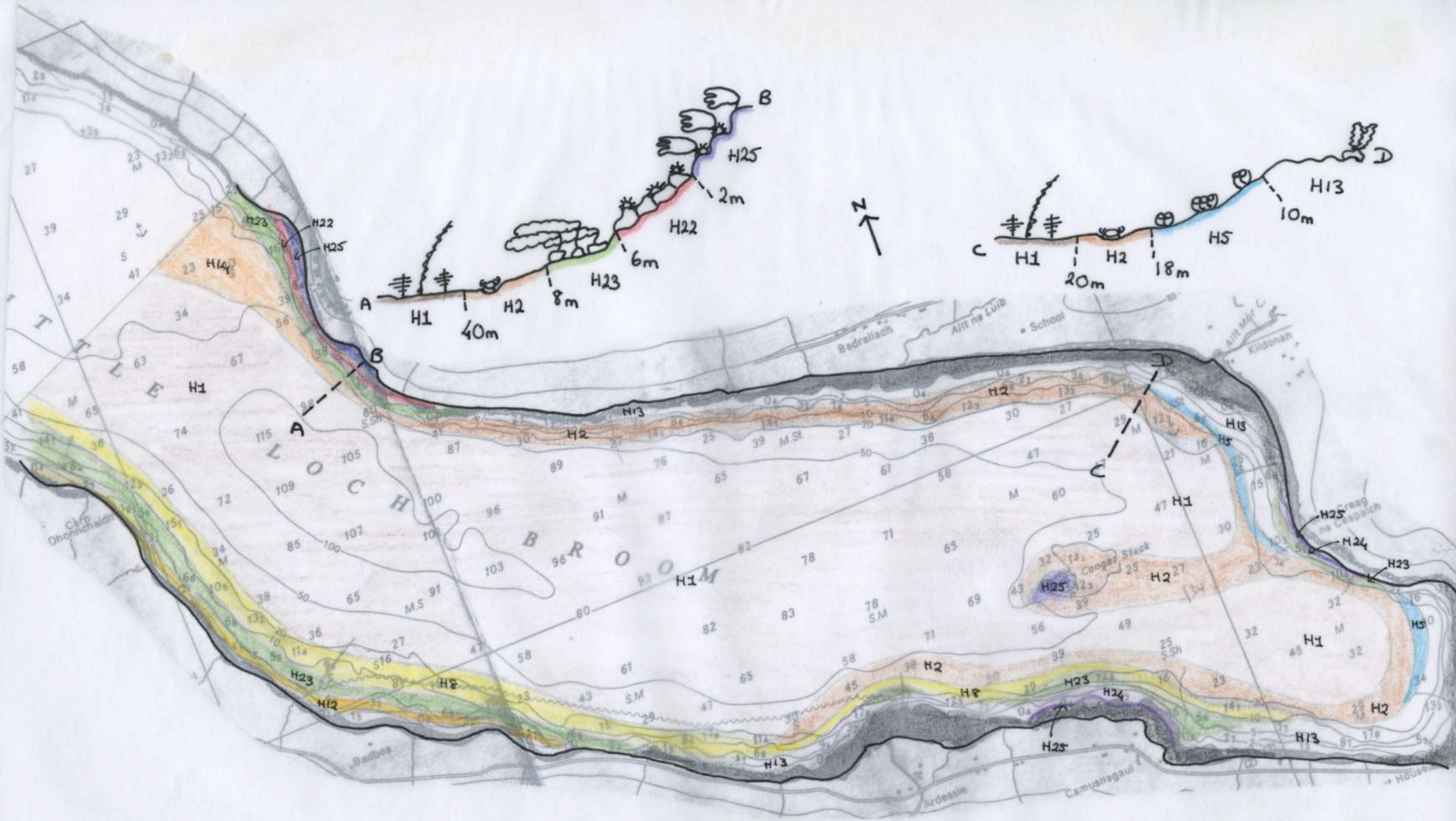


FIG 8: LITTLE LOCH BROOM (inner area)

FIG 9: LITTLE LOCH BROOM (outer area)

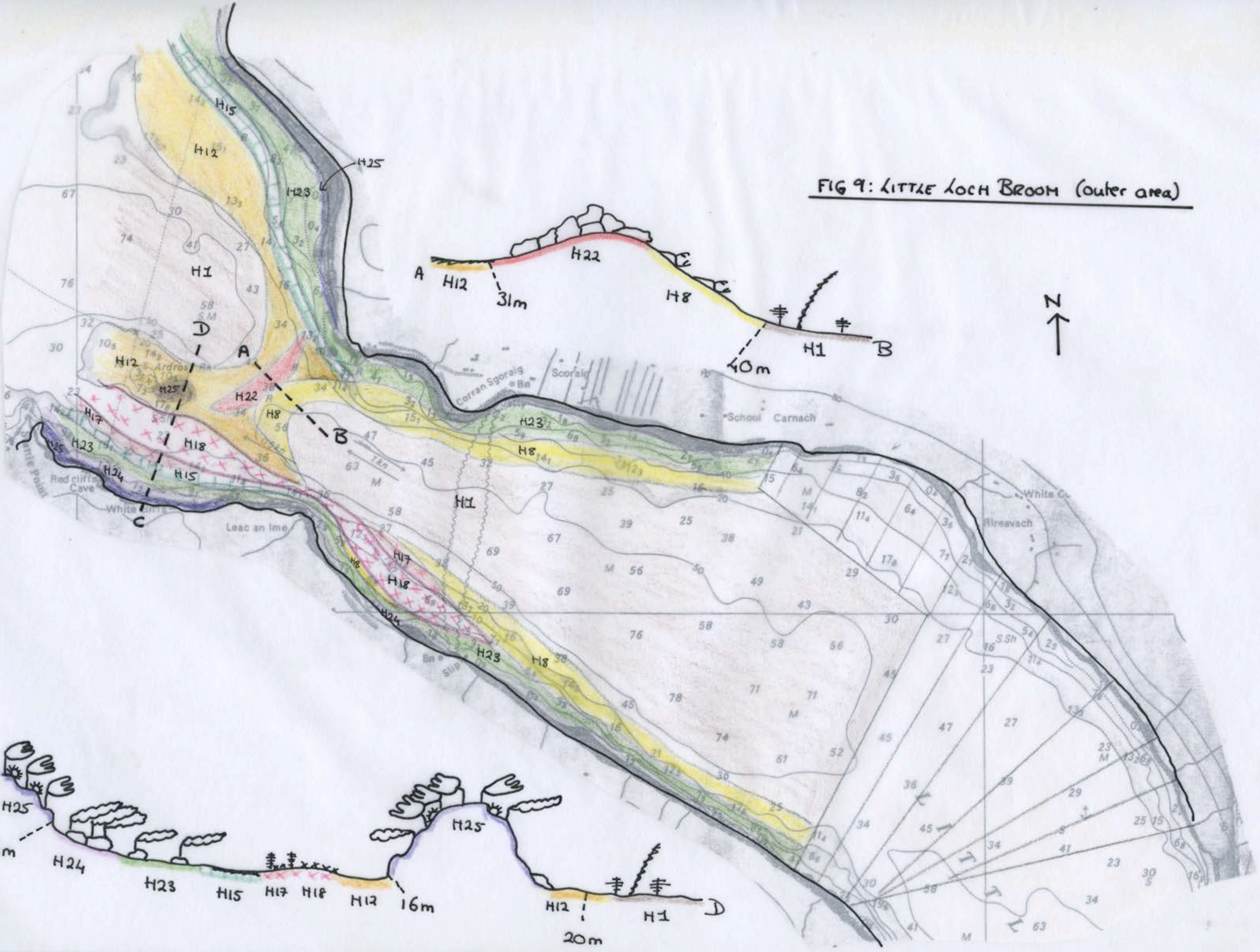


TABLE 5

HABITAT NUMBER	ZONE	HABITAT DESCRIPTION	SITES WHERE HABITAT WAS RECORDED
H1	Circalittoral	FINE STICKY MUD, USUALLY FLAT PENNATULA BEDS	25,28,29,30,33
H2	Circalittoral	FINE MUD SLOPE WITH OCCASIONAL SHELL DEBRIS	26,29,31,32,33, 34,36
H3	Circalittoral	SILTY MUD, AEQUIPECTEN BED	-
H4	Circalittoral	MUDDY SAND WITH VIRGULARIA & SEASQUIRTS	-
H5	Circalittoral	SANDY MUD WITH SPARSE SHELL DEBRIS, CLUMPS OF ASCIDIELLA	30,33
H6	Circalittoral	MUDDY SLOPE WITH EXTREMELY ABUNDANT SHELL DEBRIS	31
H7	Circalittoral	MUD WITH OCCASIONAL SMALL BOULDERS OR STONES, MUNIDA AND ASCIDIELLA	-
H8	Circalittoral	MUDDY SLOPE WITH SMALL BOULDERS, MUNIDA DOMINATED	24,26,27,32,44
H9	Circalittoral	PEBBLE CLUMPS ON COARSE MUD, LIMA HIANS BEDS	-
H10	Circalittoral	SHELLY SAND WITH PEBBLES	-
H11	Infralittoral	SAND WITH SCATTERED SHELL DEBRIS	-
H12	Infralittoral/ Circalittoral	CLEAN COARSE SAND WITH SCATTERED SHELL DEBRIS	23,25,42
H13	Littoral/ Infralittoral	CLEAN, RIPPLED, INTERTIDAL SAND FLAT	30,31,36
H14	Circalittoral	FIRM CLEAN SAND	37
H15	Circalittoral	SHELL SAND	23,39,42,43, 46
H16	Infralittoral/ Circalittoral	SANDY SHELL GRAVEL WITH SCATTERED PEBBLES	-
H17	Infralittoral	PATCHY UNHEALTHY MAERL ON SAND, VIRGULARIA PATCHES	24
H18	Infralittoral	MAERL BEDS ON COARSE SAND	24,38,47
H19	Infralittoral	PEBBLES SUPPORTING LAMINARIA SACCHARINA	-
H20	Infralittoral	CLEAN COBBLE, MODIOLUS	-
H21	Infralittoral/ Circalittoral	BOULDERS INTERSPERSED WITH MAERL & COARSE SAND	44
H22	Infralittoral/ Circalittoral	BARE BOULDER SLOPE	37,44
H23	Infralittoral	OCCASIONAL BOULDERS INTERSPERSED WITH SAND, KELP FOREST	23,24,26,27,29, 32,37,39,41,42, 43,46,47
H24	Infralittoral	DENSE BOULDER BED, KELP FOREST	29,39,40,41,42, 46
H25	Infralittoral	BEDROCK, KELP FOREST	35,37,41,42,45 46

Habitat types recorded at each dive site in Little Loch Broom

4.3. APPROACHES TO LOCH BROOM

4.3.1. Details of dive sites in the approaches to Loch Broom

Table 6 summarises the details of each dive site in Loch Broom. All depths have been corrected to Chart Datum.

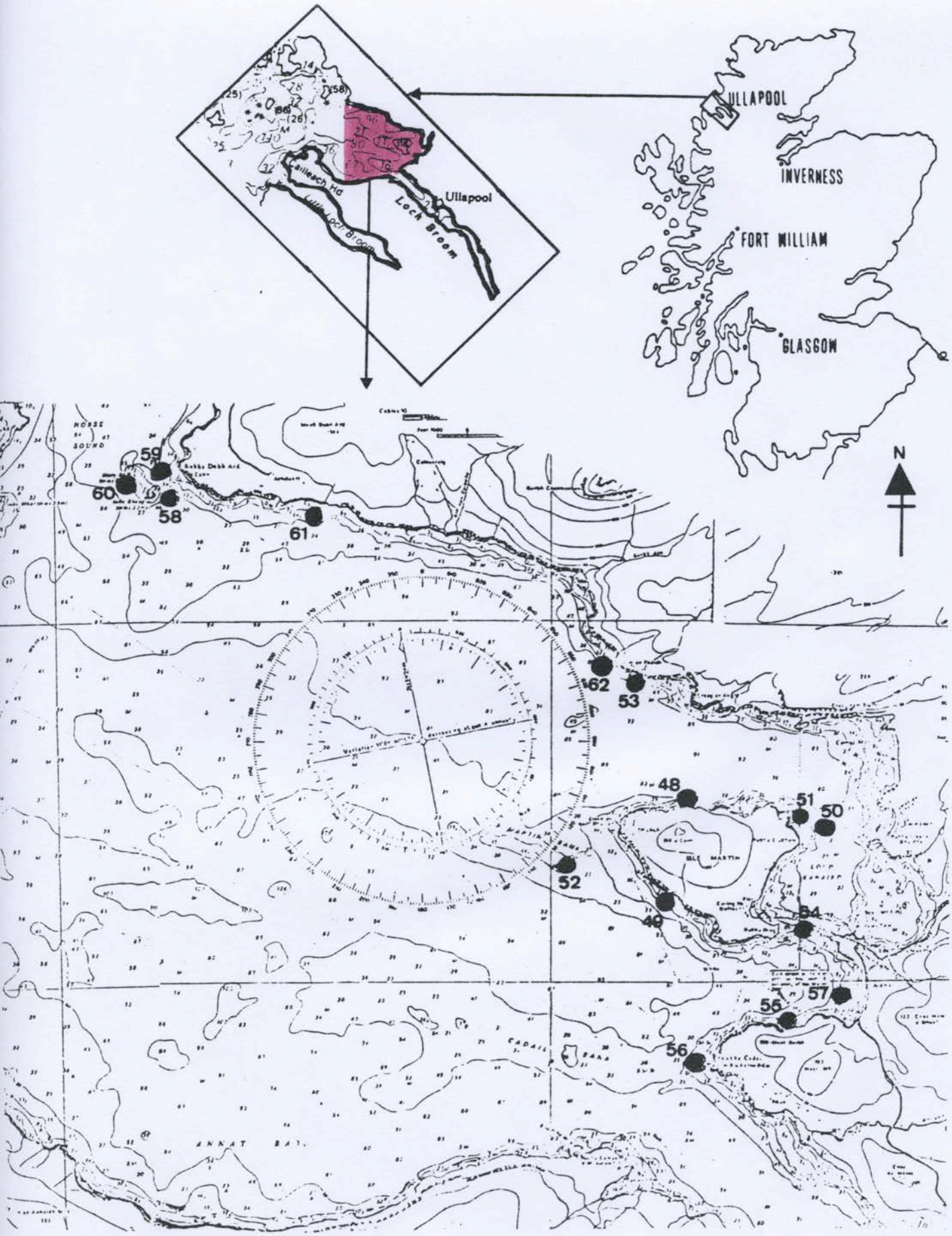
TABLE 6

DETAILS OF DIVE SITES IN THE APPROACHES TO LOCH BROOM

SITE No.	SITE NAME	GRID REF.	DATE	MAX DEPTH to CD (M)	DIVERS INITIALS
48	North Face, Isle Martin	NC 091001	4.10.88	36.4	AD,TB
49	North West of Camas a'Bhuailidh, I.Martin	NH 087991	4.10.88	14.2	JR,SG
50	Loch Kanaird narrows	NH 107998	4.10.88	38.8	JN,GD
51	N. of Rubha Glubhair Isle Martin	NH 103999	4.10.88	7.7	JN,GD
52	Martin Bank	NH 079997	4.10.88	15.5	BG,RC
53	Creag an Airgid	NC 093009	4.10.88	27.3	MB,GG
54	Rubha Beag	NH 105988	4.10.88	6.3	MB,RC
55	Meall Garbh	NH 100979	4.10.88	9.2	JR,SG
56	Rubha Cadail	NH 090974	4.10.88	14.2	AD,TB
57	Cul a'Bhogha	NH 103982	4.10.88	23.3	JN,GD
58	Rubha Dubh Ard (South)	NC 040036	5.10.88	25.7	MB,AD
59	Rubha Dubh Ard (North)	NC 040037	5.10.88	22.7	TB,GG
60	Iolla Bheag	NC 037037	5.10.88	20.5	JN,GD
61	South East of Achduart	NC 057032	5.10.88	27.4	RC,JR
62	Leuman Fheidh	NC 084015	5.10.88	23.1	BG,SG

4.3.3. General description of habitats around the approaches to Loch Broom

The last area to be investigated was outside Loch Broom. This included the area around Isle Martin, Loch Kanaird, and the northern margin of the mainland to Mary Rock and Iolla Bheag. As with the two sealochs, the predominant habitat types were clearly influenced by the amount of water movement and exposure to wave action. For example, the narrows between Loch Kanaird and the adjacent bay graded from a muddy basin supporting Munida and Ascidiella, to occasional boulders supporting L.saccharina, and dense boulders with kelp forest at the top of the ridge. As the



4.3.2.

RUBHA CADAIL to RUBHA DUBH ARD

Site numbers 48-62.

Location of survey sites in the approaches to Loch Broom

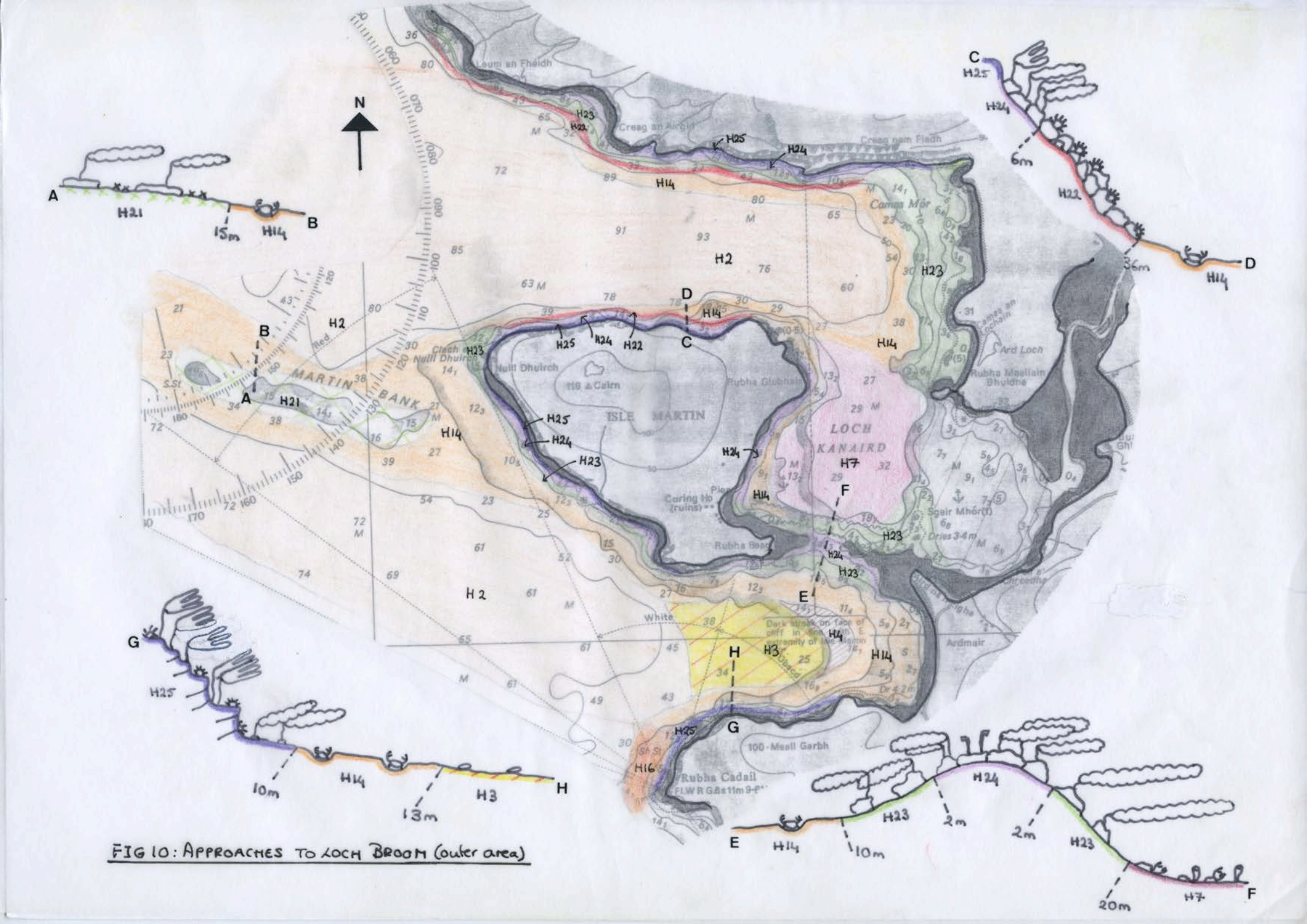


FIG 10: APPROACHES TO LOCH BROOM (outer area)

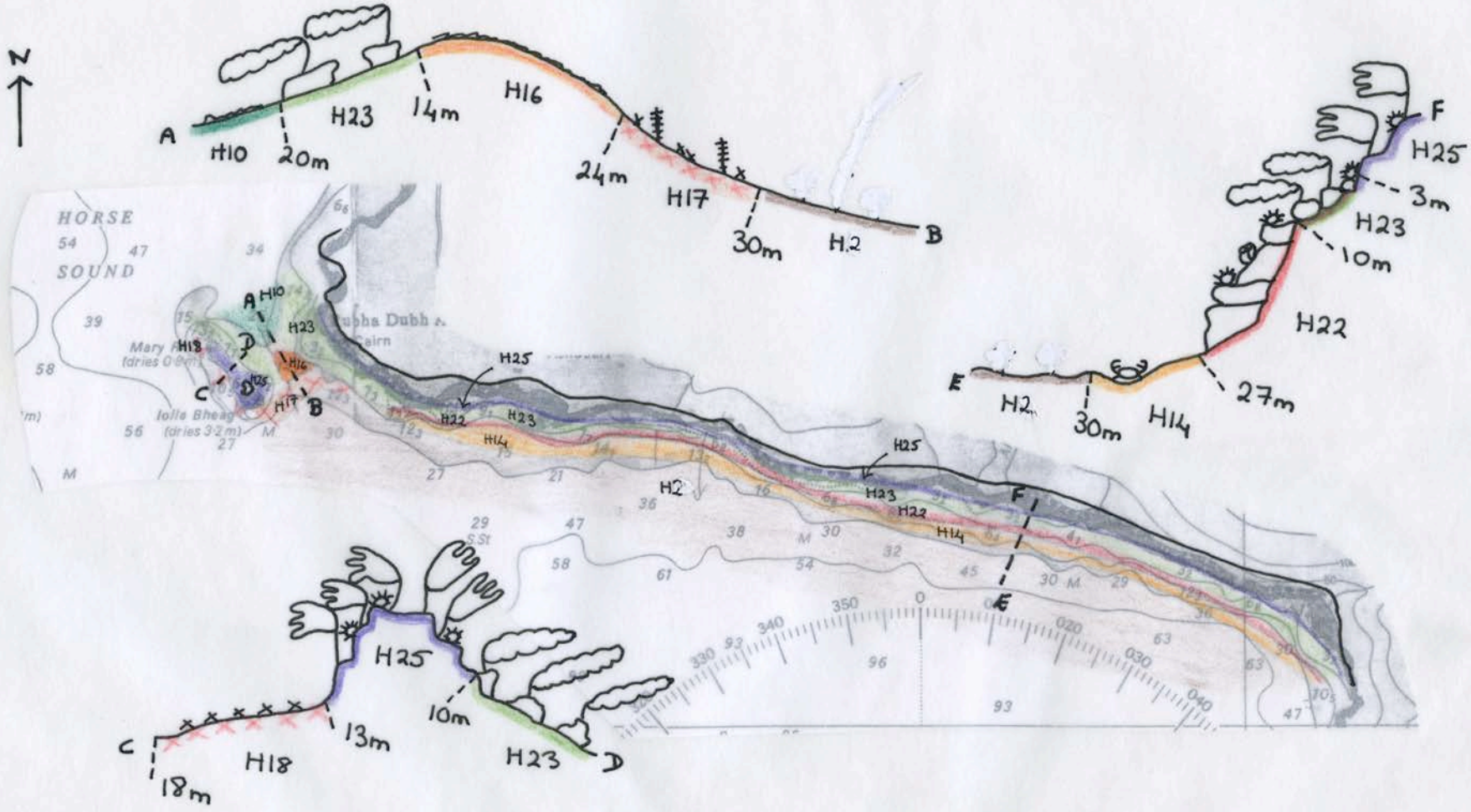


FIG 11: APPROACHES TO LOCH BROOM (outer area)

water movement drops off down the other side of the ridge the boulders become occasional again, finally grading to an area of pebbly sand (Fig.10). The coastline to the north of Isle Martin to Rubha Dubh was more exposed and here the predominant habitat type was a scree slope of unstable boulders, although the top 10m supported some kelp (Fig.10). Similar screes were noted adjacent to the rocky bluffs in Little Loch Broom but they were much more extensive (down to 40m in places) in this outer area of the approaches to Loch Broom. Two small rocky outcrops, Mary Rock and Iolla Lheag, were present at the edge of the survey area just offshore from the headland of Rubha Dubh Ard. This created a small area of narrows but was part of the larger channel of Horse Sound. The habitats in this area consisted of boulders, pebbles and maerl as well as the exposed bedrock of the two outcrops but they need to be described in the context of Horse Sound as well as the approaches to Loch Broom as this area is a transitional zone between the two. (Fig.11)

4.3.4. Habitats recorded at each dive site around the approaches to Loch Broom

Table 7 summarises the habitat types recorded at each dive site in the area of the approaches to Loch Broom. Full descriptions of each of the 25 different habitat types recorded during the survey are given in section 4.4.

TABLE 7

HABITAT NUMBER	ZONE	HABITAT DESCRIPTION	SITES WHERE HABITAT WAS RECORDED
H1	Circalittoral	FINE STICKY MUD, USUALLY FLAT PENNATULA BEDS	-
H2	Circalittoral	FINE MUD SLOPE WITH OCCASIONAL SHELL DEBRIS	-
H3	Circalittoral	SILTY MUD, AEQUIPECTEN BED	57
H4	Circalittoral	MUDDY SAND WITH VIRGULARIA & SEASQUIRTS	57
H5	Circalittoral	SANDY MUD WITH SPARSE SHELL DEBRIS, CLUMPS OF ASCIDIELLA	-
H6	Circalittoral	MUDDY SLOPE WITH EXTREMELY ABUNDANT SHELL DEBRIS	-
H7	Circalittoral	MUD WITH OCCASIONAL SMALL BOULDERS OR STONES, MUNIDA AND ASCIDIELLA	50,60
H8	Circalittoral	MUDDY SLOPE WITH SMALL BOULDERS, MUNIDA DOMINATED	-
H9	Circalittoral	PEBBLE CLUMPS ON COARSE MUD, LIMA HIANS BEDS	-
H10	Circalittoral	SHELLY SAND WITH PEBBLES	59
H11	Infralittoral	SAND WITH SCATTERED SHELL DEBRIS	-
H12	Infralittoral/ Circalittoral	CLEAN COARSE SAND WITH SCATTERED SHELL DEBRIS	-
H13	Littoral/ Infralittoral	CLEAN, RIPPLED, INTERTIDAL SAND FLAT	-
H14	Circalittoral	FIRM CLEAN SAND	49,51,55,61
H15	Circalittoral	SHELL SAND	-
H16	Infralittoral/ Circalittoral	SANDY SHELL GRAVEL WITH SCATTERED PEBBLES	56,58,59
H17	Infralittoral	PATCHY UNHEALTHY MAERL ON SAND, VIRGULARIA PATCHES	58
H18	Infralittoral	MAERL BEDS ON COARSE SAND	60
H19	Infralittoral	PEBBLES SUPPORTING LAMINARIA SACCHARINA	-
H20	Infralittoral	CLEAN COBBLE, MODIOLUS	-
H21	Infralittoral/ Circalittoral	BOULDERS INTERSPERSED WITH MAERL & COARSE SAND	52
H22	Infralittoral/ Circalittoral	BARE BOULDER SLOPE	48,53,61,62
H23	Infralittoral	OCCASIONAL BOULDERS INTERSPERSED WITH SAND, KELP FOREST	49,53,54,59,61, 62
H24	Infralittoral	DENSE BOULDER BED, KELP FOREST	48,49,53,54,61
H25	Infralittoral	BEDROCK, KELP FOREST	48,49,51,53,55, 56,60,62

Habitat types recorded at each dive site in the area of the approaches to Loch Broom

4.4. DETAILED HABITAT DESCRIPTIONS

A total of 25 different habitat types (H1-H25) were identified during the survey. Three main principles were used to distinguish between them;

(1) In some cases clearly different habitats were easily recognisable as such and these were used to describe the 'typical' example of a habitat type. eg.maerl beds, bedrock, boulder beds.

(2) More often a number of subtley different habitats, which graded into one another, were observed. In these cases it would have been inappropriate to identify them as separate habitat types for a Phase 1 survey therefore they were classed as a single habitat eg."shelly sand with pebbles" (H10).

(3) In some cases reasonably clear boundaries between habitats were apparent and these were used to distinguish between the different habitat types which lay either side of the boundary. For example this was used to distinguish between "sand with scattered shell debris" (H11) and "sandy mud with sparse shell debris, clumps of Ascidiella" (H5),

Each habitat is described below together with details of the of the dominant community types associated with each one. The symbols for each habitat are those which have been used for the site profiles in Figs 5 - 11 . All depths have been corrected to Chart Datum.

The occurrence of each habitat type at the different dive sites is also summarised in Table 3 for Loch Broom, Table 5 for Little Loch Broom, and Table 7 for the area of the approaches to Loch Broom.

KEY FOR HABITAT MAPS (Figs 5-11).

H1 - Fine sticky mud, *Pennatula* beds

H2 - Fine mud slope with occasional shell debris

H3 - Silty mud, *Aequipecten* bed

H4 - Muddy sand with *Virgularia* & seasquirts

H5 - Sandy mud with sparse shell debris, clumps of *Ascidiella*

H6 - Muddy slope with extremely abundant shell debris

H7 - Mud with occasional small boulders or stones, *Munida* and *Ascidiella*

H8 - Muddy slope with small boulders, *Munida* dominated

H9 - Pebble clumps on coarse mud, *Limaria hians* beds

H10 - Shelly sand with pebbles

H11 - Sand with scattered shell debris

H12 - Clean coarse sand with scattered debris

KEY FOR HABITAT MAPS (Figs 5-11). contd.

H13 - Clean, rippled, intertidal sand flat

H14 - Firm clean sand

H15 - Shell sand

H16 - Sandy shell gravel with scattered pebbles

H17 - Patchy unhealthy maerl on sand, Virgularia patches

H18 - Maerl beds on coarse sand

H19 - Pebbles supporting Laminaria saccharina

H20 - Clean cobble, Modiolus

H21 - Boulders interspersed with maerl and coarse sand

H22 - Bare boulder slope

H23 - Occasional boulders interspersed with sand, kelp forest

H24 - Dense boulder bed, kelp forest

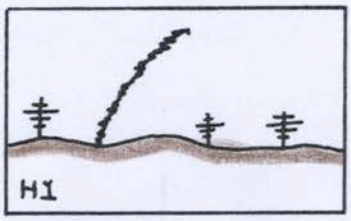
H25 - Bedrock, kelp forest

H1 - FINE STICKY MUD, USUALLY FLAT, PENNATULA BEDS

Sites; 12, 25, 28, 29, 30, 33.

Zone; Circalittoral

Symbol;



H1 was a soft, fine, sticky mud which was easily disturbed by divers. It was observed between 11 & 32m and, at the deeper end of this range (below 20m), was usually a flat or gently sloping plain. The mud surface often showed signs of biological activity which was generally in the form of tracks and conical excavations about 30cm deep. Nephrops burrows were also a feature of the habitat at some locations. In places detached kelp plants and occasional pebbles or shell fragments were seen on the mud surface. The visually dominant community type on this habitat consisted of beds of Pennatula phosphorea with occasional Funiculina quadrangularis although some Virgularia mirabilis were present at one site (12).

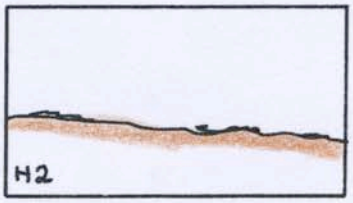
This habitat was observed where the seabed levelled out to form the basin of the loch. It is therefore likely that it covers much of the seabed in both lochs which were beyond the depths which could be investigated by divers.

H2 - FINE MUD SLOPE WITH OCCASIONAL SHELL DEBRIS

Sites; 4, 11, 15, 21, 26, 29, 31, 32, 33, 34, 36,

Zone; Circalittoral

Symbol;



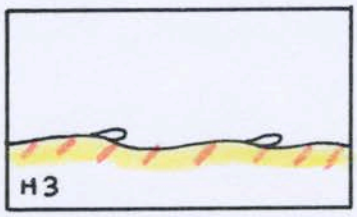
H2 was a soft mud habitat occasionally mixed with some fine sand and scattered with shell debris. It was recorded between 7.5 & 31.4m. The habitat was generally sloping, up to 45°, although occasionally formed a muddy plain. Almost all sites where this habitat was recorded had shell debris scattered over much of the surface, rather than in patches (Pecten maximus, Ensis sp., Turitella communis and Arctica islandica). Occasional small boulders, cobbles or pebbles were also present together with detached kelp plants. Crab excavations and algal fluff or mats were also noted on the surface of the mud. In contrast to H1, Pennatula was rarely recorded on this habitat.

H3 - SILTY MUD, AEQUIPECTEN BED.

Site; 57

Zone; Circalittoral

Symbol;



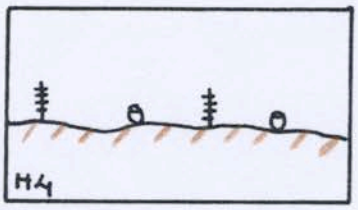
H3 was a silty mud plain, only recorded at one site, between 18 & 23m. The surface was worked into occasional mounds with worm casts and had many crab excavations. Shell debris was scattered over the surface and Aequipecten opercularis was the visually dominant species.

H4 - MUDDY SAND WITH VIRGULARIA AND SEASQUIRTS

Sites; 57

Zone; Circalittoral

Symbol;



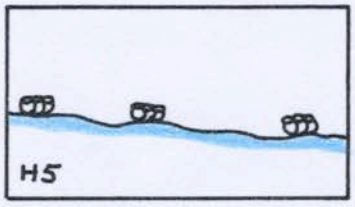
H4 was a muddy sand plain reported from one site from 17m to 23m The visually dominant community was beds of Virgularia mirabilis which were interspersed with solitary sea squirts.

H5 - SANDY MUD WITH SPARSE SHELL DEBRIS, CLUMPS OF ASCIDIELLA

Sites; 17, 30, 33

Zone; Circalittoral

Symbol;



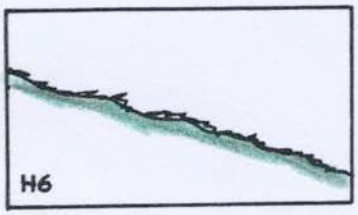
H5 was a sandy mud on a gentle slope or plain, observed at depths of 8m to 16m. Some scattered dead shells (usually Arctica islandica) lay on the surface with fine shell fragments. There was an occasional small boulder or pebbles supporting some hydroid turf. The visually dominant species was Ascidiella aspersa which occured in large clumps. Cerianthus lloydii was only present at one site (30) although the habitat looked suitable for this species. The difference between this habitat and H4 was that it was more sandy and had a different visually dominant community.

H6 - MUDDY SLOPE WITH EXTREMELY ABUNDANT SHELL DEBRIS

Sites; 31

Zone; Circalittoral

Symbol;



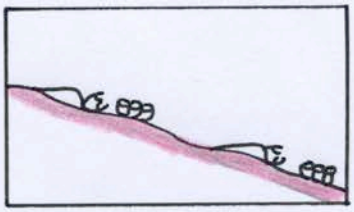
H6 was a steep silty mud slope of about 30°, dominated by shell debris. Huge numbers of shells, mainly Ensis sp., covered virtually all the surface, possible sorted into this area by the stream which enters the loch near the dive site. The conditions may have been anoxic not far below the surface. Occasional solitary sea squirts and hermit crabs were observed amongst the shell debris.

H7 - MUD WITH OCCASIONAL SMALL BOULDERS OR STONES, MUNIDA AND ASCIDIELLA.

Sites; 21, 50, 60

Zone; Circalittoral

Symbol;



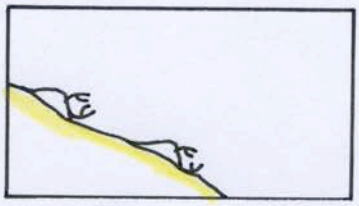
H7 varied from silty to sandy mud and was usually flat plain or gentle slope. It was observed between 5-39m. Occasional small angular boulders protruded from the mud harbouring Munida rugosa and supporting Ascidiella aspersa, which were the two visually dominant species. The surface of the mud was scattered with some shell debris and was worked, with burrows of Nephrops seen at one site (17). Asteroidea species were particularly common and included Martasterias glacialis, Astropecten irregularis, Luidia ciliaris, and Porania pulvillus.

H8 - MUDDY SLOPE WITH SMALL BOULDERS, MUNIDA DOMINATED

Sites; 4, 6, 7, 8, 24, 26, 27, 32, 44.

Zone; Circalittoral

Symbol;



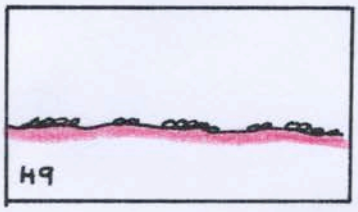
H8 was a muddy habitat with frequent small angular boulders or large stones on the suface. It was usually sloping, from a gentle angle up to 45 and was frequently a fine silty soft mud. It was recorded from shallow waters (3m) down to 35m. Broken shells were mixed in with the sediment and the boulders were covered with a thin layer of silt. Munida rugosa was very common in this habitat, sheltering by the small boulders. A diatom mat was visible on the mud surface at many sites. In shallower water, Laminaria saccharina was attached to the larger stones and Arenicola casts were observed in the sediment at one site (6). The main difference between this habitat and H7 was that boulders and stones were more common on H8, and Munida was clearly the visually dominant species. Occasional Virgularia were seen at one site (24).

H9 - PEBBLE CLUMPS ON COARSE MUD, LIMARIA HIANS BEDS

Sites; 3, 5, 9, 10, 14.

Zone; Circalittoral

Symbol;



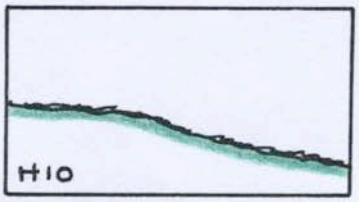
H9 was a flat plain or gentle slope of clumps of pebbles and small stones, with patches muddy sediment in between. This was interspersed by the occasional small boulders and some shell debris was also present on the surface. The habitat was recorded between 13m & 15.5m in areas where a gentle current was observed. The clumps of pebbles and stones were held together over nests of Limaria hians which was the dominant species. The pebbles supported a hydroid turf, small red foliose algae and the occasional L.saccharina. The knobbly form of Lithothamnion sp. encrusted the small stones and Psammechinus miliaris was also common at one site (14). Patches of horse mussel Modiolus modiolus held the clumps together at one site (14).

H10 - SHELLY SAND WITH PEBBLES

Sites; 59

Zone; Circalittoral

Symbol;



H10 was a gently sloping shelly sand plain scattered with pebbles, cobbles and some gravel. It was reported at one site (59) between 14m and 23m. The shell fragments made up around 50% of the substratum although there were occasionally more complete shells (particularly Turritella communis) on the surface. Crab excavations were common and E.esculentus was observed on the loose kelp.

H11 - **SAND WITH SCATTERED SHELL DEBRIS**

Sites; 2, 13, 15, 16, 17

Zone; Infralittoral

Symbol;

H11 was a flat or gently sloping plain of sand varying in texture from firm to soft although mostly coarse. It was reported between depths of 0m to 14m. Some shell debris was present on the surface (Turritella communis or Ensis sp.) which was worked into irregular undulations with many burrows as well as crab excavations and tracks. There was loose algal debris and a fine diatom mat on the surface. The occasional stone or boulder supported Laminaria saccharina.

H12 - CLEAN COARSE SAND WITH SCATTERED DEBRIS

Sites; 23, 25, 45

Zone; Infralittoral/Circalittoral

Symbol;

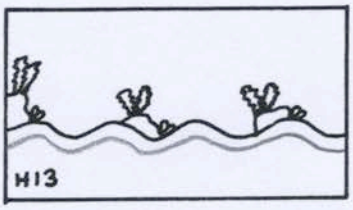
H12 was a gently sloping habitat of clean coarse sand with occasional patches of pebbles scattered on the surface. It was recorded between 9m and 30m although site 25 consisted of a steep slope from 17m to 30m. There was some shell debris with loose kelp or red algae on the surface. There were many crab excavations and Virgularia mirabilis was observed at one site (25).

H13 - **CLEAN, RIPPLED, INTERTIDAL SAND FLAT**

Sites; 1, 30, 31, 36

Zone; Littoral/Infralittoral

Symbol;



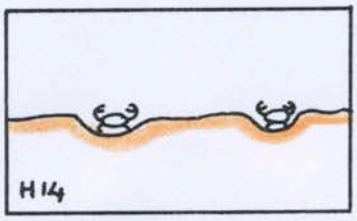
H13 was a sandy plain worked into ripples and observed in shallow water (1.5m above CD to 11m). The sand was firm, coarse and mixed occasionally with some shells and gravel. This habitat was comparatively barren with a diatom mat on the surface (sites 1 & 31) and occasional worm holes, Arenicola marina casts, and burrows of Cancer pagurus. Where this habitat was observed in the intertidal zone there were occasional boulders supporting Fucus serratus and at one site (1) clumps of Mytilus edulis.

H14 - **FIRM CLEAN SAND**

Sites; 37, 49, 51, 55, 61

Zone; Circalittoral

Symbol;



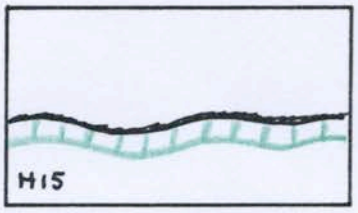
H14 was generally a flat plain of very clean coarse sand recorded between 7m and 27m although site 61 was a 30° slope. Numerous crab excavations pitted the surface of this habitat which supported very few species on the surface apart from Cancer pagurus.

H15 - SHELL SAND

Sites; 23, 39, 42, 43, 46

Zone; Circalittoral

Symbol;



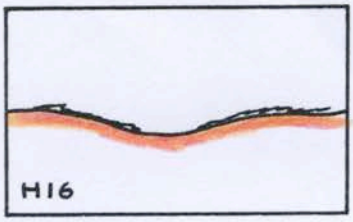
H15 was a flat or gently sloping plain of very clean shell sand recorded between 9m and 21m. Fragments of shell eg.Mytilus edulis and barnacle plates were clearly visible and there was little or no surface algae. There were some pebbles scattered on the surface with occasional rocks and large dead shells. Worm casts and crab excavations were common and occasional Virgularia and Cerianthus were recorded at one site (39).

H16 - SANDY SHELL GRAVEL WITH SCATTERED PEBBLES

Sites ; 18, 56, 58, 59

Zone; Infralittoral/Circalittoral

Symbol;



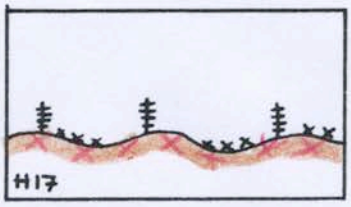
H16 was a gentle slope of coarse sand with upto 50% of shell fragments. It was recorded from 3m to 22m. Shell debris lay scattered over the surface together with patches of pebbles, cobbles, shell gravel and angular stones. The stones supported fine red algae and Lithothamnion species. There were occasional Laminaria saccharina and L.hyperborea attached to the stones and Echinus esculentus was common in these areas. Crab excavations and burrows were observed in this habitat.

H17 - PATCHY UNHEALTHY MAERL ON SAND, VIRGULARIA PATCHES

Sites; 24, 58

Zone; Infralittoral

Symbol;



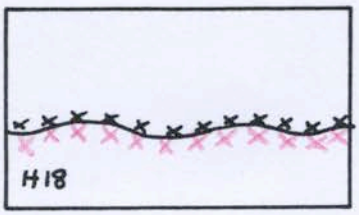
H17 was a flat plain of coarse sand overlain with patches of maerl. It was recorded between depths of 20-26m. The maerl bed was broken, unhealthy and mostly dead. The surface of the sand and maerl bed was scattered with dead shells and, in places, overlain by fine silt. Occasional Virgularia mirabilis were observed along with worm burrows, mounds, hydroids on occasional stones, and patches of Ophiocomina nigra

H18 - MAERL BEDS ON COARSE SAND

Sites; 24, 38, 47, 60.

Zone; Infralittoral

Symbol;



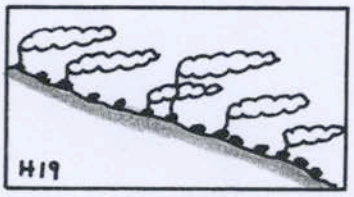
H18 was a gentle slope or plain of coarse sand, containing shell fragments and gravel, overlain by a living maerl bed. This habitat was recorded between 1.5m & 20m. The maerl was patchy, lying in gentle sandy dips in places, but extensive elsewhere, where an estimated 60% was living. Occasional L.saccharina holdfasts were embedded in the maerl mesh and red foliose algae, algal fluff and many small species of crustacea and mollusca were also noted on this habitat. At one site (47) there were a few small patches of Zostera amongst the maerl and sand.

H19 - PEBBLES SUPPORTING LAMINARIA SACCHARINA

Sites; 9, 10,

Zone; Infralittoral

Symbol:



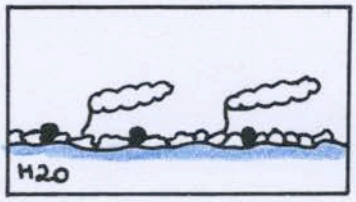
H19 was a gentle to sloping (10°- 30°) area of pebbles recorded between 0m to 11m. Cobbles, some coarse sand, gravel and shell fragments were present between the pebbles and there were occasional small boulders. The pebbles supported Laminaria saccharina forest or Fucus serratus (shallow site 9) with Gibula cineraria and Spirobis sp. on the fronds. There was some scattered debris and fluffy red algae and terebelid worms on this habitat as well as Cancer pagurus burrows.

H20 - CLEAN COBBLE, MODIOLUS

Site: 22

Zone; Infralittoral

Symbol;



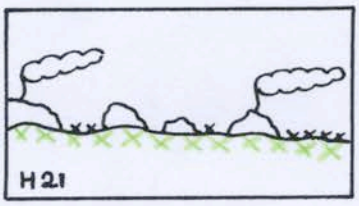
H20 was a level area in shallow water (1.5m) consisting of cobbles and individual Modiolus modiolus embedded in sand. There were occasional clearings where boulders lay on the sand and supported L.saccharina. The habitat had a very clean appearance and both the cobbles and Modiolus were encrusted with Lithothamnion. Some E.esculentus were noted.

H21 - BOULDERS INTERSPERSED WITH MAERL AND COARSE SAND

Sites; 52

Zone; Infralittoral/Circalittoral

Symbol;



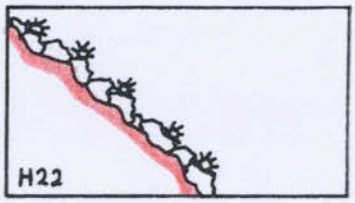
H21 was a flat area of coarse sand abundantly scattered with boulders and interspersed with cobbles and patches of maerl. It was only recorded at one site, between 15-16m. The boulders were encrusted with Lithothamnion sp. and bryozoan turf, and supported the occasional Laminaria saccharina plant. Some of the boulders were covered with silt or sand and harboured Munida rugosa. Most of the maerl between the boulders was not living and was mixed in with the sand.

H22 - BARE BOULDER SLOPE

Sites; 37, 44, 48, 53, 61, 62.

Zone; Infralittoral/Circalittoral

Symbol;



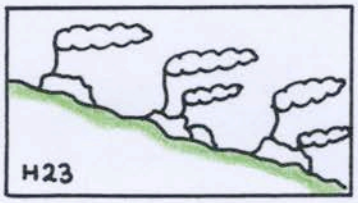
H22 was a bare steep boulder slope (up to 80°), often unstable, and resembling a scree slope. It was recorded from near the surface to 31.5m. In shallow water the boulders tended to be fairly small (0.5m across) and rounded, but in deeper water, the habitat consisted of large (2m) angular blocks. The boulders had clearly fallen from the vertical cliffs above the surface and patterns of surface weathering were still visible on some of them. The boulder sufaces were virtually bare of all but encrusting Lithothamnion due to heavy grazing by Echinus esculentus which was abundant and the visually dominant species. Clumps of seasquirts (Ascidia mentula) were also fairly frequent on the sides on the boulders in deeper water. This habitat was farily extensive at more exposed locations (H62) when it extended from the surface to more than 20m but, within the shelter of the lochs, it usually only went down to around 10m.

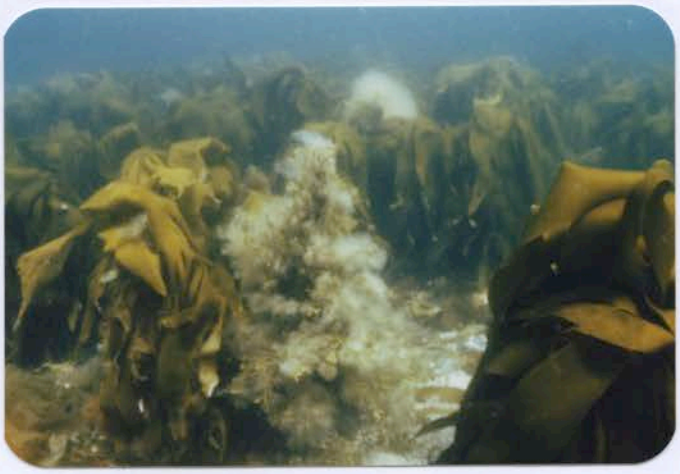
H23 - OCCASIONAL BOULDERS INTERSPERSED WITH SAND, KELP FOREST

Sites; 7, 15, 18, 19, 21, 23, 24, 26, 27, 29, 32, 37, 39, 41, 42, 43, 46, 47, 49, 53, 54, 59, 61, 62.

Zone; Infralittoral

Symbol;





H23 was a gentle slope of medium sand interspersed with occasional boulders up to 1m across. It was recorded between 1m above Chart Datum to 23m. The habitat usually had a gentle slope and some pebbles and cobbles were noted amongst the coarse sand along with shell fragments and gravel. The boulders were encrusted by Lithothamnion sp. and supported kelp plants - usually L.saccharina for sites within the lochs, but also L.hyperborea near the mouths of the lochs, Sacchoriza polyschides and, in shallower water, Halidrys siliquosa and Fucus serratus. The boulders were grazed by E.esculentus but were colonised by hydroids and patches of feather stars. Burrows of C.pagurus were present in the sediment between the boulders.

H24 - DENSE BOULDER BED, KELP FOREST

Sites; 2, 6, 20, 21, 29, 39, 40, 41, 42, 46, 48, 49, 53, 54, 61.

Zone; Infralittoral

Symbol;

H24 was a dense boulder bed, sometimes on a gentle slope, recorded at depths between 1.7m above CD to 16m. The boulder cover was almost complete with only a few pebbles and shell remains between them. In the shallower water, the boulders supported Fucus serratus or Ascophyllum nodosum with Laminaria saccharina in deeper waters within the lochs or L.hyperborea near the mouths of the lochs. Sacchoriza polyschides made up about 20% of the kelp forest. E.esculentus was common and some of the boulders showed evidence of urchin grazing as they were only covered by encrusting Lithothamnion (knobbly forms) and ascidians. Within the lochs some of the boulders were covered with a thin layer of sediment.

H25 - BEDROCK, KELP FOREST

Sites;16, 19, 20, 35, 37, 41, 42, 45, 46, 48, 49, 51, 53, 55, 56, 60, 62.

Zone; Infralittoral

Symbol;

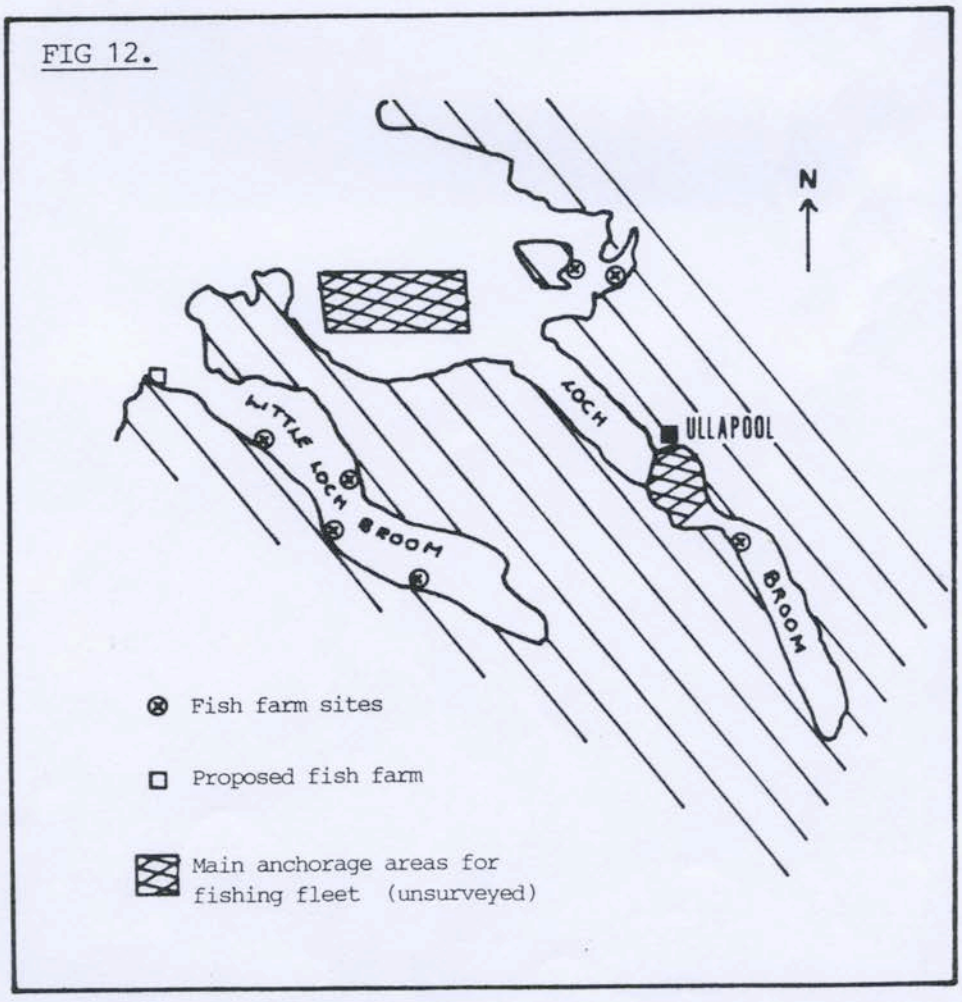
H25 consisted of bedrock which was stepped at most sites with vertical surfaces and was observed from Chart Datum to a depth of 22.5m. The ledges were generally 0.5-2m high with patches of silt, sand, gravel or shell debris on the horizontal surfaces although some were scoured clean. The vertical surfaces were colonised by calcareous tube worms, along with kelp, chitons and urchins. Overhanging ledges, crevices, fissures, and weathered strata were common. The predominant community was L.hyperborea kelp forest often covered with abundant Antedon bifida on the stipes as well as solitary seasquirts and sponges. Laminaria saccharina was only occasionally present (with some Saccorhiza polyschides) below 11m. The ledges were encrusted with Lithothamnion sp and E.esculentus was common. One site (48) had a short, vertical cliff face supporting Alcyonium digitatum.

4.5. Human Impacts in the survey area

The two most conspicuous marine activities in the survey area were shipping and fish farming operations. The port of Ullapool is particularly busy in the winter months because it acts as a base for Russian factory ships. The vessels anchor in Loch Broom and its approaches between September and March, during which time they purchase mackerel from U.K. fishing vessels to process on board. During the expedition, 11 such vessels were present in the central part of Loch Broom and 20 in the area of Cadail Bank, near the mouth of Loch Broom (Fig.5). Any fish waste deposited overboard on completion of processing is likely to have an impact on marine communities. However, nothing of this nature was observed as the survey team kept clear of all anchored vessels. Nevertheless, noise and vibrations from the factory ships were clearly audible when diving around the margins of the central part of Loch Broom although this did not seem to deter a number of grey seals which frequented the area. Occasional litter (eg.shoes, tin cans) was also observed on the seabed in this part of the loch.

Fish farming was clearly a well established industry in the area with a total of 7 operations being noted. All were fairly small, except for the operation near Isle Martin which had quite a negative visual impact. This was also adjacent to the RSPB reserve of Isle Martin and was an area frequented by seals. The positions of fish farm cages within the survey areas are shown in Fig.12.

FIG 12.



6. REFERENCES

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STANDARD SYMBOLS FOR MARINE COMMUNITIES

	Common name	Scientific name
	Kelp	Laminaria hyperborea
	Sugar Kelp	Laminaria saccharina
	Dead Man's Fingers	Alcyonium digitatum
	Sea Urchin	Echinus esculentus
	Burrowing Sea Cucumber	Neopentadactyla mixta
	Sea Rush	Virgularia mirabilis
	Sea Pen	Pennatula phosphorea
	Burrowing Sea Anemone	Cerianthus lloydii
	Maerl	Phymatolithon spp.
	Peacock Worm	Sabella penicillus
	Feather Star	Antedon bifida
	Razor Shell	Ensis spp.
	Brittle Star	various
	Mussels	various

NATURE CONSERVANCY COUNCIL

SEASEARCH

Marine Nature Conservation Review

MARINE CONSERVATION SOCIETY

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 retrived. 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 ☐

SEASEARCH

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?

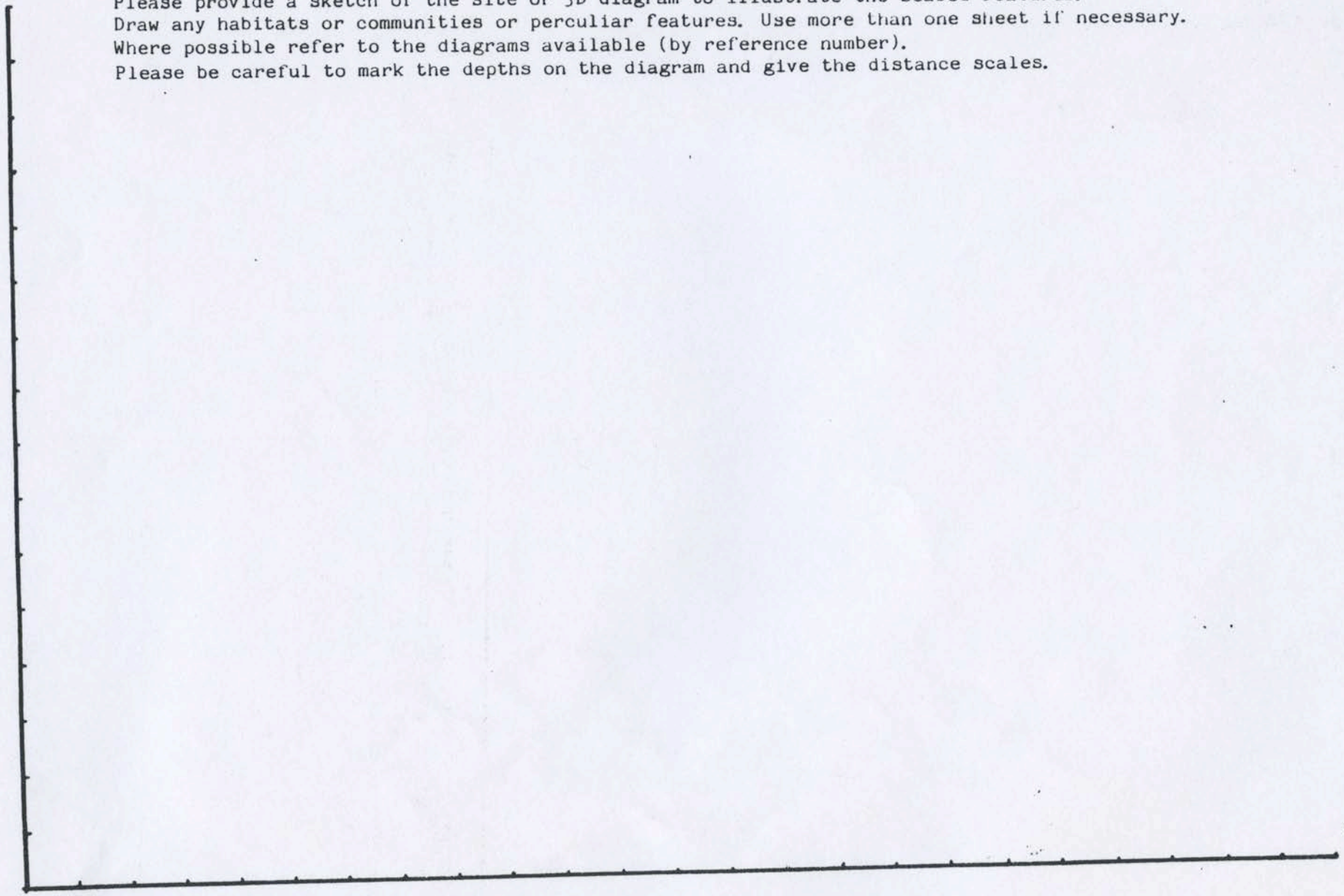
Project Leader comments

SEASEARCH

Site Number_____.

SKETCH SHEET

Please provide a sketch of the site or 3D diagram to illustrate the seabed features.
Draw any habitats or communities or perculiar 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.



SKETCH SHEET

HABITAT & COMMUNITY RECORDING

Depth	Distance	Seabed Type	Circ - Animal Infra Plant. Zones

CHECKLIST	DIVE NOTES
HABITAT FEATURES COMMUNITY PLANTS/ANIMALS DOMINANT SPECIES	

Depth	Distance	Seabed Type	Circ - Animal Infra Plant. Zones

CHECKLIST	DIVE NOTES
HABITAT FEATURES COMMUNITY PLANTS/ANIMALS DOMINANT SPECIES	

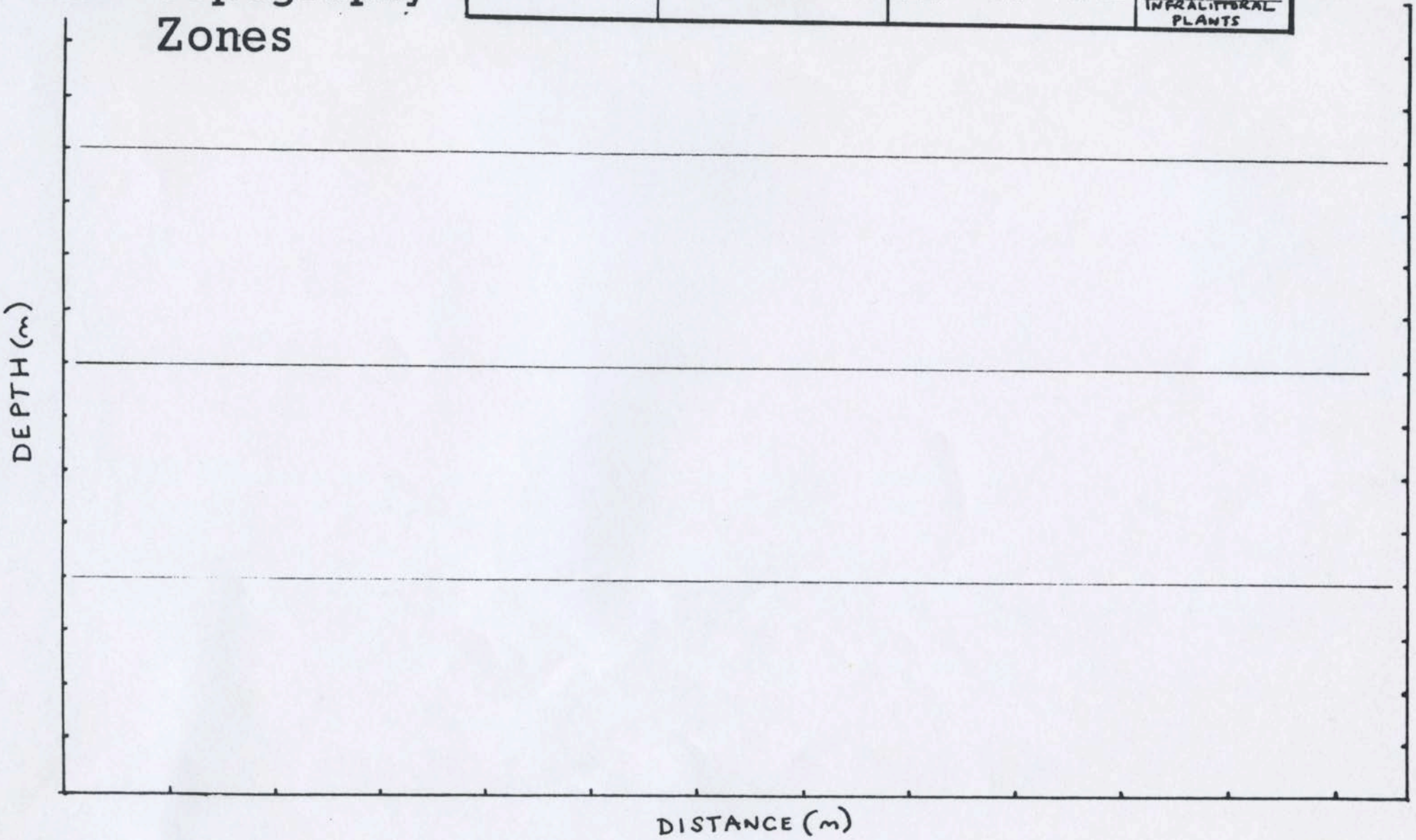
Depth	Distance	Seabed Type	Circ - Animal Infra Plant. Zones

CHECKLIST	DIVE NOTES
HABITAT FEATURES COMMUNITY PLANTS/ANIMALS DOMINANT SPECIES	

PROFILING

Aim: Topography Zones

DEPTH	DISTANCE	SEA BED TYPE	CIRCALITTORAL ANIMALS / INFRALITTORAL PLANTS



APPENDIX 3

The Molluscan Fauna of Loch Broom and Little Loch Broom

Julia Nunn

In addition to carrying out SEASEARCH at Loch Broom and Little Loch Broom, one of the authors (J. Nunn) examined the molluscan fauna of the area in more detail. Species were recorded, and collected for confirmation of identity where observed during each dive. In addition, samples of algae (mostly foliose red; not kelp), maerl (site 60) and hydroids were collected and examined in a laboratory for small species. Unfortunately, time did not permit any examination of the shores in the Survey Area. Observation from the boats indicated steep rocky/boulder shores along the sides of the loch, with muddy sand at the head of each loch. The north side of Isle Martin was exposed cliff with a low diversity of molluscs (entirely dominated by 'juvenile' Mytilus edulis) at the intertidal level.

In total, 17 of the 25 habitats described in this report were examined by the author, comprising muddy habitats (H1, H2, H3, H4, H6, H7, H8, H9) sandy habitats (H12, H13, H14, H15), a maerl bed (H16), pebbles (H19) boulders (H23, H24) and bedrock (H25). 85 species were recorded, of which 69 were observed alive (a list is given at the end of this Appendix). Most species were not abundant. The commonest opisthobranchs were Philine aperta (sites 11,13,17) and Aplysia punctata (3-4 specimens on red foliose algae (sites 18,39,41). No one site supported either large numbers or diversity of nudibranchs, with site 41 being the best with 4 dorid species. Limaria hians was locally common (in nests, sites 10,14) as were Modiolus modiolus (sites 14,22), Aequipecten opercularis (site 57) and Mytilus edulis (sites 1,48). Ensis sp. (probably arcuatus) was abundant and almost certainly living over much of both lochs. The dead shells were found on many dives as were those of Arctica islandica. Gibbula cineraria and Calliostoma zizyphinum were common in shallower waters, on kelp. A number of unusual species were recorded from the survey area. Janolus hyalinus, Embletonia pulchra (discovered in the laboratory amongst Tonicella marmorea collected from silt covered bedrock) and Doto millbayana (on Plumularia setacea) were all new records for sea area 30 in the Sea Area Atlas published by the Conchological Society of Great Britain and Ireland (1982; ed. D.Seaward). Two other interesting species were Alvania beanii only previously observed by the author on a shallow sublittoral maerl bed in Co.Galway, Eire and Turbonilla rufescens, which was a new observation for the author. Both species were recorded from the maerl bed near Iolla Bheag (site 60). One specimen of Cuthona caerulea was collected when observed underwater on the inside of a dead Arctica islandica shell on a muddy habitat (site 57).

Brief notes on the molluscan fauna within each habitat

As expected, the muddy habitats supported very few species of mollusc. No molluscs were observed in H1 which was dominated by Pennatula phosphorea beds. H2 largely had dead shells on the mud surface - Pecten maximus, Ensis sp. and Arctica islandica with some live specimens of Turritella communis. Similarly, H3, H5, H6, H7, H8, H9 and H10 supported mainly dead shells on the surface such as Arctica islandica (H5) or large numbers of dead Ensis sp. (H6) or both with some live Pecten maximus, Modiolus modiolus, Philine aperta and Buccinum undatum (H7, H8). Habitat H9 was unusual in so far as it consisted of pebbles and stones held together in clumps on mud above nests of Limaria hians. The mud habitat H4 was dominated by Aequipecten opercularis.

The sandy habitats (H11, H12, H14, H15, H16) supported varying quantities of shell debris, of a similar nature to that of the mud habitats - that is Ensis sp., Pecten maximus and Arctica islandica. Habitat H13 was largely barren sand, except site 1 which was a typical intertidal site representative of the head of a loch. There were clumps of Mytilus edulis with Cerastoderma edule at the base of stands of Fucus serratus. Some of these sandy sites supported stands of kelp and red foliose algae, but no samples were taken by divers. No detailed information concerning the mollusca of habitat H17 is available.

H19 and H20 sites were dominated by pebbles and cobbles with some kelp. H20 supported Modiolus modiolus either as a bed or scattered over the surface. The variety of molluscan species increased, being typical of kelp (Trochidae sp.) with chitons (Tonicella sp.) on the stones.

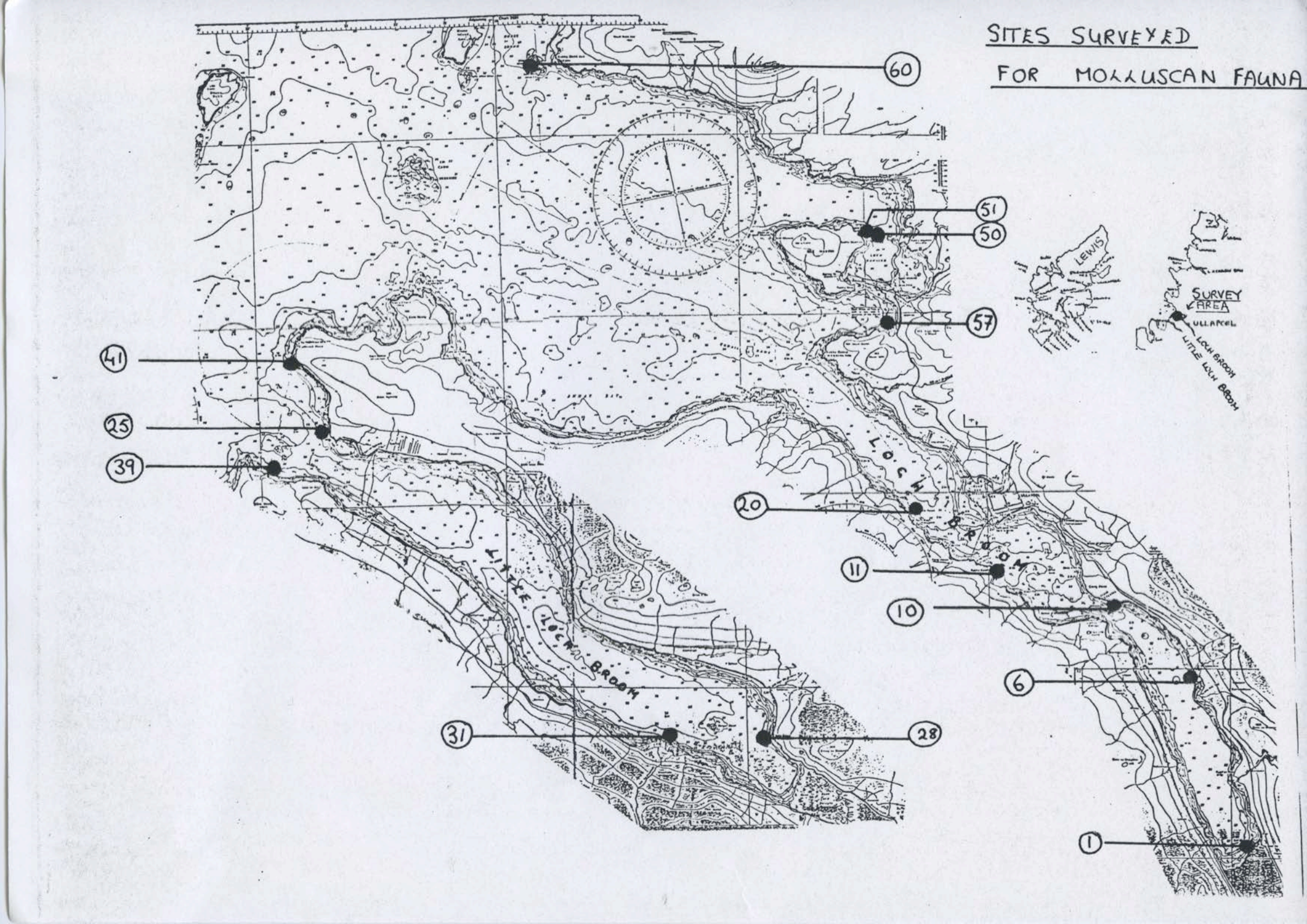
Habitats H21 and H22 were not examined in detail for molluscan species, and H22 (boulder slope) is known to be comparatively barren, probably due to grazing by Echinus esculentus.

Habitats H23, H24 and H25 were boulders or bedrock, usually in shallower water (≤15m), with kelp, and supported a wide diversity of species - especially on the vertical surfaces of the bedrock. Samples of red foliose algae and hydroids yielded a number of small species and most of the nudibranchs observed during this survey.

Finally, H18 was the richest molluscan habitat of those examined. 44 species were observed at site 60 which was a maerl bed at about 15m. 14 of these species were unique to this site alone. The chiton Tonicella marmorea was particularly common on the vertical surface of bedrock underlying part of the maerl bed.

In conclusion, it is clear that the molluscan fauna within the two lochs is poor in diversity, although typical, reflecting the dominance of mud and sandy habitats both at the head of the lochs and the sides. Even the shallow (≤5m) sites within the lochs supported few species on the boulders and kelp, possibly due to grazing by Echinus esculentus. A comparable shallow water site

(51) on Isle Martin supported a greater number of species. In fact, 49 live species of mollusc were found in the Isle Martin/Outer Loch Broom area as compared with 34 for Little Loch Broom and 29 for Loch Broom. The higher number of species for LittleLoch Broom as compared with Loch Broom may be due to the inclusion of three sites (25, 39, 41) which are at the outermost edge of the Loch. Unfortunately, the author was unable to survey the maerl bed present in the outer waters of Little Loch Broom (site 38). It would be extremely interesting to compare the molluscan fauna with that of site 60, the maerl bed at Iolla Bheag, Outer Loch Broom. This brief survey of the molluscan fauna of Loch Broom and Little Loch Broom underlines how important it is to conserve certain types of habitat, particularly maerl beds which support such a wide diversity of species, yet are known to be vulnerable to impact by man.


SITES SURVEYED
FOR MOLLUSCAN FAUNA
60
51
50
57
41
25
39
20
11
10
6
31
28
1
LOCH BROOM
LITTLE LOCH BROOM
LEWIS
SURVEY AREA
ULLAPOOL
LOCH BROOM
LITTLE LOCH BROOM

Sites examined for molluscan fauna by author

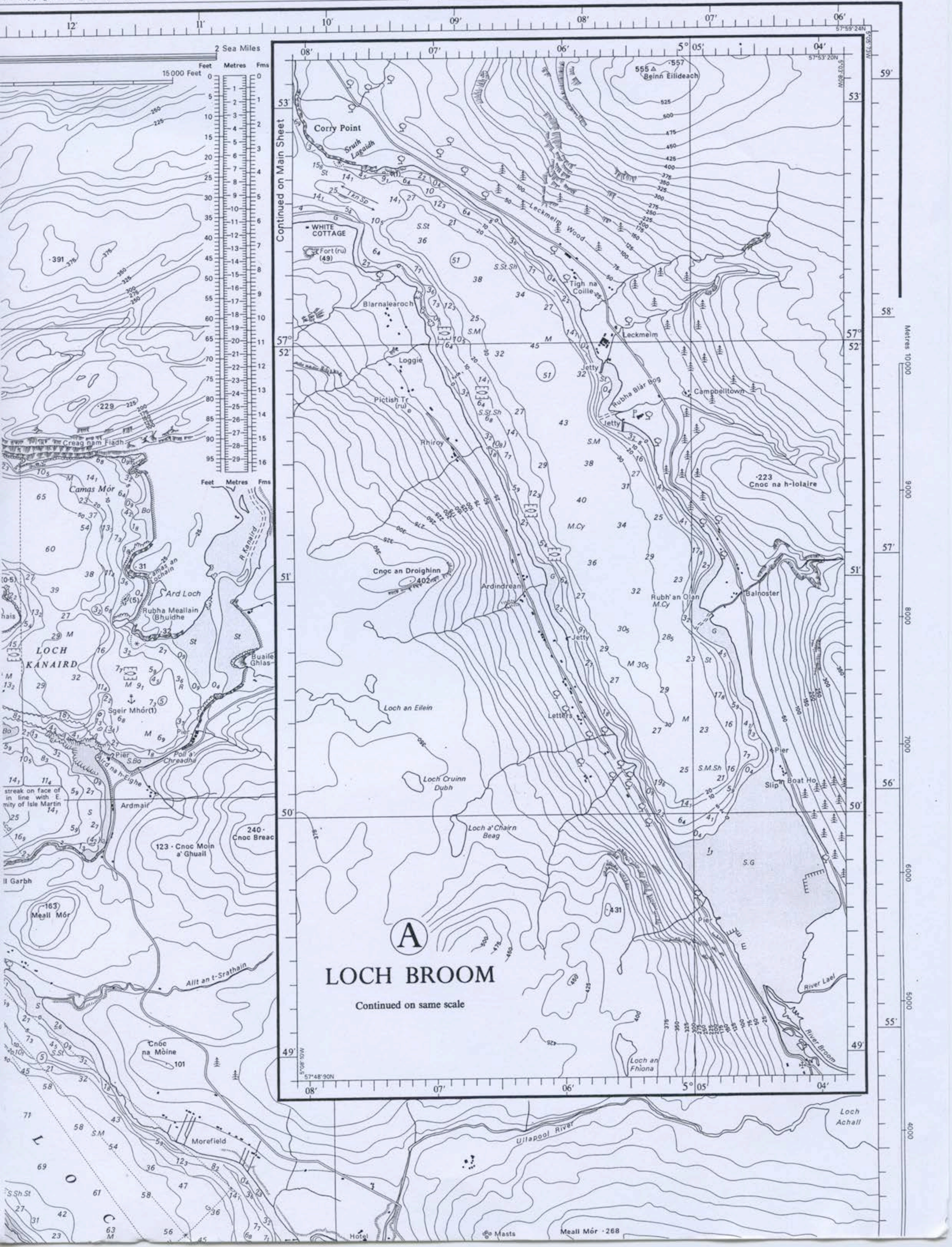
No.	Name	Depth range (m to C.D.)	Habitats
1	Rubha Airdan Turc, Loch Broom	+2.0 - +0.7	H13
6	Off Leckmelm Farm, Loch Broom	-3.3 - 28.2	H8; H24
10	Camas an Daimh, Loch Broom	-11.5 - 15.5	H9; H19
11	Rubha Buidhe, Loch Broom	-7.5 - 9.5	H2
20	Buckle Patch, Loch Broom	-10.5- 26	H24; H25
25	N.W of Corran Sgoraig,Little Loch Broom	-18 - 32.4	H1; H12
28	Sron Creag Na Cipaich,Little Loch Broom	-13.5 - 25.3	H1
31	Ardessie, Little Loch Broom	-3.0 - 26.9	H2;H6;H13
39	Red Cliffs, Little Loch Broom (2 dives)	-18.5 - 19.5) -6.8 - 11.8)	H15;H23;H24
41	Sron a Gheodha Dubh,Little Loch Broom	-9.1 - 11.1	H23;H24;H25
50	Loch Kanaird Narrows, Isle Martin	-27.8 - 38.8	H7
51	North of Rubha Glubhair, Isle Martin	-1.7 - 7.7	H14; H25
57	Cul a Bhogha, Outer Loch Broom	-17.3 - 23.3	H3; H4
60	Iolla Bheag, Outer Loch Broom	-7.4 - 20.5	H7;H18;H25

These sites are shown on the map in this Appendix.
There were additional occasional observations of large molluscan species from other divers for sites 8, 9, 12-18, 22, 23, 26, 30-34, 38, 42, 44, 47-49, 55, 56, 59, 61.

Species Directory Number	SPECIES	SITES (d=dead specimen)
W55	Leptochiton asellus	10,20,25,57,60
W74	Lepidochitona cinereus	1
W78	Tonicella marmorea	1,6,10,20,60
W79	Tonicella rubra	39,60
W111	Emarginula fissura	44,60
W126	Tectura virginea	6,10,20,39,51,57,60
W139	Helcion pellucidum	20,39,41
W161	Margarites helicinus	51
W190	Gibbula magus	39d,51,60
W192	Gibbula tumida	51,57,60
W194	Gibbula cineraria	10,22,39,41,51
W201	Calliostoma zizyphinum	22,41,48,51,60
W254	Turritella communis	11,15d,51d,60
W308	Lacuna vincta	18,26,39,41,51,60
W314	Littorina littorea	1
-	Rissoa rufilabrum	18,39,41,51
W347	Rissoa interrupta	10,18,39,51,60
W348	Rissoa parva	41,60
W358	Pusillina inconspicua	26
W359	Pusillina sarsi	41
W370	Alvania beanii	60
W376	Alvania punctura	20,60
W403	Onoba semicostata	10,20,51
W481	Aporrhais pes-pelecani	60d
W529	Lamellaria latens	51
W535	Velutina velutina	57
W544	Lunatia montagui	60
W546	Lunatia poliana	60d
W660	Vitreolina philippi	60
W694	Ocenebra erinacea	20d,60d
W709	Buccinum undatum	11,13,17,22,51
W752	Hinia incrassata	26,38,39,41,60
W787	Mangelia nebula	60d
W810	Raphitoma linearis	39,60
W830	Chrysallida obtusa	60
W861	Odostomia plicata	51
W875	Brachystomia rissoides	60
W921	Turbonilla rufescens	60
W980	Philine aperta	11,13,17
W1018	Retusa truncatula	60d
W1103	Aplysia punctata	18,39,41
W1247	Tritonia plebeia	39
W1253	Lomanotus marmoratus	26,60
-	Doto sp. (juvenile)	57
W1275	Doto coronata (agg.)	34
W1280	Doto fragilis	34,60
W1285	Doto millbayana	34
W1298	Goniodoris nodosa	41
W1325	Adalaria proxima	41
W1336	Onchidoris muricata	26,41,60

W1364	Polycera quadrilineata	41
W1433	Janolus hyalinus	39
W1457	Coryphella verrucosa (juvenile)	39
W1468	Cuthiona caerulea	57
W1507	Embletonia pulchra	60
W1516	Eubranchus pallidus	20
W1593	Antalis entalis	44
W1621	Nucula nucleus	60
W1652	Mytilus edulis	1,42d,48
W1671	Modiolarca tumida	60
W1677	Modiolus modiolus	6,8,10d,14,22
W1741	Limaria hians	10,14
W1771	Ostrea edulis	1d
W1807	Aequipecten opercularis	10,11,14,20,26,34, 58,60
W1811	Pecten maximus	4,10,12,18d,20,23d,25 26,39d,49d,51,59,60
W1822	Pododesmus patelliformis	22
W1824	Pododesmus squamula	10,11,20,26,41,48,51,60
W1844	Lucinoma borealis	10d,51d,60d
W1971	Acanthocardia echinata	10d,20d
W1977	Parvicardium exiguum	39,60
W1989	Laevicardium crassum	20d,60d
W1993	Cerastoderma edule	1
W2013	Lutraria lutraria	20d,39d,60d
-	Ensis sp.	9d,16d,23d,31d,33d,47d, 49d,55d,56,61
W2025	Ensis arcuatus	18,60d
W2092	Gari tellinella	39d
W2127	Arctica islandica	11,30d,32d,33d,34, 39d,57
W2153	Circomphalus casina	26
W2168	Dosinia exoleta	10d,11d,20d,39d,41d,57d
W2183	Paphia rhomboides	10d,41d,60d
W2187	Venerupis senegalensis	26d
W2195	Clausinella fasciata	39d,51d
W2207	Timoclea ovata	20d,60
W2224	Turtonia minuta	51
W2233	Mya truncata	10d,11d,51d,57d,60d
W2257	Hiatella arctica	10,60
W2359	Thracia villosiuscula	60

SEE RELATED ADMIRALTY PUBLICATIONS: **Notices to Mariners** (recent, imminent and temporary changes), **Sailing Directions** (local conditions, directions, regulations, port information), **List of Lights, List of Radio Signals** (navigational warning and weather transmissions, pilot and port operations services, traffic management, radiobeacons), **Tide Tables, Tidal Stream Atlases, The Mariner's Handbook** (general information), **5011** (symbols and abbreviations), etc.
ENSURE CHARTS AND PUBLICATIONS ARE KEPT CORRECTED.


2 Sea Miles
15 000 Feet
Feet
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Continued on Main Sheet
Corry Point
Sruth Lagaidh
WHITE COTTAGE
Fort (ru)
Blarnalearoch
Loggie
Pictish Tr (ru)
Rhiroy
Cnoc an Droighinn
Ardindrean
Letters
Loch an Eilein
Loch Cruinn Dubh
Loch a' Chairn Beag
Loch an Fhiona
Beinn Eilideach
Leckmelm Wood
Tigh na Coille
Leckmelm
Jetty
Rubha Blàr Bog
Campbelltown
Cnoc na h-Iolaire
Rubh' an Olan
Balnoster
Pier
Slip
Boat Ho
River Lael
River Broom
A
LOCH BROOM
Continued on same scale
Creag nam Fiadh
Camas Mór
Ard Loch
Rubha Meallain Bhuidhe
LOCH KANAIRD
R. Kanaird
Buaile Ghlas
Sgeir Mhór
Poll a' Chreadha
Rubha na h-Eighe
Ardmair
Cnoc Breac
Cnoc Moin a' Ghuail
Meall Mór
Allt an t-Srathain
Cnoc na Móine
Morefield
Ullapool River
Loch Achall
Hotel
Masts
Meall Mór
Metres 10000