

Serpulid Reef survey

Linne Mhuirrich, Loch Sween

November 1999

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Serpulid Reef survey in the Linne Mhuirich, Loch Sween

November 6th, 7th and 20th 1999

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Linne Mhuirich Serpulid Reef Survey
November 1999



Plate 1: Relict reef at 2.5 metres



Plate 3: Debris Field at 3 metres

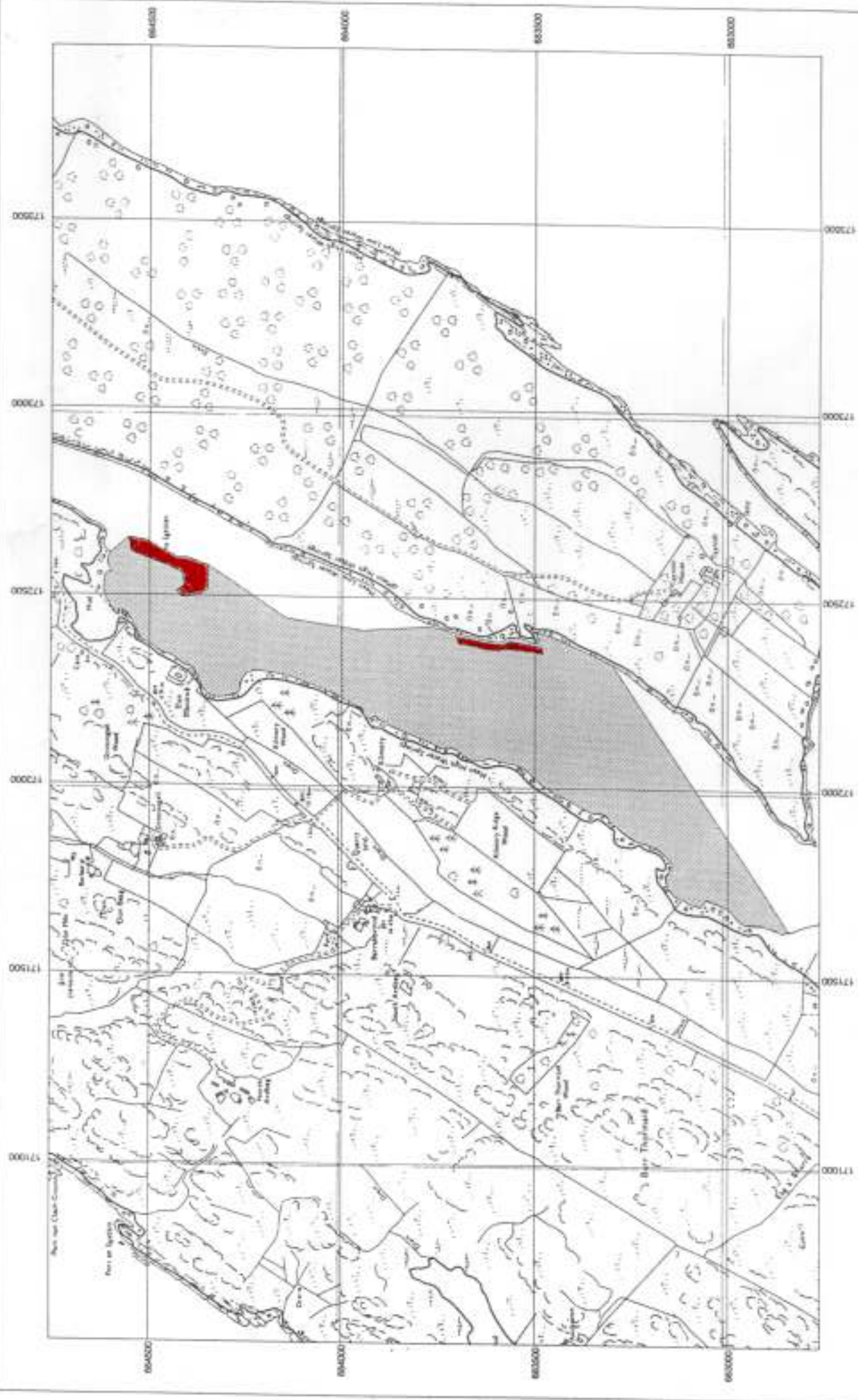
Map 1

*Areas in Linne Mhuirich where reef reefs of *Serpula vermicularis* were encountered during January 1999*

Black stippling shows extent of area studied

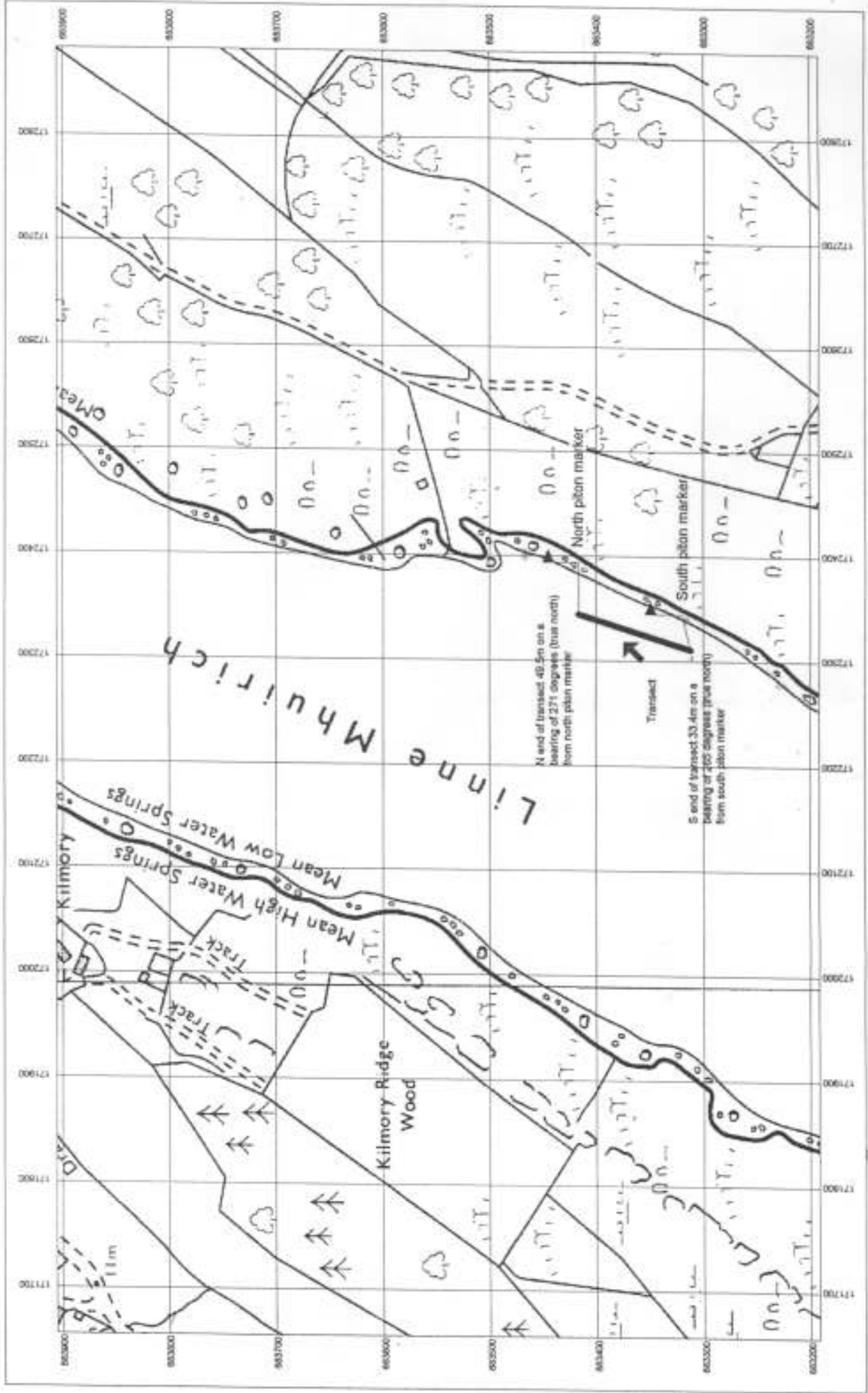
Diagonal red shaded areas show where reefs were encountered
(nb areas are only approximate and reefs sporadically distributed within these)).

Scale 1:14000



Map 2 Linne Mhuirich, showing location of *Ostrea edulis* monitoring transect, January 1999

Scale 1:5000



Based on Fig 4 from Dipper et al 1999

Introduction

1.1 The Linne Mhuirich

The Linne Mhuirich is a shallow side arm of Loch Sween with a maximum charted depth of 13 metres though much of it is less than 5 metres deep. The eastern side of the Linne Mhuirich is bounded by Taynish National Nature Reserve and connects to the main body of Loch Sween via a shallow tidal rapids area. The area is of considerable marine biological interest and has been the subject of numerous scientific surveys dating back to the 19th Century.

The marine littoral and sublittoral communities to be found around the Taynish peninsula are recognised to be of national significance with some features being of international importance- notably the sponge communities in the rapids area, the Serpulid reefs and the native oyster beds present in the main Linne Mhuirich. Protection of these littoral and sub-littoral communities has become a primary management objective for the Taynish NNR. To enable the assessment of recreational and other human impacts it was decided to establish a monitoring program concentrating on the rapids area but also encompassing the native oysters, serpulids and eel grass areas in the Linne Mhuirich.

1.2 Monitoring program

In January 1999 Francis Bunker of marine_ seen was commissioned to carry out initial monitoring work mainly in the rapids area but some work was also carried out in the Linne Mhuirich, (Bunker 1999). No live serpulid reefs were encountered in the area searched though relict reefs were found in two areas (map.1).

The divers also recorded the presence of eel grass (*Zostera marina*) and laid a transect to assess native oyster (*Ostrea .edulis*) abundance, (map 2).

1.3 Serpulid Reefs

These reefs are only recorded from two areas in Scotland, Loch Creran and Loch Sween though recent reports suggest that they may be present in Loch A'choire on the west side of Loch Linnhe. A great deal of work has been carried out in Loch Creran by Dunstaffnage marine laboratory and Heriot-Watt University to map the distribution and health of the reefs present there. The reefs were also included as an Argyll speciality in the biodiversity audit for Argyll and Bute (Selkie Associates 1997) and a biodiversity action plan for the reefs is in the process of being compiled (November 1999, R.Leishman SNH pers.com)

Part of the action plan is expected to include recommendations that further survey work is carried out in Loch Sween to determine the current status of the serpulid reefs there and to investigate the feasibility of translocating reefs from Loch Creran to Loch Sween. The urgency of this work has been increased by proposals to carry out harbour development work at Rubh Garbh, Loch Creran, which is one of the prime sites for Serpulid reefs in the Loch.

During surveys carried out in the Linne Mhuirich in 1993 and 1994 (Paisley 1994) no live reefs were found despite extensive searching. Bunker (1999) found two patches of relict reefs but only searched a relatively small area of the Loch.

The Linne Mhuirich is one of the few sites on the west coast known to be supporting a relatively healthy native oyster population. This has been subject to intermittent collecting for several years though 1998/99 seemed to be a particularly bad year with oysters being collected during and after the January 1999 survey work.

2. Objectives

The following objectives for the survey were given by SNH

To carry out a thorough search of the Linne Mhuirich for evidence of Serpulid reefs in areas which were not surveyed during the Bunker survey.

To carry out a repeat survey along the *Ostrea edulis* monitoring transect laid by Bunker et al in January 1999

3 Methodology

3.1 Timing of the Survey

Survey work was initially scheduled to take place during the weekend October 30/31st but had to be cancelled due to gale force winds and heavy rain. The following weekend proved to be more amenable and much of the survey was carried out over the weekend of the 6/7th November with the oyster transect being surveyed on November 20th.

3.2 Access to site

Access to the site was via the Taynish NNR track as far as the SNH sheds and then down through the field to the shore and an old jetty. The field itself presented few problems but between the field and the shore there was an area of very boggy ground which was impassable to the vehicles available. However enough man power was available to push a trailer laden with diving equipment and boats through the mud and down to the shore. Retrieval of equipment was aided considerably by the presence of an SNH 4WD vehicle. Even with this vehicle it was necessary to tow the trailer from the field to the shore using a tow rope as the soft ground made it impossible to take a vehicle down to the shore.

3.3 Equipment and personnel.

Oban and mid Argyll Scottish Sub-aqua club supplied the personnel necessary for this project. In all 8 volunteers were involved.

Two inflatable boats were hired by OSAC a 3m Avon Redcrest with a 3Hp engine and a larger Avon inflatable with a 4Hp engine. These boats were ideal as both they and their engines were easily carried about. OSAC was also able to provide appropriate safety equipment in the form of an O₂ set and two hand held VHF sets. Additional safety equipment in the form of a first aid kit and mobile phone was provided by O.Paisley the project organiser.

Personnel for the project were as follows:

Project Organiser Owen Paisley

Dive organiser Angie Rowlands

Divers/snorkellers: John Rees, Dave Hewitt, Phil Rowlands, Trish Grey, Kirsti Reid, Anne Longbone and Marilyn Franks

3.4 Position Fixing

Positions were fixed using a Garmin GPS12 (non-differential) hand held unit and then marked on a photocopied 1:10 000 map supplied by SNH. As the GPS used was a non-differential unit there was inevitably a variable error in the positions recorded which could on occasion exceed 100metres but was generally much less.

3.5 Serpulid Reef Survey Methodology

The serpulid survey was carried out by divers operating in pairs swimming parallel to the shore and shadowed by the safety boats. As much of the Linne Mhuirich is very shallow, (< 4 metres) and the in water visibility >5metres the divers spent much of their time swimming face down on the surface only descending to check particularly large aggregations of relict reef or possible live

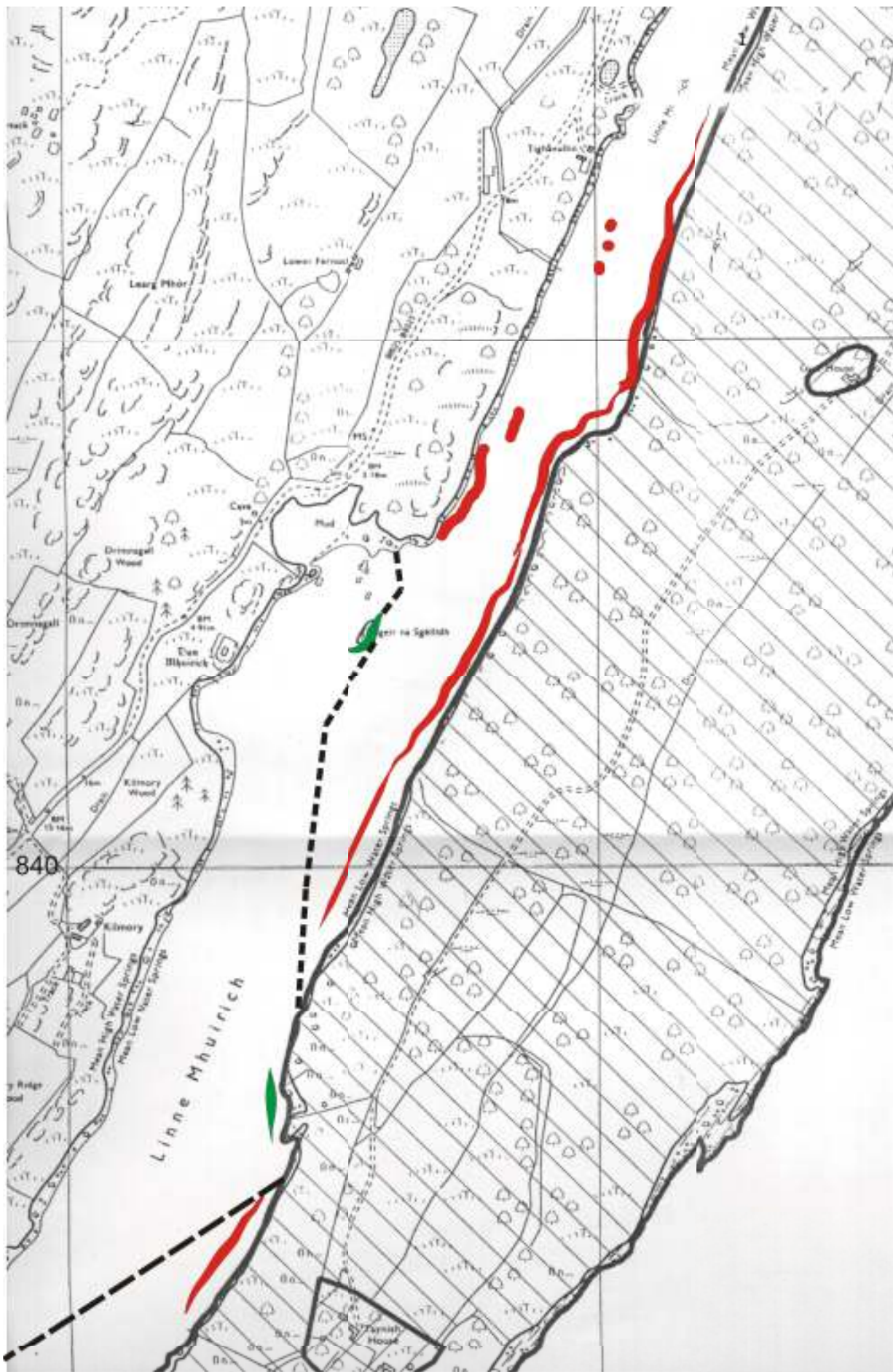
S.vermicularis tubes. When relict reefs or live worms were sighted the divers would inform the cover boats and the position would be recorded using the handheld GPS. For the very shallow southern area of the loch surveying was carried out by a snorkel team.

3.6 Native Oyster Survey Methodology

Bunker et al laid out the *Ostrea edulis* monitoring transect at the position shown on map 2. Either end of the transect was marked by a small cairn while on land nickel chrome molley steel pitons were hammered into supra littoral rocks. GPS readings, photographs and video footage were all taken to aid in re-locating the transect. The transect was 2 metres wide and 108 metres long.

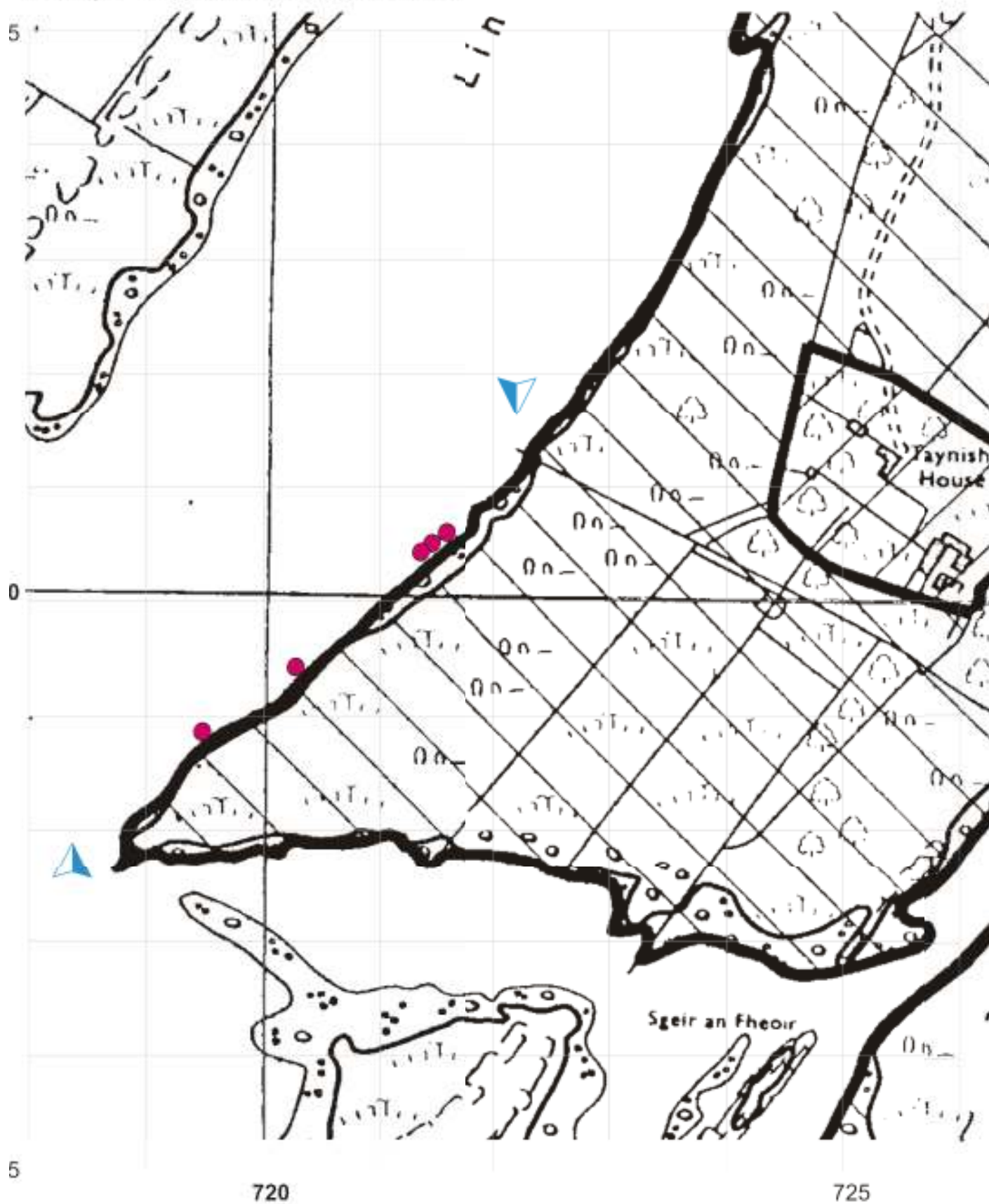
Unfortunately during the present survey no photographs, video footage or GPS readings were available. Only the northern piton was re-located with neither the dive team nor the site management officer being able to re-locate the southern piton. Accordingly the northern end of the transect was started at a distance of 49.5 metres on a bearing of 271 degrees (True) from the northern piton, (as recorded in Bunker 1999) . A small pile of stones was found at this point but as there were several small piles of stones in the vicinity this may or may not have been the original cairn. One hundred and ten metres of 8mm leaded rope transect line was laid out roughly parallel to the shore on the bearing indicated on map 2. At around 108m another small pile of stones was located and this was used as the south end of the transect.

As in the Bunker survey pairs of divers worked with 1m² quadrats and surveyed a continuous belt 1m either side of the transect line. In each quadrat the number of live oysters was counted. The presence of live serpulid worms was also recorded as was the presence/absence of eel grass.



- █ Areas with relict reefs found during January 1999 survey by Bunker (
- Boundary of area surveyed by Dipper et al January 1999
- █ Areas with relict reefs found during current survey

Map 4: Relict serpulid reefs in southern Linne Mhuirrich



KEY



start and end point of survey



area with relict reefs

4. Results

4.1 Serpulid Reefs

The general location of the relict serpulid reefs is shown on maps 3 and 4 while the detailed positions and comments are recorded in the appendices tables 1 to 5 and maps A to D

Relict reefs were found in an almost continuous band along the eastern side of the Linne Mhuirich. Very few were found along the western shore with the exception of the point to the North of Sgeir na Sgeilidh and the shallow rocky reef recorded at (NR 727 847).

Relict reefs were located at various depths. Generally they were in deeper water, 2.5m to 3.5m though a number of smaller clumps were found in shallower water, around 1.5m. Historically, (in the late 1800's) , Loch Creran reefs were known from amongst eel grass beds in water depths of less than 1m. However the present day reefs in Loch Creran are found in a depth band from around 5 metres to 15+metres.

The sea bed topography where relict reefs were located also varied. Most commonly they were found lying in the mud at the boundary between rock or sloping loch sides and the flatter sea bed. Along some stretches extensive areas of relict reef seemed to be lying buried in the mud.

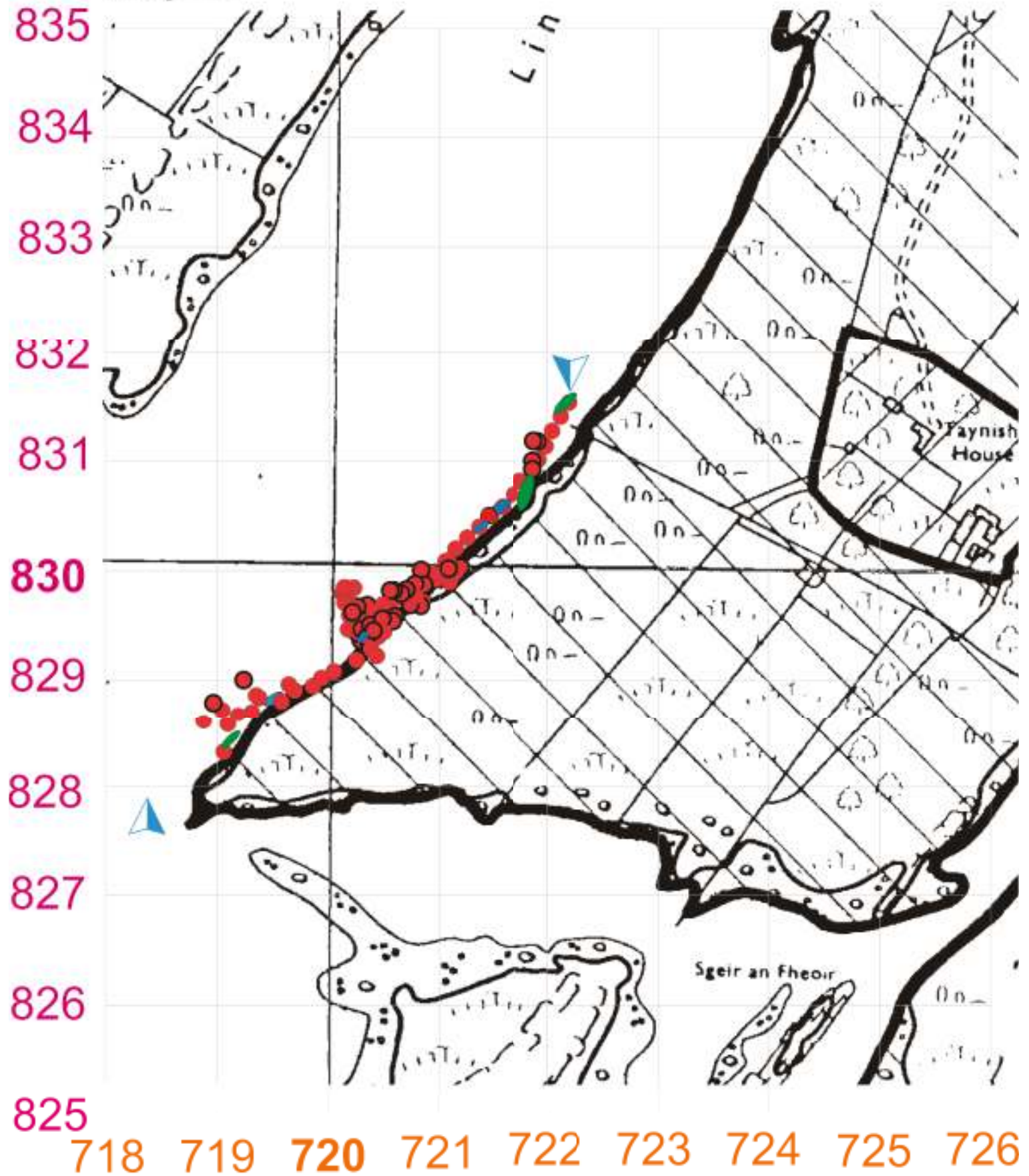
The appearance of a "relict reef" and debris fields are shown in plates 1 and 2.

A number of live serpulid worms were found during the survey and their positions are shown in map 5 and map 6. In the northern part of the Linne Mhuirich, apart from a few instances of two or three worms occurring side by side all the records were of individuals growing on either stones or old oyster shells. No worms were noted growing on relict reefs. These results should be interpreted with caution as none of the divers had been trained in identification skills and it took them some time to "get their eye in". However the map shows those areas where live worms were found.






The greatest density of live serpulid worms were found in a narrow band between the old NCC pier and the approaches to the rapids area. Bunker et al recorded Serpulids as being frequent on cobbles in the vicinity of the oyster transect . The current survey found very few Serpulids along the oyster transect but they were frequent to the south of the transect. Once again the records were virtually all single worms though a few relict reefs were also present in the same area.

Bunker (1999) reported live individuals in two areas surveyed and these areas are also marked on maps 1 and 5.

Map 6:



KEY

-  start and end point of survey
-  approx. position of live Serpulids
-  approx. position of more than one live Serpulid
-  area with relict reefs
-  dense *Zostera* bed

4.2 Native Oysters

At the end of the survey the divers recorded a length of 105 metres which indicates that the transect was not laid in exactly the same position as previously or that it stopped short of the previous transect end. However positioning of the northern end of the transect was as accurate as possible, the depth of the transect , (less than 1metre), was much the same as in Bunker (1999) and the type of sea bed encountered was similar to the previous study. If the transect was not in exactly in the same place as previously it was very close.

The results of the transect are shown in the appendices, Tables 6 and 7. A mean density of 0.72 oysters per m² was recorded , compared to 1.3 per m² recorded by Bunker. The number of oysters per quadrat varied from 0 to 5 (Bunker recorded 0 to 9)

4.3 Zostera marina beds

Several areas of eel grass were noted during the survey with the largest bed being an extensive area at the northern end of the Linne Mhuirich. Eel grass was also abundant in the south eastern area of the loch. Elsewhere there was a fringe of eel grass at a depth of 1 to 1.5 metres around much of the area surveyed. Details of eel grass records are included in tables 1 to 7 in the appendices. Eel grass was also present in the *Ostrea* monitoring transect and is recorded in fig 1.

5. Discussion

5.1 *Serpula vermicularis* reef studies

The main aim of this survey was to determine the current status of Serpulid reefs in the Linne Mhuirich arm of Loch Sween. Divers and snorkellers surveyed all of the arm apart from the area surveyed by Bunker earlier in the year. No live reefs were found and it seems highly unlikely that any still survive within the loch. Relict reefs were common along the eastern shore of the loch both north and south of the area surveyed by Bunker et al. A few solitary live Serpulids were noted in the northern part of the loch but the highest concentration of live worms were found between the old NCC pier and the approaches to the rapids area. Virtually all the live worms were located in very shallow water, around 1m on cobbles, rock or old oyster shells with the highest density recorded around NR 7205 8295. The presence of a few relict reefs in this area alongside frequent live reefs is of interest. This area should be surveyed at annual intervals as it seems the most likely spot for the reefs to re-form.

If at some future date it was decided to translocate serpulid reefs from Loch Creran to the Linne Mhuirich a potential site would be in the deeper water around the point at NR 7295 8480. Relict reefs were common on both sides of the Loch at this point and the deeper water in this area would provide some protection from changes in water quality.

However as there is an apparently healthy population of Serpulid worms in the southern part of the loch it may be that, given sufficient time, the reefs will re-form of their own accord.

5.2 *Ostrea edulis* monitoring transect

The number of oysters recorded was approximately half that recorded in January 1999, (0.72 per m² compared with 1.3 per m²). As has been mentioned there is some doubt that the transect was re-laid in exactly the same position as previously. However the northern end of the transect was located accurately and it is the position of the southern end which was open to doubt. If the records in Tables 6 and 7 are considered it can be seen that most of the oysters seen were recorded in the southern half of the transect (mean density 1.03 m² in the first 100 quadrats) and it was the counts in the northern end of the transect which brought down the mean density to 0.72 per m². As the northern end of the transect was laid accurately this suggests that there has been a genuine drop in native oyster abundance in the transect area.

Native oysters were found in scattered pockets throughout the Linne Mhuirich with some of the highest densities in the less accessible northern area.

5.3 *Zostera marina*

The eel grass beds appear to be healthy with quite large areas found at the northern and south-western ends of the Loch. The abundance and density of eel grass beds seen by the project organiser seem very similar to those noted during previous survey work in 1993 and 1994. More eel grass was recorded in the *Ostrea edulis* transect than previously but this may simply be due to the timing of this survey, autumn rather than mid winter.

6 Conclusions and recommendations

- 1) It is highly unlikely that there are any live *Serpula vermicularis* reefs within the Linne Mhuirrich.
- 2) The highest density of live *S. vermicularis* occurred in the southern part of the Loch between the old NCC pier and the rapids.
- 3) Native Oysters were found throughout the Loch with the highest densities in the less accessible Northern parts of the Loch.
- 4) The mean density of oysters recorded along the monitoring transect was 0.72 per m² compared with 1.3 per m² in the January 1999 survey.
- 5) Extensive and apparently healthy eel grass beds are found at the head of the Linne Mhuirrich and at the southern end.

Recommendations

- 1) The area to the south of the NCC pier should be re-surveyed at annual intervals for any evidence of serpulid reef re-generation.
- 2) If it is decided to attempt translocating reefs from Loch Creran to the Linne Mhuirrich the area around the point at NR 7295 8480 is probably the best site.
- 3) Some difficulty was experienced locating the oyster monitoring transect. The transect should be marked underwater using a dexian frame which should last several years in the sheltered conditions. It would also help if copies of the photographs showing the piton locations were held in the Kilmory office of SNH.

The intensive oyster harvesting taking place in the Linne Mhuirrich over 1999 seems to have effectively halved the oyster density in the study area. In order to detect any future trends the oyster transect should be surveyed on an annual basis with a second transect being installed in the less accessible northern area of the loch.

7 Acknowledgements

I would like to thank the following for their help during the field survey:

Angie Rowlands for organising the diving and ensuring that enough people were present to carry out each days work.

John Halliday of SNH for arriving with a four wheel drive and extricating trailer and diving equipment from the field.

Alistair Davison of SNH for taking the time and trouble to bring me up to date with HSE legislation and its requirements.

The members of the survey team for carrying out the work required of them in often unpleasant conditions. Without their good humoured help this survey would have been impossible. They were: Marilyn Franks, Trish Grey, Dave Hewitt, Anne Longbone, John Rees, Kirsti Reid and Phil Rowlands.

8 References

- Bunker, F.St.P.D (1999) Monitoring within Linne Mhuirich and Rapids in January 1999. A report from marine_seen, Estuary Cottage, Bentlass, Hundleton, Pembrokeshire, SA71 5RN, Wales UK
- Paisley, O (1994) Loch Sween Project Report 1992-1994
- Selkie Associates (1997) Biodiversity in Argyll and Bute-a preliminary audit of priority habitats and species

Appendices

Tables 1-4	Notes and GPS readings for points of interest found during survey of the Linne Mhuirich on the 6 & 7 th November 1999.
Table 5	Notes and GPS readings for points of interest found during survey of the southern Linne Mhuirich on the 20 th November 1999. (See Map 6 for location of survey points)
Table 6	Oyster monitoring – Inshore side of transect
Table 7	Oyster monitoring – Seaward side of transect
Map A	Northern end of Linne Mhuirich showing survey points from Table 1.
Map B	Northern end of Linne Mhuirich showing survey points from Table 2.
Map C	Northern end of Linne Mhuirich showing survey points from Table 3.
Map D	Northern end of Linne Mhuirich showing survey points from Table 4.

Table 1 Saturday 6th November		Surveyors: J.Rees & P.Rowland Time: 11.00 to 12.30
Grid Ref.	Survey points	Comments
73293 85537	1	Start
73304 85535	2	Relatively large no's of live oysters, numerous keel worms
73283 85443	3	O.edulis present
73245 85389	4	First fragment of serpulid reef found
73230 85364	5	Reef remnants, numerous empty oyster shells
73176 85288	6	Live oysters plus some small ones
73160 85248	7	Dead serp clump
73193 85276	8	Serp remains , cobbles and silt
73173 85258	9	Dead serp clump
73139 85208	10	Dead serp clump, oysters
73162 85150	11	Dead serp clump
73138 85167	12	Scattered serp clump
73132 85155	13	At 2.8m depth remnants of a reef scattered over three metres. On soft mud
73119 85120	14	Dead clump, then 25m offshore in 3.3m reef remnant scattered over large area
73100 85085	15	Small clump dead serpulid, inshore another further out in 3.5m
73121 85034	16	Dead serpulid clump
73050 85100	17	Dead serpulid clump inshore, less than 2metres depth
73143 84975	18	Fist sized lumps of dead reef, larger lump at 2.2m
73125 84973	19	2 dead clumps
73113 84963	20	25m offshore-numerous fragments of reef, 2 small lumps inshore
73121 84923	21	Sandy gravel substrate, scattered reef fragments approx. 25m offshore
73123 84917	22	(dyke on shore) 25m offshore area of fragmented reef, O. edulis quite common
73087 84871	23	30 metres offshore-2 live serpulids in 1.9m depth. Zostera inshore
73060 84848	24	Zostera bed to about 40m offshore
73000 84826	25	Serpulid fragments approx. 50m offshore in 1.5m depth
73009 84794	26	Band of fragments between 35-40m offshore in 3m depth
73020 84764	27	Dead serpulid clump
72991 84817 to 72983 84819	28	Dead reef fragments 20+ m offshore
72980 84762	29	Wooden post-end of morning survey

Table 2		Surveyors : D.Hewitt & A. Rowland
Saturday 6th		Time : 14:00 to 15:00
November		
		Point-start of afternoon survey
		3 relict reefs, 15m offshore, 2-3m m deep,
		2 small fragments inshore
		boulder slope, then mud slope leading to flat mud plain-debris field of
		relict reefs at 2-3.5m at the break of slope from the mud slope to the
72975 84789	1	mud plain.
		End of debris field-to south of small point
72900 84656	2	
		Scattered fragments at 2.5 m depth, 20m offshore at edge of boulders/
72897 84598	3	mud boundary
		Stream-light scattering of serpulid reef fragments at 2-3m depth-
72858 84562	4	continuous from above
		Continual fragments at 2.5m -
72834 84494	5	
		Fragments continue to 72700 84200-divers reported "sheets" of
72833 84488	6	serpulid reef buried in the mud along this stretch
		Scattered oysters inshore
72726 84472	7	
		Scattered eel grass
72832 84461	8	
		Half dozen live serpulid worms, 1.5m depth, single on stones or oyster
72804 84381	9	shells
		Single live serpulid, plus two stuck together
72749 84352	10	
		Single live serpulid
72691 84267	11	
		End of survey-wall on rock outcrop-opposite Dun
72700 84200	12	
Table 3		Surveyors: J. Rees & P.Rowland
Sunday 7th		Time: 11:10 to 12:40
November		
		Start of survey, Point North of Sgeir na Sgeilidh
72699 84600	1	Zostera plus numerous O.edulis shells
		Single serpulids, debris patches about 20m offshore in 2.2m water
72710 84618	2	
		10metre strip of debris, 4 live serpulids inshore on stones-sandy gravel
72724 84687	3	seabed
		1 metre diameter debris on muddy bottom-inshore Zostera on mud
72742 84784	4	
		Diver reported a rocky reef running parallel to the shore about 30
		m offshore, top in 1m of water. Continuous band of debris along the
		western side of the reef in 1.5 to 2m of water reef continued to 72865
72870 84829	5	84834-band approx.25m long
		No serpulids-
72958 85009	6	
		In centre of loch, muddy basin in 2m depth with patches of Zostera,
72985 85231	7	inshore continuous Zostera
		Serpulid reef debris about 40m offshore (near centre of loch) , forming
73012 85222	8	3m diameter patches in 2m of water-mud bottom
		House & old quarry. Inshore diver over extensive Zostera-diver 20m
73034 85350	9	offshore over mud
		Extensive Zostera
73162 85528	10	
		End of survey: shallow<1.5metres, mud and Zostera
73250 85700	11	

Table 4		Surveyors: D. Hewitt & T.Grey
Sunday 7th		Time 15:00 to 15:35
November		
72495 83811	1	Small point to North of landing beach-strip of eel grass 5m offshore
72485 83807	2	Steep slope to 4m @ 20m offshore-few fragments to 72?91 83942
72521 83983	3	1 live serpulid-more fragments of old reef
72518 84003	4	From above-continual debris field at 2.6m
72520 84085	5	2 live serpulids
72568 84189	6	Continual debris field from above at 2.5m, several live serpulids along this stretch-end at wall on rock.
		From landing beach south towards rapids-snorkellers found a continual debris field including several intact 30+cm dead reef fans.

Table 5

Surveyors: P.Rowlands, A. Rowlands,

Saturday 20th November 99K. Reid, John Rees, Trish Grey, Anne Longbone and
Marilyn Franks

Point	Co-ordinates		Co-ordinates		Notes
	From	To	From	To	
1	71838	82786			Start of survey, headed north (cobble to approx 1.5m depth then mud)
2	71920	82851	71904	82836	Dense <i>Zostera</i> bed
3	71911	82852			1 live Serpulid (depth approx. 70cm, cobble)
4	71919	82864			1 live Serpulid (depth approx. 50cm, cobble)
5	71906	82829			1 live Serpulid
6	71889	82859			1 live Serpulid
7	71896	82874			2 live Serpulids
8	71902	82869			1 live Serpulid
9	71922	82896			2 live Serpulids
10	71935	82881			1 live Serpulid
11	71932	82869			1 live Serpulid
12	71956	82878			1 live Serpulid
13	71963	82890			1 live Serpulid
14	71958	82883	71948	82877	Serpulid debris band
15	71935	82880			1 live Serpulid
16	71950	82882			Serpulid debris band over 2m ² area
17	71987	82880			1 live Serpulid
18	71993	82898			1 live Serpulid
19	72006	82903			1 live Serpulid
20	72026	82914			1 live Serpulid
21	72035	82928			7 live Serpulids in 1.5m ² area
22	72042	82934			1 live Serpulid
23	72031	82935			Serpulid debris
24	72045	82933			1 live Serpulid
25	72030	82952			1 live Serpulid
26	72025	82954			1 live Serpulid
27	72029	82953			1 live Serpulid
28	72026	82961			2 live Serpulid
29	72018	82942			1 live Serpulid
30	72034	82964			2 live Serpulids
31	72037	82952			1 live Serpulid
32	72024	82950			1 live Serpulid
33	72022	82957			1 live Serpulid
34	72018	82970			1 live Serpulid
35	72023	82980			1 live Serpulid
36	72017	82980			1 live Serpulid
37	72016	82979			1 live Serpulid
38	72013	82973			1 live Serpulid
39	72018	82966			1 live Serpulid
40	72020	82966			Large pieces of Serpulid debris
41	72021	82956			7 live Serpulids in 3m ² area
42	72056	82946			3 live Serpulids in 1m ² area
43	72030	82941			1 live Serpulid every 0.5m ² along 30m (approx.) band
44	72030	82937			4 live Serpulids
45	72028	82941			4 live Serpulids in 1m ² area
46	72039	82944			4 live Serpulids in 1m ² area
47	72048	82944			1 live Serpulid
48	72049	82950			3 live Serpulids in 0.5m ² area
49	72055	82951			2 live Serpulid
50	72059	82955			2 live Serpulids
51	72042	82918			1 live Serpulid
52	72039	82924			1 live Serpulid
53	72034	82933			2 live Serpulids
54	72034	82946			3 live Serpulids
55	72040	82957			1 live Serpulid
56	72045	82962			1 live Serpulid
57	72056	82977			2 live Serpulids on bolder
58	72059	82977			4 live Serpulids on bolder
59	72066	82978			4 live Serpulids in 0.5m ² area

60	72069	82975			1 live Serpulid
61	72069	82979			4 live Serpulids in 0.5m ² area
62	72075	82975			1 live Serpulid
63	72072	82966			2 live Serpulids
64	72074	82974			1 live Serpulid
65	72076	82984			3 live Serpulids
66	72084	82982			3 live Serpulids on live oyster
67	72081	82997			2 live Serpulids on live oyster
68	72091	82993			1 live Serpulid
69	72097	82989			1 live Serpulid
70	72108	83002			1 live Serpulid
71	72117	82995			1 live Serpulid
72	72119	82989			3 live Serpulids in 0.5m ² area
73	72110	82984			1 live Serpulid
74	72110	82970			3 live Serpulids in 0.5m ² area
75	72082	82963			2 live Serpulids on bolder
76	72085	82966			1 live Serpulid
77	72105	83005	72209	83141	2 to 3 live Serpulids every 1m ² along band (with odd denser areas as noted below)
78	72137	83039			Serpulid debris
79	72143	83047			Large dead Serpulid vase
80	72143	83047	72160	83059	Serpulid debris band
81	72185	83081	72176	83053	Dense <i>Zostera</i> bed
82	72187	83089			6 live Serpulids in 1m ² area
83	72188	83097			8 live Serpulids in 1m ² area
84	72189	83115			5 live Serpulids in 1m ² area
85	72190	83115			4 live Serpulids
86	72214	83155	72209	83141	Dense <i>Zostera</i> bed
87	72214	83155			End of survey (old stone dyke leads into water)

Co-ordinates		Notes
72025	82612	Snorkel survey of southwestern area of Linne Mhuirich to the southern boundary of area surveyed by Dipper et al. Soft mud at the start.
72021	82545	Dense <i>Zostera</i> bed
72011	82528	Dense <i>Zostera</i> bed
72023	82494	Dense <i>Zostera</i> bed
72025	82490	Dense <i>Zostera</i> bed
71886	82422	Dense <i>Zostera</i> bed
71821	82429	Dense <i>Zostera</i> bed
71788	82426	Dense <i>Zostera</i> bed
71718	82942	End of survey – no Serpulids found (either debris or live)

Table 6 Oyster monitoring-inshore side of transect(Zost) indicates *Zostera marina* present in quadrat(Serpula) indicates *Serpula vermicularis* present

Quadrat No	No of Oysters	Quadrat No	No of Oysters	Quadrat No	No of Oysters
1	1 (Zost)	37	4	73	0 (Zost)
2	2 (Zost)	38	3	74	0 (Zost)
3	5 (Zost)	39	0	75	0 (Zost)
4	4 (Zost)	40	1	76	0 (Zost)
5	0	41	0	77	0 (Zost)
6	1	42	4	78	0 (Zost)
7	1	43	2	79	0 (Zost)
8	0	44	2	80	0 (Zost)
9	1	45	2	81	0 (Zost)
10	1	46	2	82	0 (Zost)
11	3	47	1	83	0 (Zost)
12	0	48	1	84	0 (Zost)
13	0	49	1	85	0 (Zost)
14	2	50	0	86	0
15	2	51	0	87	0
16	0	52	1	88	0
17	0	53	5	89	0
18	0	54	1	90	4 (1 Serpula)
19	0	55	1	91	1
20	0	56	1	92	0
21	0	57	2 (1 Serpula)	93	0
22	0	58	2	94	1
23	0	59	0 (Zost)	95	0 (Zost)
24	0	60	0 (Zost)	96	1 (Zost)
25	0	61	0 (Zost)	97	1 (Zost)
26	0	62	0 (Zost)	98	0 (Zost)
27	0	63	0 (Zost)	99	1
28	4	64	0 (Zost)	100	0
29	1	65	0 (Zost)	101	0
30	1	66	0 (Zost)	102	0 (1 Serpula)
31	0	67	0 (Zost)	103	1
32	0	68	0 (Zost)	104	5
33	0	69	0 (Zost)	105	0
34	5	70	0 (Zost)	106	
35	0	71	0 (Zost)	107	
36	3	72	0 (Zost)	108	

Sub total**37****36****15**

Total oysters found along the inshore side of the transect = 88

Mean Density of Oysters 0.84

Table 7 Oyster monitoring-seaward side of transect

(Zost) indicates *Zostera marina* present in quadrat

(Serpula) indicates *Serpula vermicularis* present

Quadrat No No of Oysters Quadrat No No of Oysters Qquadrat No No of Oysters

1	1 (Zost)	37	1 (Zost)	73	0 (Zost)
2	1 (Zost)	38	2 (Zost)	74	0 (Zost)
3	0 (Zost)	39	1 (Zost)	75	0 (Zost)
4	0 (Zost)	40	1	76	1 (Zost)
5	5 (Zost)	41	2	77	0 (Zost)
6	2 (Zost)	42	3 (Zost)	78	0 (Zost)
7	0 (Zost)	43	0 (Zost)	79	0 (Zost)
8	0 (Zost)	44	1 (Zost)	80	0 (Zost)
9	0 (Zost)	45	1 (Zost)	81	0 (Zost)
10	2 (Zost)	46	1 (Zost)	82	0 (Zost)
11	0 (Zost)	47	2 (Zost)	83	0 (Zost)
12	1 (Zost)	48	0 (Zost)	84	0 (Zost)
13	2 (Zost)	49	2 (Zost)	85	0 (Zost)
14	0 (Zost)	50	3 (Zost)	86	2
15	1 (Zost)	51	0 (Zost)	87	1
16	0 (Zost)	52	1	88	0
17	1 (Zost)	53	1	89	0
	0	54	1 (Zost)	90	0
18					
19	0	55	3 (Zost)	91	0
20	0 (Zost)	56	0 (Zost)	92	0
21	0	57	1 (Zost)	93	0
22	0 (Zost)	58	0	94	0 (Zost)
23	1 (Zost)	59	0	95	2 (Zost)
24	1 (Zost)	60	0 (Zost)	96	1 (Zost)
25	1	61	0 (Zost)	97	1 (Zost)
26	0	62	0 (Zost)	98	0 (Zost)
27	1	63	0 (Zost)	99	1 (Zost)
28	0	64	0 (Zost)	100	1
29	0	65	0 (Zost)	101	0
30	3	66	0 (Zost)	102	0
31	0	67	0 (Zost)	103	0
32	0 (Zost)	68	0 (Zost)	104	1
33	1 (Zost)	69	0 (Zost)	105	3
34	0 (Zost)	70	0 (Zost)	106	
35	0	71	0 (Zost)	107	
36	0 (Zost)	72	0 (Zost)	108	

Sub-Total Oysters 24

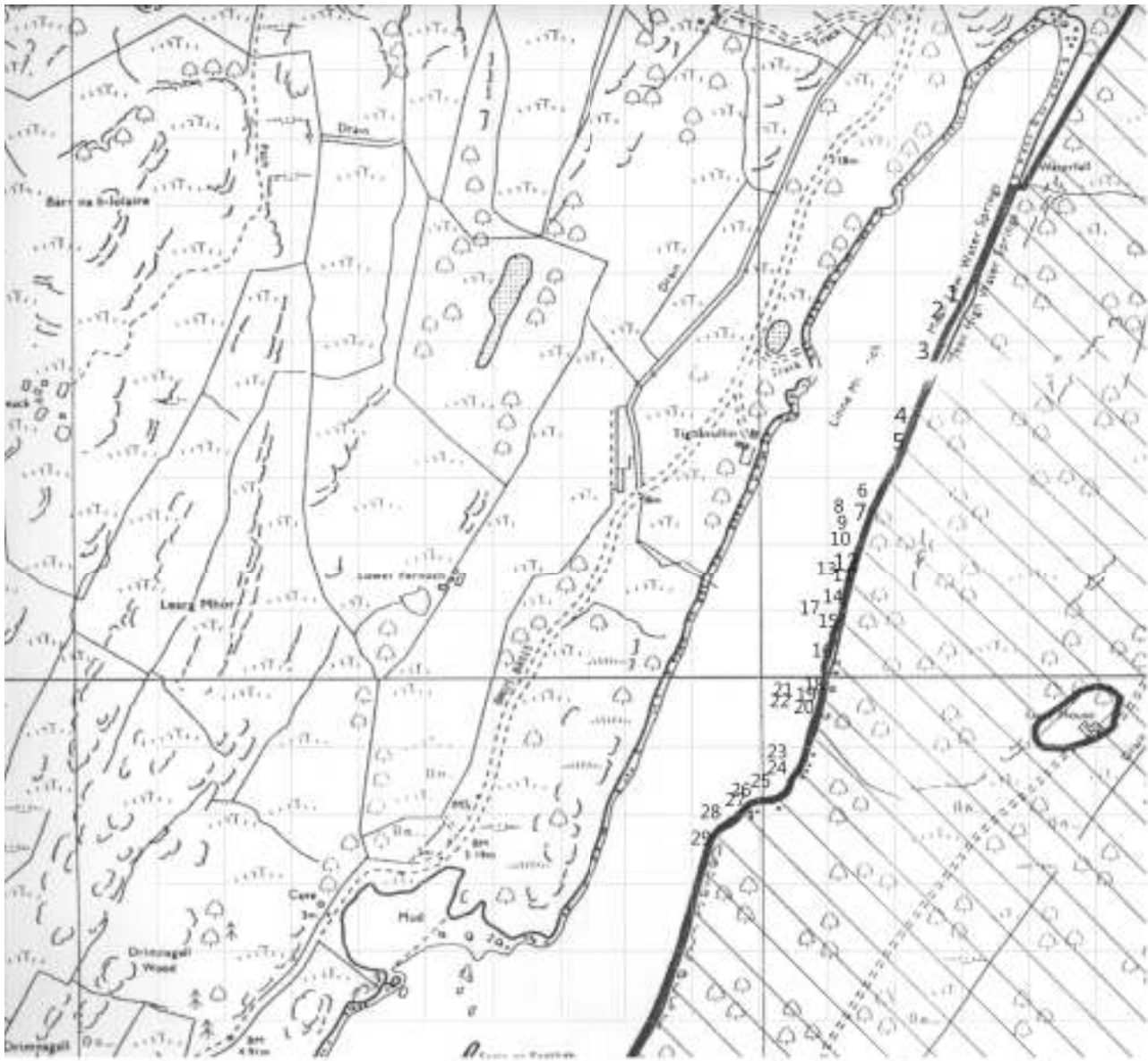
27

13

Total No of Oysters found along the seaward transect = 64

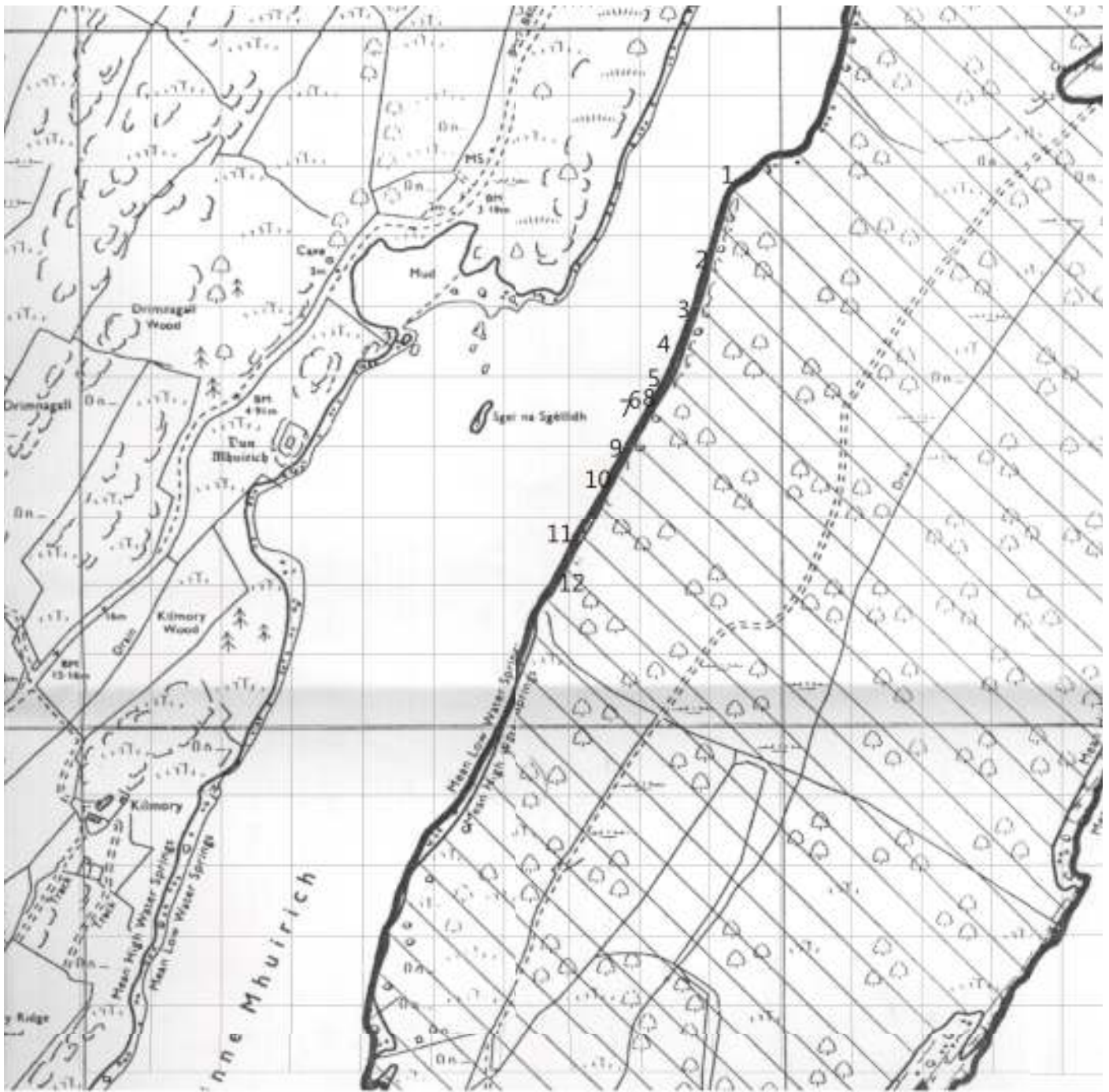
Mean Density 0.61 oysters per m²

Overall mean density of Oysters 0.72 per m²

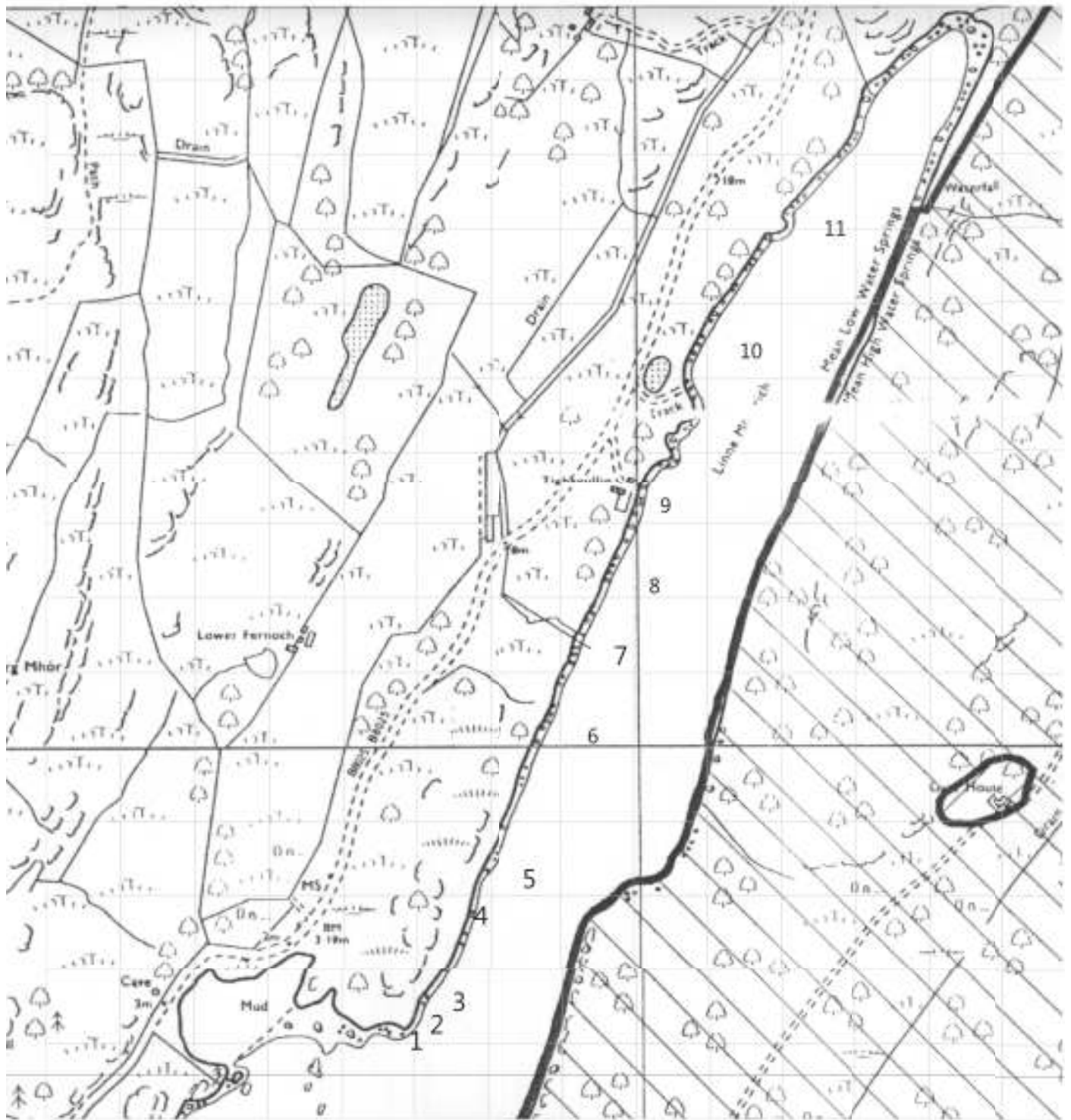


Map A:

Northern end of Linne Mhuirrich showing survey points from Table 1

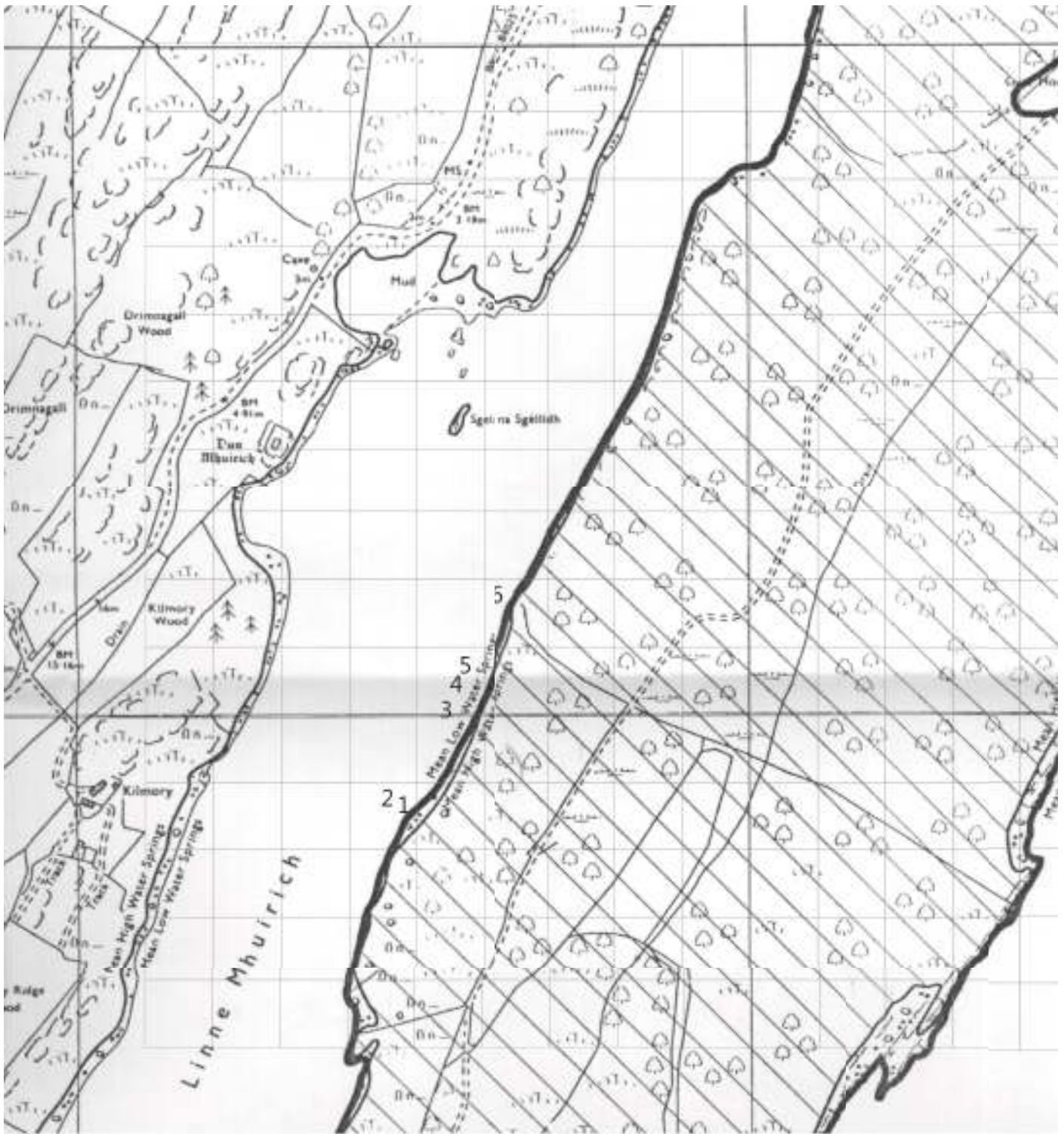


Map B:
 Mid Linne Mhuirich showing survey points from Table 2



Map C:

Northern End of Linne Mhuirich showing survey points from Table 3



Map D:
 Mid Linne Mhuirich showing survey points from table 4