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SURVEY OF IRISH LAGOONS, 1998

Volume I Part 2

Edited by Brenda Healy

Contents

Contributions by: Cilian Roden (Vegetation)
Geoff Oliver (Aquatic Fauna)
Jervis Good (Ecotonal Coleoptera)

INTRODUCTION

This volume contains the reports of the 16 lagoons surveyed in 1998. Their positions are shown on the map (Fig. 1) and Table 1.

These reports supplement those written for the 20 lagoons surveyed in 1996. The total of 36 lagoons constitutes over a third of all Irish lagoons identified. Volume I part 1 contains a summary of the survey results, a classification of Irish lagoons, and discussion of their scientific value in national and international terms.

For each site report, there is a general description of the lagoon, and separate accounts by different members of the survey team on Vegetation, Aquatic Fauna, and Ecotonal Coleoptera. Impressions of the sites sometimes differ between authors. The editor has made no attempt to reach an agreed interpretation of the history, hydrology or likely future for each site, believing that each author makes valid points. Each account ends with a short assessment of the scientific value of the site. A final evaluation of each site, taking into account all the different aspects investigated, is given in Volume I Part 1.

Full descriptions of vegetation units can be found in Volume III, together with complete species lists. For aquatic fauna, a list of lagoonal specialist species and a complete species list for all 36 sites is given in Volume IV. Volume V provides more details on ecotonal Coleoptera. Descriptions of the habitats occurring in Irish lagoons and their characteristic flora and fauna are given in Volume I Part 1.

Interpretation of maps

The maps in this volume are reproduced from Volumes III and IV. They are based on OS 6" maps with the km grid added. As some of the maps are old, modifications were sometimes necessary. They were made using aerial photographs and on-site GPS readings. In some cases the latter did not correspond precisely to map outlines. The names of lagoons are as shown on OS 1:50 000 maps (Discovery Series) and grid references are for the centre of the lagoon. Irish names are used for lagoons in the Gaelteacht.

The vegetation maps show positions of relevés and snorkelling paths in green and salinities, measured during faunal surveys, in red. The colour codes for the benthic and marginal vegetation types are given at the end of this volume. Positions of aquatic faunal sampling stations are also shown on the vegetation location map. The precise position of faunal stations is shown on the location map for the aquatic faunal surveys. Positions of marginal beetle sampling stations are explained in the text.

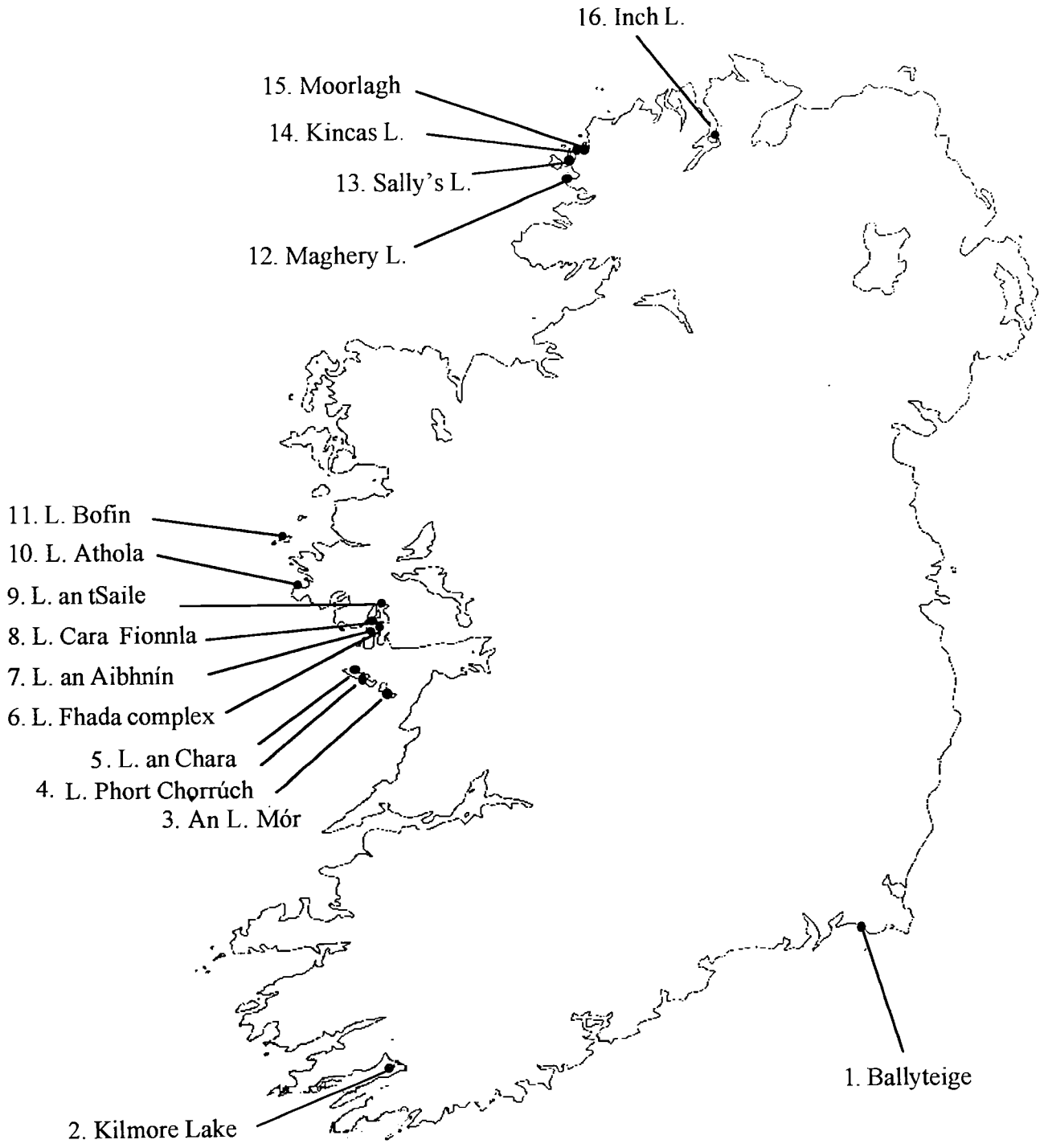

Fig. 1. Location map of the 16 sites surveyed in 1998.

Table 1. Sites selected for survey in 1998. Loch an Ghadaí and the upper pools were studied as part of the L. Fhada complex. Cara na gCaorach was sampled briefly as part of Cara Fionnla.

Lagoon	County	Map No.	Grid ref.	Nearest town or village
Ballyteige drainage channels	Wexford	77	T 9506	Kilmore Quay
Kilmore Lake, Whiddy Is.	Cork	85	V 8548	Bantry
Loch Mór	Galway	51	L 9802	Inis Oírr
Loch Phort an Chorrúch,	Galway	51	L 8511	Árainn
Loch an Chara	Galway	51	L 8810	Árainn
Loch Fhada	Galway	45	L 9330	Cheathrú Rua Thuaidh
L. Fhada upper pools	Galway	45	L 9531	Cheathrú Rua Thuaidh
Loch an Ghadaí	Galway	45	L 9330	Cheathrú Rua Thuaidh
Loch an Aibhnín	Galway	45	L 9431	Muiceanach idir Dha Sháile
Loch Cara Fionnla	Galway	45	L 9628	Casla
(Cara na gCaorach)	Galway	45	M 9631	Cinn Mhara
Loch an tSáile	Galway	45	L 9539	Scriob
Lough Athola	Galway	44	L 6348	Clifden
Lough Bofin	Galway	37	L 5265	Inishbofin
Maghery Lough	Donegal	1	G 7209	Dunglow
Sally's Lough	Donegal	1	B 7216	Burtonport
Kinkas Lough	Donegal	1	B 7920	Kincaslough
Moorlagh	Donegal	1	B 7919	Annagary
Inch Lough	Donegal	6	C 3427	Buncrana

SURVEY METHODS

Vegetation

Sampling

Each lake was visited briefly during a preliminary survey in June/July 1998. A more detailed survey was carried out in August-September, 1998.

Sublittoral vegetation was examined by snorkelling through each lake. As little vegetation was found below 5m, this method was sufficient to obtain an impression of the sub littoral diversity of each site. For every subjectively recognised vegetation type, a species list was made from a 2 x 2m area. A rough sketch map was then made of the distribution of vegetation. Data was recorded on a plastic slate. Voucher specimens were collected and examined later. The limitations of this method include the difficulty of making detailed species lists or observations at depths greater than 2m. It was also difficult to determine the exact position of each sample, as maps could not be carried or extensive notes made. Equally, salinity readings could not be taken when snorkelling, therefore in this account, the accurate data obtained by Mr. G. Oliver are used. These readings are presented on the maps which show the locations of sampling points. This procedure is justified because on most occasions the botanical and zoological surveys were carried out at same time. The advantage of the method is that it permitted large areas to be examined and even remote sites could be easily reached without the need to transport diving equipment such as regulators or bottles.

At each site a plankton sample was collected using a 30 μm mesh net. The plankton was then preserved in Lugol's iodine for later examination.

Marginal vegetation was surveyed by first examining aerial photographs, and then exploring the lake perimeter on foot (except in the case of Loch a tSáile, where only part of the lake was examined due to its very large size). 1 x 1m relevés were made of each of the different

types of vegetation that were seen. A sketch map of the major vegetation types was then made.

Site photographs and underwater photographs were taken where possible but in general it was found that underwater photography was very difficult due to the quantity of suspended material in lagoon water.

Identification

Most species identifications were easily made using standard floras (Clapham, Tutin, Moore 1987; Seaweeds of the British Isles 1985-1993, Moore 1986, Tomas 1996, Dodge 1982). However certain groups presented difficulties:

Ruppia. The two species of *Ruppia, R. maritima* and *R.cirrhosa* can supposedly be distinguished on the basis of vegetative characters (Verhoeven 1979), however Preston (1995) states that in British or Irish material this is not possible and fruiting material is necessary. An analysis of material collected during this survey conformed to Preston's opinion and no correlation could be found between leaf shape and fruit or peduncle morphology in many cases. An exception was the material collected in Loch an Aibhnín where plants with obvious *R. cirrhosa* fruits also had broad blunt leaves. For this reason no attempt was made to identify non-flowering *Ruppia* to species. The variety termed *R. maritima* var. *brevirostris* (Verhoeven, 1979) with very short fruit stalks was found at Inch and Ballyteige. Voucher specimens were collected from all fruiting populations and these are currently being studied by C.D. Preston.

Potamogeton. Only one species, the easily recognised *P. pectinatus* was frequently encountered. An unusual form of what is thought to be *P. pectinatus* is currently being examined by Mr. Preston. It was found at two sites and probably corresponds to var. *flabellatus.*

Cladophora. Samples of this difficult genus were collected and preserved in 70% alcohol whenever encountered. This material was examined by microscope and provisionally sorted into different groups. An attempt was made to name the forms that had been recognised. The European expert Prof.. C Van den Hoek kindly agreed to examine some of the material, especially samples thought to be the rare *C. battersii.* These, along with examples of the other groupings were sent to Prof. Van den Hoek who confirmed the identity of *C. battersii* and named specimens of the other groupings. All the drift *Cladophora* collected were thought to belong to a single species and Prof. Van den Hoek determined two samples from this grouping to be *Cladophora vagabunda.* On this basis all the drift material in the lagoons is assumed to be *C. vagabunda* but it must be stressed that this material is at times impossible to name without culture studies (Van den Hoek 1963) so only the material confirmed as *C. vagabunda* by Prof. Van den Hoek should be formally accepted as such.

Chara. In general material in this genus was easily recognised and the identification was confirmed by Mr. James Ryan of Dúchas. However some difficulty in separating *C. aspera* from *C. baltica* was encountered. It is possible that some *C. baltica* plants seen in the field were assumed to be *C. aspera.*

Enteromorpha. Material in this genus is common in lagoons. As in the case of *Cladophora,* samples were collected, preserved in 70% alcohol, and later examined under the microscope. However very little variation could be seen and provisionally nearly all the material was identified as *E. intestinalis,* a widespread and common taxon.

Red algae. The majority of the taxa found were identified without difficulty but Prof. M. Guiry of N.U.I.G. kindly determined those specimens which presented difficulties.

An unusual calcareous secretion was found at 5m depth from An Loch Mór, Inish Oírr, Co. Galway. When this was examined microscopically it was found to include some species of endolithic green algae but the identity of the algae which produced the calcareous nodules could not be determined. At present samples are being examined by Dr. Marcos Gektidis, Geologisch Palaeontologisches Institut, Germany.

Data presentation and analysis

For each site sample points and snorkelling paths are shown on a map carrying the Irish National Grid. From this map the location of each sampling point is read. A brief account of the sampling points is presented. A list of all species found at each point is given in the appropriate vegetation table in Volume III. In these tables sampling points are identified by a site name and sampling point number, e.g. Maghery 5. Species abundance is given using the Braun-Blanquet scale.

The species data was entered onto a computer based spreadsheet and an attempt was made to identify species groupings using the general principles of the Zurich- Montpellier school of vegetation analysis. The previous work of Verhoeven (1980) on *Ruppia* communities and Wymer (1984) on salt marshes was used as a general guide to likely vegetation units. All the data is available on computer disc and it would be possible to analyse it using statistical analysis or PCA packages, in order to objectively define vegetation units.

No attempt was made to classify the seaweed or plankton data, in part because recognised classifications of this vegetation are not commonly in use, but mainly because insufficient data was collected. However seaweed data is compared to the biotope list prepared by Covey and Thorpe (1994) for Scottish Lagoons.

For each site, maps of the major vegetation units are presented but it must be emphasised that these are more sketch maps than accurate representations, as they were based on rapid surveys using simple techniques. Where marginal vegetation forms a band less than 5m in width along the shore, it is not shown on the vegetation maps. Colour codes for benthic and marginal vegetation are given at the end of this volume.

An assessment of the sites was made based on the presence and extent of plant communities and rare species.

Nomenclature follows Scannell and Synott (1987) for vascular plants, Guiry (1997) for seaweeds, Stewart and Church (1992) for charophytes and Tomas (1996) for marine plankton.

Aquatic fauna

Sampling

A number of sampling stations were selected at each site to reflect the influences of substrate, vegetation, freshwater and tidal inflows. Positions of stations were determined using a GPS Personal Navigator (Global Positioning Satellite, Garmin GPS 45). Makers of the GPS claim accuracy of 10m although on occasions this degree of accuracy was not achieved, possibly due to poor satellite coverage. When there is doubt about the accuracy of the position of the sampling station, this is marked on the map with a question mark. Names and spellings used were taken from the Discovery Series 1:50,000 O.S. map and grid references for each site refer to the centre of the site. Names often differ on other maps and a full list of alternative names is given in the relevant sections of Vol. I, Part 2 of this report. Sketch maps of each site were based on scanned sections of O.S. 6" maps with an overlaid 1 km grid, updated when necessary using aerial photographs and field observations.

At each sampling station, the depth of water and substrate type were recorded, salinity to a depth of up to 5m was measured using a conductivity meter (WTW LF330), and additional readings by other members of the survey team were made using a salinity refractometer (No. 1270, Chemlab, U.K., precision 1 ppt). Tidal exchange was estimated and a photographic record was made of the site whenever practical and local information sought concerning background and recent history.

Sampling at each station was mostly confined to depths of less than 1m, but additional samples were also collected by snorkelling and dredging with a grapnel from an inflatable dinghy. Faunal samples were collected by a combination of sweep-netting (0.5 mm. mesh),

sieving of sediment (1 mm. mesh) and close inspection of stones and vegetation for one hour at each station. Perspex light-traps were left overnight at certain stations: These consisted of a Perspex box (25x25x25 cm) containing a chemical light (Starlight). The boxes were constructed in the Zoology Dept. at U.C.D., according to the model described by Holmes and O'Connor (1988). Faunal samples were preserved in 70% alcohol and stored for subsequent sorting and identification. Examples of certain species (e.g. hydrobiids, cnidarians) were necessary in order to complete the species lists and be better informed as to which sites were the most important to protect and conserve.

Fyke nets were used at certain stations when water depth allowed. Standard procedure was that followed by Moriarty (1975) and Poole (1994). The nets used are referred to as summer fyke nets and consist of two 3m traps, facing each other, joined by a 6m leader net, mesh size 16mm. The trap at each end consists of two chambers and a cod end with knot-to-knot mesh sizes of 16, 12 and 10 mm., respectively. Nets were generally placed at right angles to freshwater inflows or tidal inlets in order to trap fish swimming from either direction, although this was not always possible, due to either strong winds or tidal flows. Unless the water body was particularly small and the likelihood of trapping otters (*Lutra lutra*) was particularly high, nets were set in the evening, left overnight, and retrieved the following morning. A maximum of 2 nets was used on a maximum of two consecutive days in each lake. A small number of individuals were retained for identification purposes and some were damaged or killed as a result of trapping, but unless otherwise stated all individuals were returned alive, immediately following retrieval of the nets.

Identification

Nomenclature used in results for most of the marine fauna are those according to Hayward and Ryland (1995) and Howson and Picton (1997) when not listed in the former. Other nomenclature used are those according to Costello et al. , 1989 (Amphipoda), Savage, 1989 (Hemiptera), Anderson et al., 1997 (Coleoptera), Macan, 1977 and Kerney, 1976 (freshwater pulmonates). Certain groups were identified or certain species verified by relevant specialists: Polychaeta (B. O'Connor), Isopoda (S. deGrave), Amphipoda (J. O'Brien), Mysidacea, Decapoda (D. McGrath). Hemiptera (B. Nelson, M. Speight), Ephemeroptera (M. Kelly-Quinn), Coleoptera (G. Foster, Balfour Brown Club) Mollusca (S. Smith, E. Moorkens).

Ecological categories

Tables showing species recorded at each station use an approximate abundancy scale of present, occasional, common and abundant based on observations only. Quantitative figures are given for light traps. Species are divided into broad ecological groups as follows:

1. **Marine:** more or less stenohaline, not known to be tolerant of reduced salinity.
2. **Marine/ polyhaline:** species of intertidal and estuarine habitats, known to have some tolerance to reduced salinity.
3. **Poly/mesohaline:** brackish species in the high salinity range 15-30ppt.
4. **Euryhaline:** species able to tolereate the full salinity range from 0-35ppt.
5. **Meso/oligohaline:** brackish species in the low salinity range of 0-15ppt.
6. **Oligohaline/limnetic:** freshwater species known to tolerate low salinities.
7. **Limnetic:** not known to tolerate saline conditions.

Ecotonal Coleoptera

Sampling

The sampled areas were generally those most influenced by seawater, because the emphasis of the survey was marine. These areas were mostly associated with the barrier and outer parts of the lagoon or lake shores; the inflow marshes were not sampled. Four sampling

methods were used: (1) Suction sampling using a Stihl® BR 400 suction apparatus, mounted on the operator's back. This machine (referred to as an 'S-vac' to distinguish it from the 'D-vac' suction sampler) has a suction pipe of 58 mm diameter (0.0026 m^2 surface area). Six subsamples within a defined vegetation type of 100 x 1.5 sec. 'sucks' per subsample were taken at each site, resulting in a total area of 1.56 m^2 covered. Because the hand-held pipe was shaken when the apex of the pipe was in the vegetation, a larger area (c. 2 m^2) was effectively sampled. (2) Six plastic cup pitfall traps with undiluted ethylene glycol (commercial anti-freeze) as preservative. (3) Ground search turning cobbles (n = 30 / sample). (4) Flotation of beetles in sand or soil in a bucket of water, in areas of potentially suitable *Bledius* habitat (16 samples of c. 100 cm^2 x 8 cm depth) (see Good in press). An equivalent sampling effort was used at each site, except where suitable microhabitats were not available for ground search or flotation.

Salinity measurements were taken using a portable salinity refractometer, calibrated using distilled water.

Indicators

Species were selected as indicators of well-developed habitat if: (1) they have a restricted habitat preference to the types of microhabitat associated with the lagoon shores; and, (2) they are reported in the literature as being local or rare, from which it is assumed that they are less likely to survive in historically degraded ecosystems. By 'well-developed habitat' it is meant that the ecosystem is sufficiently undisturbed by human activity to allow it to retain many local or rare stenotopic species. The presence of two or more indicator species, likely to breed in the shoreline habitats sampled, is considered an indication of habitat quality (see Good and Speight, 1991).

Nomenclature of Coleoptera follows Anderson *et al.* (1997). Plant nomenclature follows Webb *et al.* (1996). Voucher specimens of a number of species have been deposited in the National Museum of Ireland, and other species have been retained in the author's collection.

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1. BALLYTEIGE DRAINAGE CHANNELS Co. Wexford

Ballyteige (Ballyteigue) Slob.

Location: S 955060; 52°12.0'N, 6°37.0'W. OS Sheet 77
Ballyteige Slob, 2-3 km north-west of Kilmore Quay, Co. Wexford. Only channels in the area bounded by the Ballyteige Burrow, Cull Bank, Killag Slob and the road running north from Kilmore Quay to Baldwinstown have been sampled.

Lagoon type	polder drainage channels
Area	ca 5 ha (as far as first road bridge)
Salinity	0-31‰ (including the Cull Lake)
Maximum depth	3 m
Seawater entry	percolation through dune barrier, entry through sluice and unsluiced artificial canal
Tidal range	none
Conservation status	pcSAC (dunes and Cull), SPA No. 1, NHA No. 0696

Origin and history

The main drainage channel replaces a former tidal creek which drained an enclosed bay known as Ballyteige Lough. A report to the Drainage Commission in the last century (Russell 1844) describes a vast area of tidal mudlands bordered by lands "liable to frequent and injurious floods", lying behind a range of sandhills called the Burrow of Ballyteige. The Cull Inlet which connected the lough with the sea was then much narrower than it is today, but it was navigable at high tide as far as Lacken. The tidal range in the lough was only 3 feet compared with 10-12 feet outside. As a number of small rivers flowed into the lough it was brackish at the time (occasionally even freshwater according to Russell), but possibly too tidal to be called a lagoon according to our definition.

Marshland and areas of open water extended inland along the Bridgetown, Baldwinstown and Muchtown rivers and it was estimated that 2845 statute acres (1152 ha) of the land were capable of being drained, reclaimed and improved. Orford and Carter (1982) estimated the area of Ballyteige Lough before reclamation to have been about 1500 ha. Russell's recommendations for the drainage scheme were ambitious by modern standards. They involved not only construction of the present Cull Bank, with a number of outlet pipes controlled by a pumping station, but also excavation of a new channel from Bridgetown to Blackstone at the mouth of the Duncormick River as it enters the Cull, a distance of nearly 7 km, which would reduce the amount of freshwater entering the lough area. The total cost of the scheme was estimated to be £15,650 4s 9d. These projects were subsequently carried out, and a channel running towards a sluiced outfall just west of Kilmore Quay was also excavated, although Russell had not recommended it.

The map which accompanied Russell's report (Fig 2) shows a natural creek running along the inward edge of the dunes which persists to this day (called here the seepage channel), although it is periodically deepened. It now receives percolating seawater, but Russell could find no evidence of seawater penetration through the dunes. This probably occurred only

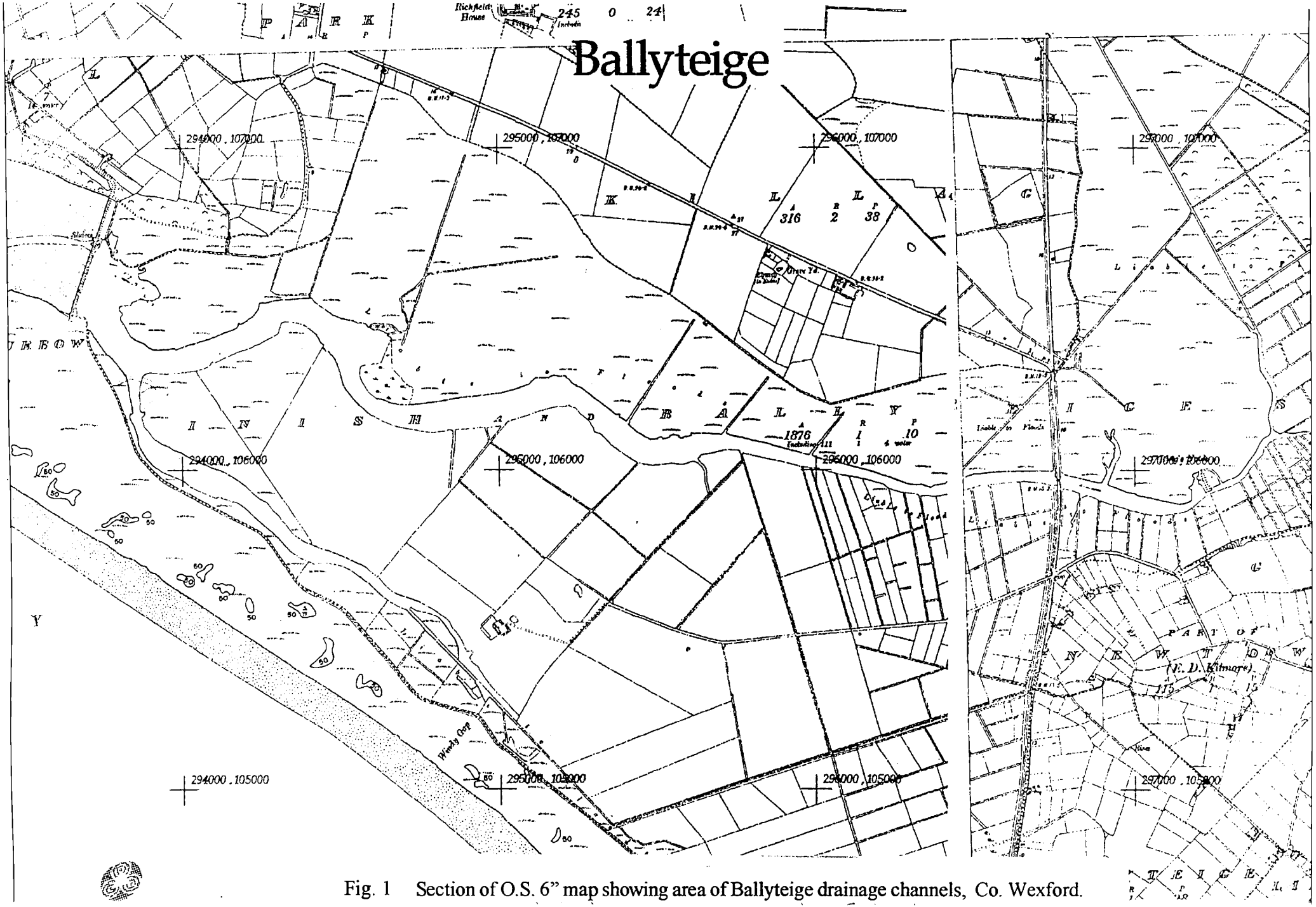
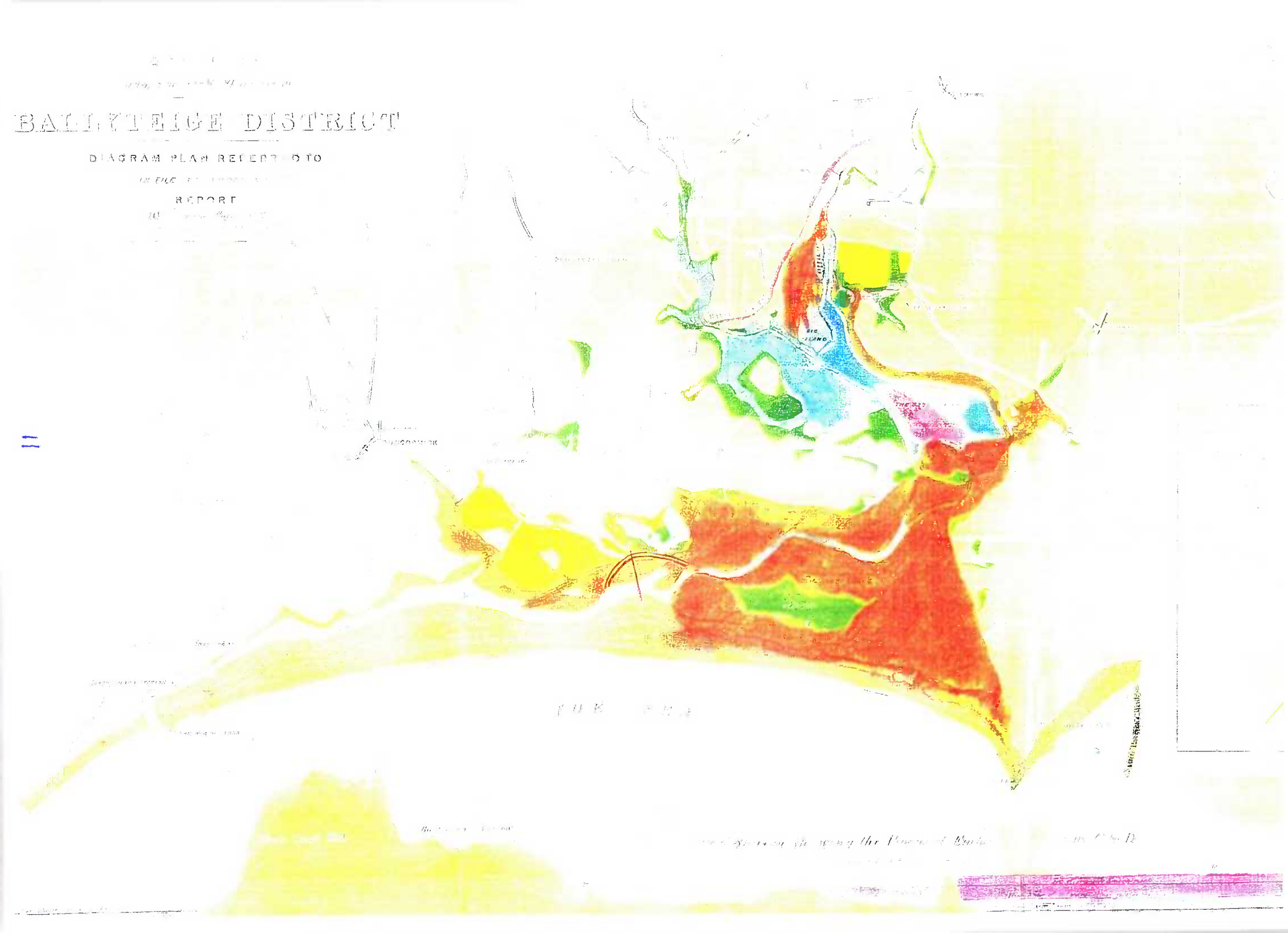


Fig. 1 Section of O.S. 6" map showing area of Ballyteige drainage channels, Co. Wexford.

BALLYTEIGE DISTRICT

DIAGRAM PLAN REFERRED TO

REPORT



when the water table was lowered by pumping. The main channel was deepened in the 1960s, and was probably also straightened at that time, and a new connection with the seepage channel dug, so that the present layout differs from that shown on the 6" map (Fig 1).

Construction of the sea wall caused tidal water to flood onto land to the north of the Cull, broadening the inlet, and the new channel caused additional silting leading to the formation of the present mud flats of the Cull Inlet. An additional wall was built along the north side near the pumphouse to prevent flooding of farmland and this was partially rebuilt in 1997.

Geology, geomorphology and land use

The underlying rock in the Ballyteige Slob area consists of coarse conglomerates, silt and sandstone of the Permo-Trias Killag formation (Sleeman 1994), but the region is flat and covered with a layer of glacial till. Land to the north is farmed for pasture and arable crops, as is the reclaimed polder land of Ballyteige Slob. The latter overlies sand and some gravel, and Russell noted that in some areas bog and clay could be traced beneath the sand. Permission has been granted for a limited amount of gravel extraction in one area. Two experimental pits both contained freshwater in October 1998. The dune spit of Ballyteige Burrow extends for 20 km to the mouth of the inlet. The dune crests of aeolian sand rest on a gravel bed which is sometimes exposed in blow-outs.

Description of the system

The drainage system consists of the Main Channel, about 20 m across, representing the final section of the now largely artificial channel which extends from Bridgetown, where it receives a small river, to the sea. About 1 km south of Bridgetown it branches, one channel leading west to Blackstone at the mouth of the Duncormick River on the north side of the Cull, the other leading south to the Ballyteige Slob, both receiving a number of streams as well as water from artificial drainage ditches. Some water leaves the Ballyteige channel by way of the Kilmore Quay sluice, the remainder flows westwards, receiving the seepage channel which runs parallel to the dunes before discharging into the Cull.

The main channel is flanked by ridges of spoil from dredging to a height of about 2 m. Its bed is 1-3 m in depth, consisting of soft, sandy mud with shells. Water is slow moving. The seepage channel is shallow with relatively fast flowing water and a bed of muddy sand. Saltmarsh borders the seepage channel and there is an area subject to shallow flooding near the Cull wall. The farmland north and east of the South Channel is fenced, leaving a strip of unmanaged vegetation along the channel bank.

A pond near the pumphouse, referred to as Cull Lake by Galvin (1992), was sampled as part of the system. It is about 1/3 ha and was apparently excavated to provide drinking water for cattle. It has a maximum depth of 1 m, a muddy bottom, and banks of grass or shrubs with no halophytic marginal vegetation. It is slightly saline, probably as a result of percolation from the Cull.

Hydrology

At high tide, seawater at 34‰ has been measurd in water issuing from the bank of the seepage channel as seeps or even springs. Seeps are often marked by velvety *Vaucheria* mats. Salinity gradients show that comparatively little seawater enters through the Cull sluice. However, saline water was found to extend as far as Bridgetown in October 1998 and salinity was was even higher there than at Ballyteige.The presence of floating *Fucus* at Bridgetown shows that the seawater has penetrated from the Cull Inlet by way of the unsluiced canal to the Duncormick river. The salinity of water in the Kilmore Quay channel has not been measured but the height of the outfall makes it unlikely that any significant

amount of seawater could enter. This sluice is currently blocked by weed. It is concluded, therefore, that the high salinity in the main channel of Ballyteige Slob is derived from two sources: seepage through the dunes and tidal water from the Blackstone-Bridgetown canal.

The Cull pump station is automatic, one or more outlets opening for varying lengths of time according to the water level in the channel. The dependence of the area on the pumps was demonstrated on one occasion in the 1980s when a power failure resulted in extensive areas of farmland becoming quickly flooded by saline water. A backup generator has since been installed.

Exploitation and threats

A portion of the considerable quantities of fertilizer needed to maintain productivity on the polders end up in the channels causing severe eutrophication in places. Farmyard wastes add to the nutrient load. The Bridgetown River, of which the main Ballyteige channel is an extension, was described in 1989 (Clabby *et al.*) as "mostly unsatisfactory; seriously polluted by farmyard wastes in its upper reaches and moderately polluted by sewage at Bridgetown. Further surveys in subsequent years showed only slight improvement. Gravel extraction may well prove a benefit for conservation by providing an opportunity for conversion of the abandoned pits that have become flooded into brackish lagoons.

Conservation status

Ballyteige Burrow is a pcSAC and SPA (No. 20), its landward boundary extending to near the edge of the seepage channel. The Cull inlet is a part of the SAC and SPA. The area of sloblands and polders in which the channels surveyed lie comprise the Wexford Nature Reserve and are an SPA (No. 1), principally for Bewick's Swans. The area is included in the proposed South Wexford Coast National Park (Hurley 1991).

VEGETATION

Site description

Ballyteige cannot be termed a lagoon at present as drainage schemes have reclaimed intertidal ground behind the Ballyteige sand and gravel spit. However a complex of brackish channels occur behind the dyke which crosses Ballyteige Bay. The site is of potential interest as a brackish lagoon could be established by suitable water table management.

The major channel which ends at the dyke pump house has been dredged and is flanked by spoil heaps, its banks form cliffs 1-2m high. A second channel (location 3, Fig 3) is much shallower and has a sandy bottom. While the larger channel is bordered by agricultural land , the smaller channel is bordered in places by saltmarsh. These channels result from seawater percolating under the sand and shingle coast and then emerging inland. They are only maintained by continuous pumping which lowers the water table below sea level. A brackish marsh (location 1) is of interest as *Chara canescens* was found there in 1991.

Underwater observations

The main channel in Ballyteige is about two metres deep. The banks shelve steeply while the channel floor is flat. The water in the channel is extremely silt laden and visibility is

very poor. Consequently, there is little benthic vegetation. A sparse band of *Ruppia* sp. grows on each bank but does not cover the channel floor. At certain points dense stands of *Phragmites australis* occur along the bank.

The site was surveyed on 28-29/9/1998. Shallow channels were surveyed by wading while the deeper channels were surveyed by snorkelling. A plankton sample was taken (location 4). The marginal vegetation was not studied in detail for several reasons. The channels are artificially deepened and are flanked by agricultural land except in a few places where salt marsh occurs. As no lagoon can be recognised at the site, lagoon marginal vegetation cannot be identified. The interesting saltmarsh vegetation has already been described in detail by Nooren and Schouten (1976). An attempt was made to relocate *Chara canescens* at location (1).

Sampling

Species lists were made at the following locations:
293701068 - Small brackish pond (point 2)
29401065 - Main channel at 1m depth, turbid water and muddy bottom (point 4)
Main channel at 1 m depth, turbid water and muddy bottom (point 5)
26461056 - Shallow channel, 20 cm depth with clear running high salinity water. Sand and mud bottom. (point 3)

A plankton sample was taken at point 4.

Results

Fig .4 shows sublittoral vegetation in the main channel. The only vegetation unit was monogeneric stands of *Ruppia.* a small number of plants were in flower; these were tentatively identified as *R. cirrhosa* due to the long peduncle but no fruits were found.
The vegetation at point 3 included the following:

Chaetomorpha linum
Ruppia maritima
Enteromorpha intestinalis
Enteromorpha ralfsii.
Vaucheria sp.

This unusual association occurs in flowing water of high salinity which is a rare habitat but arguably outside the scope of a study of coastal lagoons.

The pool close to the dyke contains *Potamogeton pectinatus, Myriophyllum spicatum* and *Ranunculus baudotii.* (point 2).

The dominant species in the phytoplankton was *Skeletonema costatum,* a common coastal diatom which blooms in nutrient rich water.

Notable plants

The flora of the smaller channel contains some unusual species. *Chaetomorpha linum*, (Fig. 4.) formed very dense and unusually coiled strands with a large diameter (0.4mm). *Ruppia maritima* occurred in a form in which the main axes are buried by sand but the leaves emerge above ground.. In these plants the fruit stalks are short 0.3-0.8 cm, the plant appears to approach the *brevirostris* form (Preston 1995). *Enteromorpha ralfsii* was only provisionally identified. It is either a rare or under recorded form (Burrows 1991). *Chara canescens* was found less than ten years ago in a saline marsh south east of the pumphouse on the dyke. Some non-flowering *Ruppia* still grows there but despite a detailed search, the plant was not rediscovered.

Assessment

The most unusual feature of the site is the channels of flowing seawater. The flora seems to be unusual with a possibly rare *Enteromorpha* species and a dwarf form of *Ruppia maritima*. However it is difficult to regard this totally artificial habitat as coming within the definition of coastal lagoon used in this study. It is unlikely that this channel flora would persist if a lagoon was established

AQUATIC FAUNA

Description

Ballyteige drainage channels are situated on the south coast of Wexford, 1 km to the west of Kilmore Quay (Fig. 1). The drainage channels are artificial and were excavated to drain a lagoon and saltmarsh which were isolated behind an extensive dune system to the south and a sea wall to the west, constructed across the Cull Inlet in the mid 19th Century. Seawater enters by percolation through the dunes along the southern shore (e.g. Sta. 3) and apparently by leakage of the sluice on the Cull at high tide. It is also possible that seawater enters from the tidal river that runs from Duncormick to Bridgetown. Freshwater enters from the river running from Bridgetown which can drain at low tide into the Cull but water levels are now controlled by additional pumping at the western end. The whole area floods rapidly at times of high rainfall or when the seawater pumps fail. Area of water about 5 ha., length of channels 3.2 km., maximum depth 3m.

The reclaimed polders are rich pasture and arable land, fairly intensively farmed, but part of the area is protected as a National Nature Reserve. The area is of great ornithological interest and the adjoining Cull is an SPA.

Sampling Stations

The area was sampled on 14/7/98 and from 5-7/10/98

Five sampling stations were selected to reflect the influences of substrate, vegetation, freshwater and tidal inflows (Fig 5). Fyke nets were not used at any stations due either to shallowness of water or strong tidal flows.

Station 1 (S93746,06894) was located in the pool north of the Cull Inlet, known as the Cull Lake. This small lake measures 200m by 30m and was dug by farmers in the last 30 years. No streams enter this lake and there is no direct connection with the sea but seawater enters by percolation. Water depth was up to 1m. Salinity measured 0ppt (490mg/l) at the time of sampling but apparently is usually about 4ppt. (Healy et al., 1997b). The pool is highly eutrophic with deep organic silty sand and dense beds of aquatic and emergent vegetation.

Station 2 (S93772,06703) was located in the main channel east of the seawall and pumping station. The channel is deep in this area (2-3m) with earth banks and cliffs of clayey soil topped with grassland along the levées. Substrate is sand, heavily scoured by currents, with occasional stones and soft silty sediments in sheltered areas along the banks. Salinity measured 28.4 ppt but undoubtedly varies from extremes of fresh and seawater influence.

Station 3 (S93883,06019) was located along the channel which runs alongside and parallel to the dune system in an area where seawater "seeps" from the dune system into the

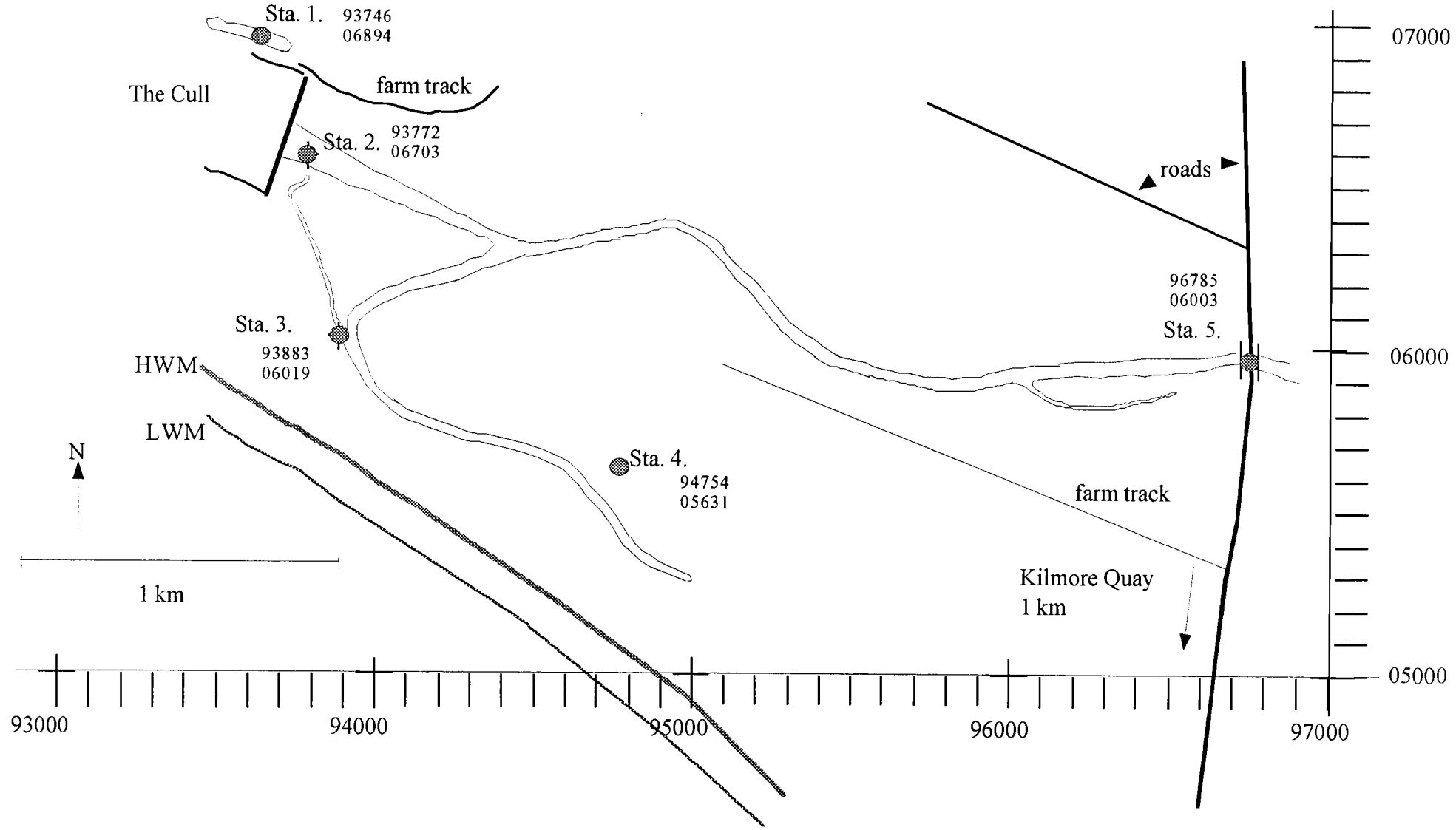


Fig. 5 Sketch map of Ballyteige drainage channels, Co. Wexford, showing sampling stations used for a survey of aquatic fauna, 1998.

drainage channel. The channel is very shallow at this point (up to 0.5m), salinity measured 18 - 31 ppt and substrate consisted of fine, anoxic, silty sand overlain with dense mats of aquatic vegetation.

Station 4 (S94754,05631) was located in a gravel pit still being excavated and surrounded by agricultural land in the central area of the polderland. Substrate was gravel, salinity was close to fresh water (0-0.2ppt) and depth at this time was approximately 1m. The pit was only sampled briefly as work was in progress.

Station 5 (S96785,06003) was located at the bridge where the main road passes over the main drainage channel at the eastern end. This bridge was taken as the eastern limit to the survey area but it is clear that there is considerable seawater influence much further inland. At this point depth was approximately 1-2m. Salinity measured 7.4 - 9.4 ppt at the surface and 26 - 27.7 ppt at 1m depth. Substrate was deep organic silt and the water highly eutrophic.

Results

Table 1 shows the taxa recorded at each sampling station. The following is a list of species arranged in broad ecological categories based on the Venice system of salinity regimes:

(L* = lagoonal specialist in Britain, L*IR = proposed as lagoonal specialist in Ireland; * = interesting or rare species. Species in brackets refer to previous records).

Marine	*Lineus ruber*	
	Notomastus latericeus	
	Dexamine spinosa	
Marine-polyhaline	*Arenicola marina*	
	Capitella capitata	
	Tubificoides benedii	
	Heterochaeta costata	
	Crangon crangon	
	Palaemon ?longirostris	
	Praunus flexuosus	
	Amphipholis squamata	
	Corophium volutator	
	Melita palmata	
	Hydrobia ulvae	
	Littorina saxatilis	
	Leptosynapta inhaerens	
Poly-mesohaline	*Abra tenuis*	
	Hydrobia ventrosa	L*
	Pomatoschistus microps	
Euryhaline	*Hediste diversicolor*	
	Neomysis integer	L*IR
	Lekanesphaera hookeri	L*
	Gammarus zaddachi	
	Carcinus maenas	
	Anguilla anguilla	
	Palaemonetes varians	L*
	Potamopyrgus antipodarum	
	Gasterosteus aculeatus	
	**Conopeum seurati*	L*
Meso-oligohaline	*Ischnura elegans*	
	Sigara stagnalis	L*
	**(Agabus conspersus)*	(L*)
	Enochrus bicolor	L*
	Notonecta viridis	L*IR
	Corixa panzeri	
Oligohaline-limnetic		
	Plea leachi	L*IR
	Lymnaea peregra	
	Hippeutis complanata	
	Callicorixa praeusta	
	Sigara concinna	L*
	Hydrometra stagnorum	
	(Haliplus immaculatus)	
	Hygrotus inaequalis	
	Rhantus frontalis	
	Sigara lateralis	
Limnetic	*Cloeon dipterum*	
	Hesperocorixa sahlbergi	
	Helochares lividus	
Uncertain	*Noterus clavicornis*	
	Rhantus suturalis	
	(Helophorus revipalpis)	
	Megasternum obscurum	
	Ochthebius dilatatus	

Table 1. Aquatic fauna recorded at station in Ballyteige channels, 1998.

		1	2	L.T. 2	3	L.T. 3	4	5	L.T. 5
Nemertea	*Lineus ruber*				a				
Polychaeta	*Arenicola marina*				a				
	Capitella capitata				a				
	Hediste diversicolor		a		c				
	Notomastus latericeus				a				
Clitellata	*Lumbricillus sp.*				+				
	Marionina sp.				o				
	Heterochaeta costata				o				
	Tubificoides benedii				a				
Crustacea									
Ostracoda		a							
Copepoda		a							
Mysidacea	*Neomysis integer*		1						
	Praunus flexuosus							o	
Isopoda	*Lekanesphaera hookeri*		c	2				a	35
Amphipoda			+			1		a	1
	Corophium volutator		+						
	Dexamine spinosa		+						
	Gammarus zaddachi	+	a					+	1
	Melita palmata		+						
Decapoda	*Carcinus maenas*		+						
	Crangon crangon		o						
	Palaemon ?longirostris		1						
	Palaemonetes varians		o	1				o	
Acarina		c							
Insecta									
Ephemeroptera	*Cloeon dipterum*	1							
Odonata	*Ischnura elegans*	a	+	1			+		
Trichoptera	Leptoceridae indet.	o							
Heteroptera	*Callicorixa praeusta*	1							
	Corixa panzeri	a							
	Gerris sp	2							
	Hesperocorixa sahlbergi	o							
	Hydrometra stagnorum	3							
	Notonecta glaucum	o							
	Notonecta viridis	c					o		
	Plea leachi	a							
	Sigara concinna	c							
	S. lateralis	1							
	S. stagnalis	a						c	c.40

L.T. = light trap. + = present, o = occasional, c = common, a = abundant.

Table 1 (cont.)

		1	2	L.T. 2	3	L.T. 3	4	5	L.T. 5
Coleoptera		9	2				2		
	(Agabus conspersus)	(c)							
	Enochrus bicolor	c							
	(Haliplus immaculatus)	(4)							
	Helochares lividus		2						
	(Helophorus brevipalpis)	(1)							
	Hygrotus inaequalis	2							
	Laccophilus minutus	4							
	Megasternum obscurum								
	Noterus clavicornis	2							
	Ochthebius dilatatus								
	Rhantus frontalis						1		
	R. suturalis						1		
Diptera	Chironomidae	a							
Mollusca									
Prosobranchia	*Hydrobia ulvae*		+	1					
	H. ventrosa		+						
	Littorina saxatilis		+						
	Potamopyrgus antipodarum	(a)	o					o	
Pulmonata	*Hippeutis complanata*	c							
	Lymnaea peregra	c					c		
Bivalvia	*Abra tenuis*	1			+				
Echinodermata	*Amphipholis squamata*				c	4			
	Leptosynapta inhaerens				c				
Bryozoa	*Conopeum seurati*		+						
Pisces	*Anguilla anguilla*				1				
	Gasterosteus aculeatus	c	a	25	c	6		a	113
	Pomatoschistus microps		a	12	a	3			

L.T. = light trap. + = present, o = occasional, c = common, a = abundant. ( ) = previous record

A total of 60 taxa were recorded in 1998 together with some additional records from 1996, of which 8 of species are listed as lagoonal specialists in Britain (although one is a record from 1991) and a further 3 species are proposed as lagoonal specialists in Ireland.

The taxa recorded show a wide range of ecological groups from marine to limnetic reflecting the varied habitats of the area which ranged from very low to high salinities and from gravel to soft sandy substrates. This site really is a complex of lagoonal habitats. Several species are of particular interest:

Conopeum seurati was recorded at many of the sites visited but is not listed in arecent review of Irish marine Bryozoa (Wyse Jackson, 1991). This may be an oversight or may be due to the fact that it is a truly lagoonal specialist and not previously recorded as lagoonal habitats had not been surveyed.

Notonecta viridis and *Plea leachi* are not on the British list of lagoonal specialists but are both regarded as such in Ireland. Both species appear to be relatively uncommon and have only been recorded in Ireland in lagoonal habitats.

Notonecta viridis is recorded previously elsewhere on the south coast as common in Lady's Island L., Tacumshin L., and Kilkerran L. but also from the North Slob and as occasional in L. Donnell, Co. Clare (Oliver and Healy, 1998). Previously known only from Wexford and West Kerry.

Plea leachi is known previously only from this site (Galvin, 1992), from Tacumshin Lake (Oliver and Healy, 1998) and was recorded by Halbert (1935) as *P. minutissima* from L. Gill, Co. Kerry and more recently from the same area by McCarthy and Walton (1980).

Enochrus bicolor was also recorded at L. Phort Chorrúch, L. an Chara and L. an Aibhnín during this survey, at 6 sites during the 1996 survey and also from Port na Curra, Inishmaan in 1998 and in samples collected at the North Slob in 1991. There are only 2 recent records from N. Ireland (Nelson *et al.*,1998).

Megasternum obscurum was also recorded at L. an Chara during this survey and at Furnace L. (and L. an tSaile) during the 1996 survey but is otherwise described as rather rare in Ireland (Foster *et al.*, 1992).

Rhantus suturalis was recorded only from Ballyteige . Apparently a southern species which occurs in Ireland sporadically (Foster, 1985).

Agabus conspersus was identified from samples collected by Galvin in 1991. It was previously recorded in Lady's Island L. by Healy (1997). The species appears to have become rare and there are only two other recent Irish records: from a salt marsh in Co. Meath, and at Dundalk harbour, Co. Louth (Nelson *et al.*,1997).

The community of *Amphipholis squamata, Leptosynapta inhaerens* and the dense population of annelids in the seepage area at Sta. 3 are of particular interest.

Evaluation

The drainage channels at Ballyteige are already partly protected as a bird reserve but they also contain very interesting lagoonal habitats with several relatively rare species of aquatic fauna.

The area is totally artificial but are the remnants of a previously extensive lagoonal system lying behind a sedimentary barrier. One of the greatest interests in the area is the potential for restoration and creation of lagoonal habitats. Gravel pits are at present being excavated and, with careful planning, the creation of small lagoons of varying depths and salinities would be of great scientific interest and value.

The protection afforded to the area at present is mainly due to ornithological interest. Care should be taken that management takes into account the value of lagoonal habitats for invertebrate as well as vertebrate fauna.

This site consists of polder channels and a shallow drain system behind a sand dune Nature Reserve through which saline water percolates at high spring tides. It includes *Carex* flats which flood with brackish water, and pools with salt-marsh vegetation, and is hydrologically part of large area (c. 4 km^2) of reclaimed agricultural land drained by deep channels with accumulating water pumped over a sea wall.

Sampling

Three areas were selected for sampling from 22/7/98-22/8/98:
(1) A c.0.3 ha flat sandy area between a drain and main channel, with *Carex* spp. (incl. *C. extensa), Glaux maritima, Plantago maritima*, and sparse grasses. The salinity of the adjacent drain was 29‰. (S953048, 23 vii 1998).
(2) The bank of drain with *Bolboschoenus maritimus*, draining to a main channel. The bank vegetation consisted of *Juncus maritimus, Juncus gerardii*, sparse *Bolboschoenus maritimus, Plantago maritma, Triglochin maritima, Agrostis stolonifera* and *Centuarium* sp. Drain-water salinity was 24‰. (S937064, 22 vii 1998).
(3) The sandy margin of wide shallow flooded drain nearest to the sand dunes, with *Schoenoplectus tabernae-montani, Bolboschoenus maritimus* and *Ruppia* sp. in standing water. Drain-water salinity was 11‰. (S953049, 22 viii 1998, after rain).

Results

In total, eight species of carabid and twenty-one species of staphylinid were recorded, none of which is regarded as an indicator species (Tables 2 and 3).

The *Pogonus* species could not be satisfactorily determined as either *chalceus* or *littoralis*. For the purposes of this report, it is assumed to be the commoner species (*chalceus*) which, although stenotopic and halobiont, has been relatively frequently recorded in Ireland and has not therefore been regarded as an indicator species.

TABLE 2. Staphylinidae from a reclaimed sand barrier lagoon shore at Ballyteige Channels (Co. Wexford). Indicato species are marked with an asterisk.

Anotylus rugosus (Fab.)	2
Astenus lyonessius (Joy)	1
Atheta amplicollis (Muls. Rey	2
Bledius limicola Tott.	18
Mycetoporus splendidus (Grav.)	3
Oxypoda umbrata (Gyll.)	1
Paederus fuscipes Curt.	3
Philonthus cognatus Steph.	2
Philonthus laminatus (Creutz.)	1
Quedius schatzmayri Grid.	1
Sepedophilus nigripennis (Steph.)	2
Stenus brunnipes Steph.	5
Stenus canaliculatus Gyll.	8
Stenus clavicornis (Scop.)	3
Stenus fulvicornis Steph.	3
Stenus juno (Payk.)	1
Stenus ossium Steph.	1
Tachyporus dispar (Payk.)	4
Tachyporus hypnorum (Fab.)	1
Tachyporus pusillus Grav.	1
Xantholinus longiventris Heer	1

TABLE 3. Carabidae from a reclaimed sand barrier lagoon shore at Ballyteige Channels (Co. Wexford). Indicator species are marked with an asterisk.

Agonum marginatum (L.)	1
Dyschirius globosus (Herbst)	11
Dyschirius leudersi Wag.	1
Elaphrus cupreus Dufts.	1
Loricera pilicornis (Fab.)	2
Pogonus chalceus (Marsham)	1
Pterostichus melanarius (Ill.)	1
Pterostichus niger (Schal.)	17

Evaluation

While the presence of only one indicator species indicates low conservation interest, the site is large and complex. Nevertheless, extra pitfall trap data from a *Bolboschoenus* sward near a drain (S950053, 4‰ water salinity) did not add any further indicator species, despite a relatively large number of species captured.

Although this poor representation of indicator species would need to be confirmed (especially by sampling in spring),the data do not provide evidence that any restoration of an open-water lagoon would be detrimental to the terrestrial-ecotonal fauna at Ballyteige.

SUMMARY

Ballyteige channels do not constitute a lagoon in the geomorphological sense but the vegetation and fauna are typically lagoonal, except in a stream which collects high salinity seepage water and where water currents create different conditions. The system includes a 2 m deep polyhaline channel with *Ruppia* and a rather poor but typical brackish fauna, and an oligohaline pool with *Potamogeton pectinatus* and a rich fauna of aquatic insects. Several rare beetles and heteropterans have been taken in the area. No indicator species of ecotonal Coleoptera were recorded.

The system is of interest as demonstrating the characteristics of lagoonal environments in situations very different from lagoons in the geomorphological sense, and for the opportunities which may occur to create new lagoons and experimental pools. *Chara canescens* occurred here formerly.

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Plate 1. Ballyteige Channels, Co. Wexford. 1. Main channel near the road bridge (faunal Stn. 5); 2. A side channel; 3. Cull Lake (faunal Stn 1); 4. Seepage channel with halophytic vegetation (faunal Stn. 3); 5. Sign at entrance to Ballyteige Burrow Reserve; 6. Area of temporary flooding near Cull Wall. 7. Outflow from pump station, 8. recently excavated gravel pit.

2. KILMORE LAKE, WHIDDY ISLAND, Co. Cork

Location: V 958489; 51°40.8'N, 9°30.2'W. OS Sheet 85
South side of Whiddy Island, Bantry Bay.

Lagoon type	former sedimentary lagoon, now tidal.
Area	6 ha
Salinity	(poly) euhaline (26) 28-34‰
Maximum depth	3 m
Seawater entry	cobble barrier with silled inlet
Tidal range	?
Conservation status	none

Origins and history

Until recently, the "lagoon" was isolated behind a complete rock and cobble barrier and was said to have been a freshwater lake although overwash waves are likely to have reached it occasionally and there may have been some seawater seepage. According to local residents, the barrier was used as a roadway during construction of the oil terminal in the 1960s and some material may have been displaced or even removed at that time. Erosion of a central portion of the barrier has since caused it to collapse and the sea now flows in through a narrow silled inlet at high tide.

Geology, geomorphology and landscape

Bantry Bay contains Ireland's most southerly drumlin swarm and the lagoon barrier is obviously a glacial formation. Borings on the island have demonstrated the presence of freshwater sediments 11-12,000 years old at a depth of 57 m. A vertical face of part of the barrier shows rocks and stones embedded in glacial till. Erosion has caused cobbles to accumulate at the edge of the lagoon while only rocks remain in the tidal inlet where they form a sill. Rocks were seen to be thrown around during a storm in September 1998 and the barrier appears to be unstable. The clean surfaces of many cobbles indicate scouring.

The island is hilly with farmland, woods, scrub, and scattered dwellings and holiday homes.

Description of the system

The lagoon is one of two Kilmore Lakes which lie in a valley running NE-SW on the south side of the island, 2 km west of the oil terminal. A small stream flowing onto the north-east shore is presumably water from the upper lake but its course is hidden by a road. A road from the ferry terminal provides easy access to the north-east shore of the lagoon where there are two houses let as holiday homes, and also leads to the barrier. The lagoon is sheltered between hills reaching over 30 m, the lower slopes of which are wooded, and there is an escarpment on the north-west side.

The inland shore where the stream enters is gently shelving with a bed of sand, gravel and a few rocks, while shores on either side are more rocky and shelve steeply to give way below 1 m to sand and silt. A practically inert organic sludge covers the central bed which reaches to a maximum depth of 3 m. The origins of this material are uncertain but it seems likely that accumulations of algae washed in from rocky shores on the sea coast, together with silt from the eroding barrier, may be partly responsible. There may also be a contribution from domestic effluent from the two houses. Living algae were very scarce and invertebrates were confined almost entirely to the peripheral fringe of the lagoon.

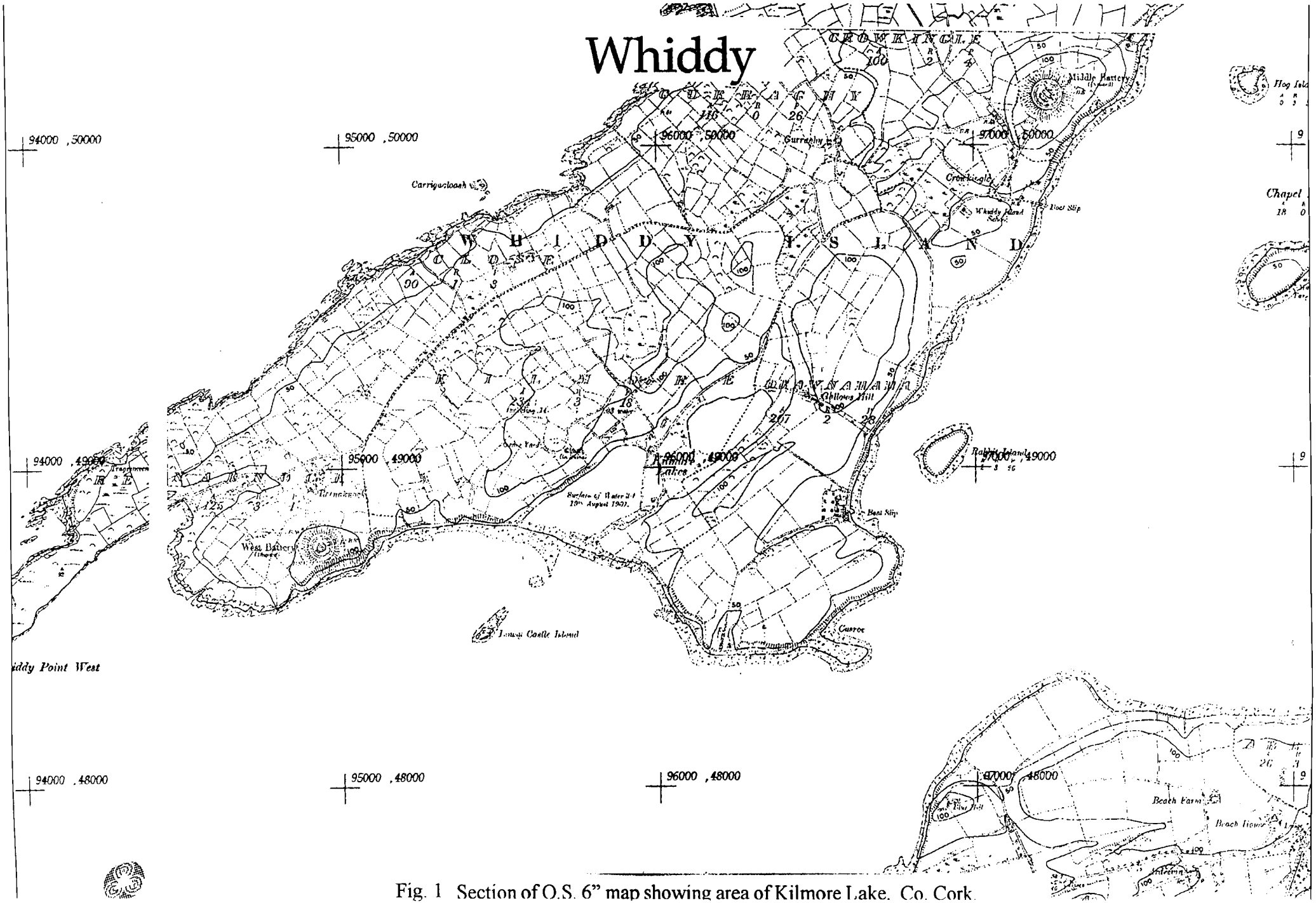

Fig. 1 Section of O.S. 6" map showing area of Kilmore Lake, Co. Cork.

The barrier is unvegetated in its central region. The cobble shore shelves steeply into the lagoon and is very mobile, while the low central region of the barrier consisting of rocks is more gently sloping like the rocky shore outside.

Hydrology

This was a mainly euhaline lagoon with a strong tidal influence. The level of the sill is estimated to be about mid tide level. Seawater floods in on all tides but the lagoon remains slightly brackish due to runoff from surrounding land and the inflowing stream. Salinity during the faunal sampling period was 31‰ but 26 and 28‰ were measured during earlier visits.

Exploitation and threats

There was an experimental mussel raft in the lagoon, and a licence for commercial culture has been sought.

Although erosion of the barrier has been blamed on human interference, natural processes may also be involved and it is doubtful whether attemps to rebuild the barrier would be successful. Cliffs of boulder clay on the coast of the island indicate gradual removal of material that may be continuing. Even in its present state, the lagoon is rich in faunal species and worth conserving as part of the Bantry Bay sea area. In this context, it would be useful to know the cause of the highly organic deposit that prevents colonisation of the bed.

The chief threat to the system may be the possibility of oil spills from the nearby terminal.

Documentation and Research

Anticipating the probable occurrence of oil spills in the area, a baseline survey of shores around Bantry Bay was carried out in 1971 (Crapp 1973). No stations in the immediate vicinity of Kilmore Lake were sampled and only relative abundance of common species of plants and animals was recorded. Oil spillages in October 1974 and January 1975, described by O'Sullivan (1975 a,b), affected the northern part of the bay south-east of Glegarriff and the mainland coast south of Whiddy Island. A re-survey of Crapp's sites in 1975 noted many biological changes but most were not obviously related to oil spillages and could not be interpreted as an overall decline (Baker *et al.* 1981).

VEGETATION

Site description

Kilmore lake is one of two lakes which lies on glacial drift and boulder clay on the west side of Whiddy Island. Cliffs of boulder clay on the coast suggest a gradual removal of material, to the point where Kilmore Lough became open to tidal flooding. Islanders report that during the construction of Whiddy Oil terminal in the 1970s, a machinery road or track ran along the coast and crossed the shingle barrier which separates the lake from the sea. This traffic may have lowered the barrier to a point where at present almost fully saline conditions obtain in Kilmore Lake. The lake shore consists of a narrow cobble beach backed by small cliffs. Bedrock outcrops in the southwest corner. There is very little development of marginal vegetation.

Underwater observations

The shallow sublittoral down to about 1.5m consists of cobbles and gravel. Below this depth fine silty sand covers the lake floor. Visibility is good, but macrophytes are very rare. A few plants of *Gracilaria* grow on stones in the centre of the lake. The cobble barrier shelves steeply and in a few places a more diverse algal community is found. A few attached oysters (*Ostrea edulis*) and fan worms also grow here. The site is marred by old wrecked cars dumped in the south west corner of the lake. Many of the barrier cobbles are very clean, which suggests recent disturbance or scouring. In contrast, a few undisturbed areas have dense growths of algae.

This site was surveyed on 1/10/1998. Shore sampling and a snorkelling survey were carried out. One plankton sample was taken.

Results

Kilmore Lough had no benthic vegetation except for a few seaweeds. *Gracilaria gracilis* occurs rarely on the lake floor (point 4). *Cystoseira foeniculaceus* and *Fucus ceranoides* are rare on cobbles. In a few places (point 3) the barrier supports a more diverse flora with *Codium fragile tomentosum*, *Enteromorpha* sp. *Cladophora* sp., *C. foeniculaceus* and *C. baccata*. A single plant of *Cutleria multifida* was collected.

Given the extreme floral poverty of the site and the possibility of recent storm damage, it is not possible to classify the sublittoral vegetation of Kilmore.

As the lake is surrounded by high ground, marginal vegetation communities are not developed. In addition, the marginal vegetation was also disturbed and damaged, with many stands of dead reeds (*Phragmites australis*) along the shore.

Plant cover was too sparse to define communities but the following species were noted along the shore near point 1. *Carex distans, Festuca rubra, Juncus maritima, Juncus gerardii, Armeria maritima, Aster tripolium, Glaux maritima, Plantago maritima, Phragmites australis.*

The flora of the barrier (point 2) included many of the above species and *Crithmum maritimum, Silene maritima, Atriplex hastata, Daucus carota, Cochlearia officinalis.*

Assessment.

A number of indicators suggest that the site had suffered storm damage shortly before the survey. These included dead stands of the fresh or brackish water Common Reed, the absence of a benthic flora, and the absence of plant growth on most of the sub littoral barrier cobbles, even though abundant growth was seen in a few places. The disturbed vegetation and small species list makes the site of little conservation value.

AQUATIC FAUNA

Description

Kilmore Lake is a natural sedimentary lagoon with a low cobble barrier. The lagoon is situated on the west coast of Whiddy Island, Bantry Bay, approximately 2 km to the west of the harbour. Seawater enters by percolation and by overflowing the low central part of the barrier, even on neap tides. The lagoon is small (c. 6 ha) and shallow (up to 3m) and with regular tidal flushing, salinity remains close to that of seawater, probably throughout the year, although 26 ppt was recorded near the barrier on 8/7/98 and salinity is always slightly lower at the northeast end where a small stream enters.

Most of the central part of the lake consists of fine, muddy sand sediments with very little vegetation or fauna.

GPS readings did not seem to be very accurate for this site.

Sampling stations

The area was sampled briefly on 8/7/98, from 24-25/7/98 and on 1/10/98.

Four sampling stations were selected to reflect the influences of substrate, vegetation, freshwater and tidal inflows.

Station 1 (V95669 48771) was located at the southern end of the lagoon inside the cobble barrier. Water depth was up to 1m. Salinity measured 33ppt in July and October, 29 ppt on 30/8/98. Substrate consisted of cobbles with sand in sheltered crevices.

Station 2 (V95737 48851) was located on the north shore of the lagoon. Salinity measured 32 ppt and substrate consisted of small pebbles and stones along the shoreline, Fig 3 Faunal sampling stationsgiving way to fine muddy silt with scattered stones and rocks within a short distance from the water's edge. Depth 0-1m.

Station 3 (V95941 49004) was located at the eastern end of the lagoon where a stream drains into the lagoon from the slightly higher freshwater lake. Salinity measured 28 ppt in this area in June and 32 ppt. in July. The beach and shoreline consisted of small cobbles and gravel with fine sediments and scattered rocks a short distance into the lagoon. Depth 0 - 1m.

Station 4 (V95916 48899) was located on the southern shore of the lagoon in slightly deeper water (up to 1.5 m) and with a hard rocky substrate. Salinity measured 32 ppt.

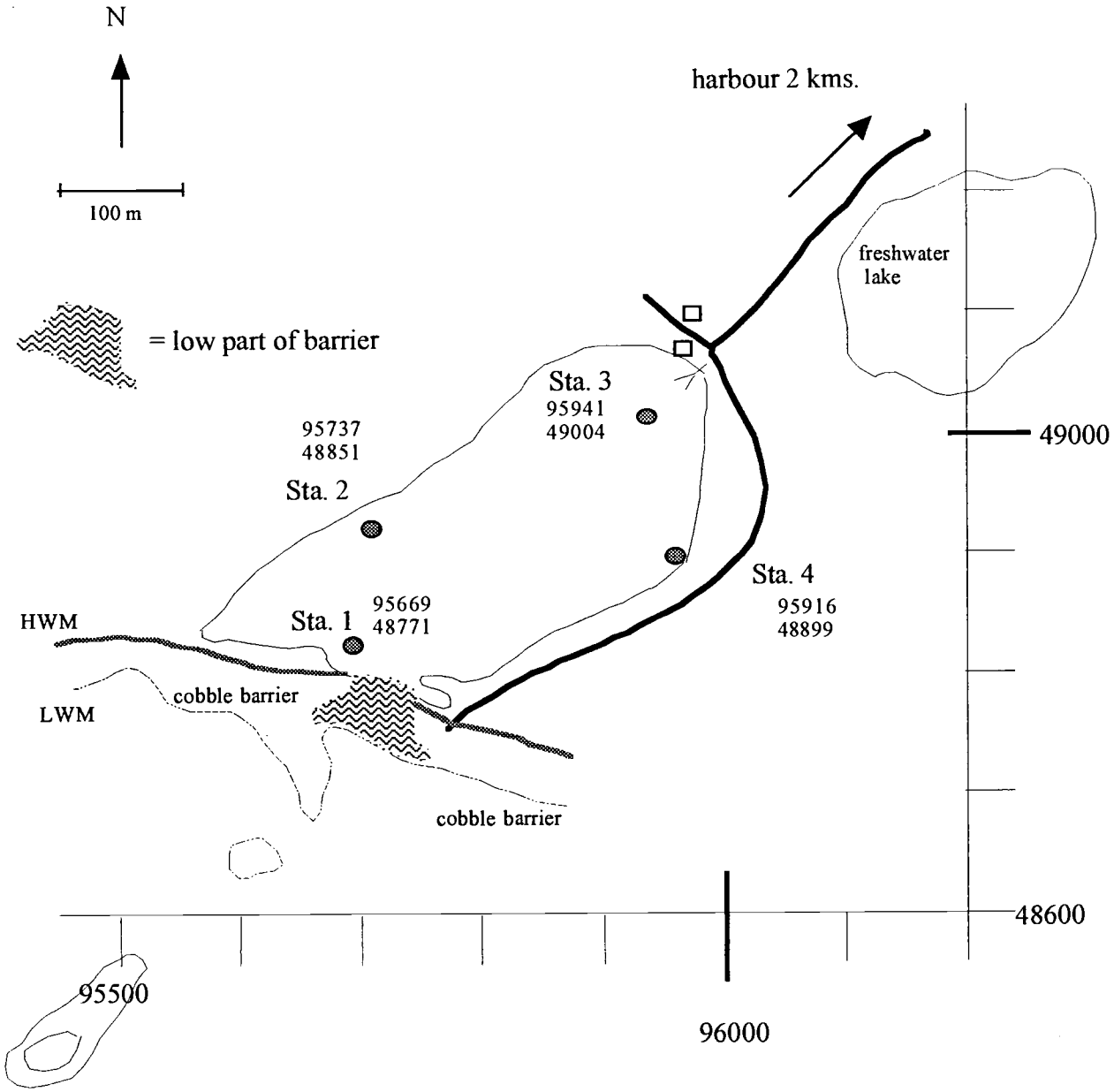

Fig. 4 Sketch map of Kilmore Lake, Co. Cork, showing sampling stations used for a survey of aquatic fauna, 1998.

Results

Table 1 shows the taxa recorded at each sampling station. The following is a list of species arranged in broad ecological categories based on the Venice system of salinity regimes: (L* = lagoonal specialist in Britain, L*IR = proposed as lagoonal specialist in Ireland; * = interesting or rare species. Species in brackets refer to previous records).

Marine

Hymeniacidon perleve
Leucoselenia botryoides
L. complicata
Suberites ficus
Anthopleura balli
Chrysaora hysoscella
Sagartiogeton undatus
Sarcodictyon roseum
Autolytus prolifer
Eupolymnia nebulosa
Exogone hebes
Harmothoë impar
Myxicola infundibulum
Nereis zonata
Perinereis cultrifera
Platynereis dumerili
Polynoë scolopendrina
Polyophthalmus pictus
Pomatoceros lamarcki
P. triqueter
Sabella pavonina
Typosillis hyalina
Pedicellina hispida
Ascidicola rosea
Doropygus pulex
Notodelphus allmani
Balanus balanus
B. crenatus
Verruca stroemia
Bodorotia scorpioides
Tanais dulongi
Mysidopsis gibbosa
Siriella armata
Idotea pelagica
Limnoria quadripunctata
Ampithoe ramondi
**Lembos ?longipes*
Microprotopus maculatus
Phtisica marina
Cancer pagurus
Liocarcinus depurator
Pagurus bernhardus
Porcellana platycheles
Cerithiopsis tubercularis
Gibbula cineraria
G. umbilicalis
L. obtusata
Monodonta lineata
Nucella lapillus
Anomia ephippium
Chlamys varia
Hiatella arctica
Modiolarca tumida
Ostrea edulis
Tapes decussata
Asterias rubens
Paracentrotus lividus
Psammechinus miliaris
Alcyonidium gelatinosum
Celleporella hyalina
Botryllus schlosseri
**Phallusia mammillata*
**Styela clava*
Pollachius virens

Marine/polyhaline

Halichondria panicea
Arenicola marina
Heterochaeta costata
B. ?improvisus
Elminius modestus
Semibalanus balanoides
**Jaera forsmani*
Corophium volutator
Melita palmata
Crangon crangon
Palaemon elegans
Palaemon serratus
Praunus flexuosus
Lepidochitona cinereus
Bittium reticulatum
Hydrobia ulvae
Littorina littorea
L. saxatilis
Mytilus edulis
Patella vulgata
Rissostomia membranacea
Skeneopsis planorbis
Amphipholis squamata
Bowerbankia gracilis
Cryptosula pallasiana
Ascidia mentula

Marine/polyhaline (cont)

Ascidiella aspersa
A. scabra
Ciona intestinalis
Atherina presbyter
Ciliata mustela
Gobiosculus flavescens
Taurulus bubalis

Poly/mesohaline

Cerastoderma glaucum L*
Pomatoschistus microps

Euryhaline *Jaera nordmanni* L*IR ?
Gammarus duebeni
G. zaddachi
Carcinus maenas
Anguilla anguilla
Mugilidae
Pleuronectes flesus

Strandline

**Cercyon depressus*
**C. littoralis*

A total of 113 taxa were recorded in the lagoon, of which 103 were identified to species. This is the highest species number of all the 36 sites surveyed. Some of these are interesting species but only one lagoonal specialist on the British list was recorded (*Cerastoderma glaucum*) and one possible from the proposed Irish list (*Jaera nordmanni*). The fauna is almost totally marine or marine/polyhaline in nature. The central part of the lagoon consists of soft, unstable sediments and the rich fauna is generally restricted to the area near the tidal inlet and a relatively narrow belt of shoreline. Several species are considered interesting or rare:

The tunicates *Phallusia mammillata* and *Styela clava* both have a very restricted range. The latter found only along the southern coast and the former apparently restricted to Bantry Bay.

Jaera forsmani was previously recorded at Drongawn L. in the 1996 survey (Oliver and Healy, 1998) and during this survey in Connemara at L.Fhada, L. an Aibhnín, Cara na gCaorach and L. Athola. The only other Irish record of the species located is for L.Hyne, Co. Cork, (De Grave and Holmes, 1998).

Lembos longipes was also recorded at L. an Aibhnín and possibly Sally's L. during this survey and at Drongawn L. and Furnace L. during the 1996 survey. There are only 3 previous records for Ireland (Costello *et al.* 1989).

Cercyon littoralis was previously recorded at Bridge L. and Mill L. (Oliver and Healy, 1998) and during this survey at L. an Aibhnín. *C. depressus* was only recorded at this site during the surveys. Both are both driftline species with few recent records.

Evaluation

Kilmore Lake is still a sedimentary lagoon in the geomorphological sense but the fauna is by no means lagoonal. According to local information the lake was fresh some 50 years ago but during construction of the oil terminal, the barrier was used as a road for heavy machinery and the sea has invaded the lake since that time.

The fauna of Bantry Bay is very rich and that of Kilmore Lake reflects this richness. The fauna are nearly all typical open coast marine species, indicative of the regular flushing of the lagoon.

It is quite likely that the lake formerly had a much more typical lagoonal community but it now appears to be in the 'dying stages' of its life as a lagoon and gradually becoming part of the open coast. It is possible that the lagoonal characteristics of the lake could be restored by rebuilding the barrier.

Table 1 Aquatic fauna recorded at stations in Kilmore Lake, 1998.

Taxa		1	L.T. 1	2	L.T. 2	3	L.T. 3	4	L.T.4
Porifera	*Halichondria panicea*					+			
	Hymeniacidon perleve	+							
	Leucoselenia botryoides	+							
	L. complicata	+							
	Suberites ficus			+					
Cnidaria	*Anthopleura ballii*	+		+		+		+	
	Chrysaora hysoscella	+							
	Sagartiogeton undatus			o					
	Sarcodictyon roseum	+							
Turbellaria	planarian indet	+							
Nemertea	indet.							+	
Annelida									
Polychaeta	*Arenicola marina*	+		+					
	Autolytus prolifer					1		3	
	Eupolymnia nebulosa	+		+					
	Exogone hebes	+							
	Harmothoë impar	+		+					
	Myxicola infundibulum	+							
	Nereis zonata			+					
	Perinereis cultrifera			+					
	Platynereis dumerili	+		+	2		4	+	4
	Polynoë scolopendrina	+		+					
	Polyophthalmus pictus	+	6	+	25	+	29	+	111
	Pomatoceros lamarcki	+						+	
	P. triqueter	+				a		+	
	Sabella pavonina	1							
	Spirorbidae indet.	+							
	Typosyllis hyalina	+							
Oligochaeta	*Heterochaeta costata*	+							
	Tubificidae indet	+							
Entoprocta	*Pedicellina hispida*	+							
Crustacea									
Ostracoda				+					
Copepoda	indet.			+			a		
	Ascidicola rosea	+		+		+		+	
	Caligus elongatus.				2				
	Doropygus pulex	+							
	Notodelphus caerulea	+							
Cirripedia	*Elminius modestus*	+		+		+		+	
	Balanus balanus	+		+				+	
	B. crenatus	+				+		+	
	B. ?improvisus					+			
	Semibalanus balanoides	+		+				+	
	Verruca stroemia	+						+	

L.T. = light trap. + = present, o = ocasional, c = common, a = abundant.

Table 1 (cont.)

Taxa		1	L.T. 1	2	L.T. 2	3	L.T. 3	4	L.T.4
Cumacea	*Bodotria scorpioides*				1				1
Tanaidacea	*Tanais dulongi*				+			+	
Mysidacea	*Mysidopsis gibbosa*		4		11		2		2
	Praunus flexuosus	o	10	o	9	c	2	+	2
	Siriella armata			1					
Isopoda	*Idotea pelagica*				5				
	Jaera forsmani			+		+			
	J. nordmanni			+		a			
	Limnoria quadripunctata						15		1
Amphipoda	Amphipoda indet	+	30	+	250	+	c70	+	c70
	Ampithoe ramondi		3						2
	Corophium volutator	1							
	Gammarus duebeni	2							
	G. zaddachi	2	3	3	50	136	44	1	40
	Lembos ?longipes		12				4		18
	Melita palmata					1		10	
	Microprotopus maculatus	a	a	a	a	a	a	a	a
	Phtisica marina			2	2		1		
Decapoda	*Cancer pagurus*	1							
	Carcinus maenas	F=80		F=160					
	Crangon crangon		2		6		1		1
	Liocarcinus depurator	F=2		+					
	Pagurus bernhardus	+			+				
	Palaemon elegans	+	4		1	a	+	+	
	Palaemon serratus	+		+	1	a	1	+	2
	Porcellana platycheles	1							
Insecta									
Coleoptera	*Cercyon depressus*	2				4			
	C. littoralis					1			
Mollusca									
Polyplacophora	*Lepidochitona cinereus*	+		+					
Prosobranchia	*Bittium reticulatum*	1							
	Cerithiopsis tubercularis			1					
	Gibbula cineraria	+						+	
	G. umbilicalis	+						+	
	Hydrobia ulvae	+		+					
	Littorina littorea	+				c			
	L. obtusata	+							
	L. saxatilis	+		+		+			
	Monodonta lineata	+		+				+	
	Nucella lapillus	+							
	Patella vulgata	+				o		+	

F = Fyke net; L.T. = light trap. + = present, o = ocasional, c = common, a = abundant.

Table 1 (cont.)

Taxa		1	L.T. 1	2	L.T. 2	3	L.T. 3	4	L.T.4
	Rissoa parva	+							
	Rissostomia membranacea	+							
	Skeneopsis planorbis	+							
Opisthobranchia	*Archidoris ?*	+						+	
Bivalvia	*Anomia ephippium*			+		+			
	Cerastoderma glaucum	+		+					
	Chlamys varia	+		+		+		+	
	Hiatella arctica	+		l					
	Modiolarca tumida	l							
	Mytilus edulis	+				+			
	Ostrea edulis			+				+	
	Tapes decussata	+		+		+			
Bryozoa	*Alcyonidium gelatinosum*	+							
	Bowerbankia gracilis	+							
	Celleporella hyalina	+							
	Cryptosula pallasiana	+							
Echinodermata	*Amphipholis squamata*	+				+		+	
	Asterias rubens	+						+	
	Paracentrotus lividus	+						+	
	Psammechinus miliaris	+							
Tunicata	*Ascidia mentula*	+							
	Ascidiella aspersa	+		+		+		+	
	A. scabra	+							
	Botryllus schlosseri	+						+	
	Ciona intestinalis	o							
	Phallusia mammillata	c		c				+	
	Styela clava	+		+					
Pisces	*Anguilla anguilla*			F=3					
	Atherina presbyter	o						o	
	Ciliata mustela			F=2					
	Gobiosculus flavescens	+							
	Mugilidae indet.	+		+					
	Pleuronectes flesus			+					
	Pollachius virens			F=2					
	Pomatoschistus microps	+	l	+		+		+	
	Taurulus bubalis	l							

F = Fyke net; L.T. = light trap. + = present, o = ocasional, c = common, a = abundant.

This site has a wide central inflow channel, which allows sewater entry with most tides. The shores are narrow with rocky shore, eroded clay loam with cobbles and narrow clay loam banks with grasses and sedges, and narrow reedbeds.

Sampling

Five areas were selected for sampling from 24/8/98 (1-4) to 11/9/98 (5).
(1) (V956 488) A narrow (c.1-2m) till bank (probably clay loam) with *Arenaria maritima*, *Puccinellia* sp., *Carex extensa*, etc., covered at high spring tides.
(2) (V957 481) As above, but with *Juncus maritimus*, salt-marsh grasses and sedges; mink (*Mustela vison* Schr.) spraints were present in this area.
(3) (V957 489) An area of shore exposed at neap tide with cobbles on fine-textured sediment in a narrow, relatively sparse stand of *Phragmites australis*.
(4) As above, but with a sandy substrate.
(5) (V959 490) An area of *Fucus/Phragmites*/leaf storm debris on the inner shore, up to 25 cm thick in patches.

Results

Three species of carabid and eleven species of staphylinid were recorded, one species of which is regarded as indicator species (Tables 2 and 3). Ten of the 14 species are characteristic marine littoral species, and many may have originated as colonists from the surrounding open coast.

Aepus marinus is a local halobiont species of westerly distribution in Great Britain. Its range is limited from Norway to Brittany (Luff 1998), and is absent from Denmark, Germany and the Benlux coast (Lucht, 1987, Hansen 19966). It is probably local in Ireland (Luff 1998); Johnson and Halbert (1902) described it as locally common at the beginning of this century. *A. marinus* is a stenotopic species of intertidal rocky seashores (Lindroth 1974), occurring in coarse sand or gravel (Hyman and Parsons 1992).

TABLE 2. Staphylinidae from a cobble barrier lagoon shore at Kilmore Lake (Whiddy Is., Co. Cork). Indicator species are marked with an asterisk.

Atheta vestita (Grav.)	8
Bledius limicola Tott.	23
Cafius fucicola Curtis	3
Cafius xantholoma (Grav.)	6
Dinaraea angustula (Gyll.)	1
Emplenota obscurella (Grav.)	2
Gabrius trossulus(Nordm.)	2
Halobrecta flavipes Thoms.	18
Myrmecopora sp.	3
Omalium laeviusculum Gyll.	12
Xantholinus glabratus (Grav.)	1

TABLE 3. Carabidae from a cobble barrier lagoon at Kilmore Lake (Whiddy Is., Co. Cork). Indicator species are marked with an asterisk.

Aepus marinus (Ström) *	2
Cillenus lateralis Samouelle	1
Trechus obtusus Er.	1

Evaluation

The presence of only one indicator species, and the small area of shore habitat at Kilmore Lake, indicates low conservation interest for this site. However, the site should be regarded as part of Bantry Bay as a whole, or part thereof, in terms of sustainable populations, and there may be a greater conservation interest at this scale.

SUMMARY

Kilmore Lake is geomorphologically a good lagoon with a cobble barrier and inlet. However, the barrier has eroded and the lagoon is probably tidal on most tides. As little freshwater drains into it, the salinity remains high and the fauna and flora consist almost entirely of marine species of the open coast. Algal growth was poor and only 7 species were recorded in addition to *Enteromorpha* and *Cladophora.* Algae and fauna were confined to the littoral fringe, the central bed being occupied by a sludge-like deposit. The fauna was rich, however, with 113 taxa recorded. One indicator species of coleopteran was recorded.

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Plate 2. Kilmore Lake, Whiddy Island. 1. North and west shores. 2. *Phragmites* bed and stony shore at stream outlet; 3. East shore. 4. Barrier and temporary pool, 5. Lagoon and barrier at high spring tide; 6. Glacial material in remains of drumlin at the barrier; 7. Cobble barrier with inlet/outlet channel

3. AN LOCH MÓR, INIS OÍRR, Co. Galway

Lough More, Inisheer, Aran Islands

Location: L 989019; 53°03.5'N, 9°304'W. OS 1:25 000 Sheet "Aran Islands"
East shore of the island, 1 km from the harbour.

Lagoon type	karst rock lagoon
Area	6.6 ha
Salinity regime	oligohaline (0-5 ppt)
Maximum depth	23 m
Seawater entry	rock fissures
Tidal range	none
Conservation status	pcSAC, NHA No. 1275

Origins and history

This is a deep lake which is connected to the sea through underground rock fissures. Because of its depth, there were tentative plans during the last war to blast an entrance so that it could be used as a safe haven for submarines.

Palaeoecological studies of the lake's sediments currently being carried out by Prof. M. O'Connell of N.U.I., Galway show that this was once a freshwater lake.

Geology, geomorphology and landscape

The rock throughout the island is karstic limestone of lower Carboniferous age. The Aran Islands represent the remains of a long escarpment in which the limestone strata are separated by layers of shale and dip slightly towards the SSW giving a series of terraces on the north sides of the islands and low-lying land near the north coasts. Cracks and fissures run nearly north-south and water tends to drain northwards.

Loch Mór lies in a valley between hills reaching about 30 m and an escarpment runs along the west side. The land is mostly divided into small fields by stone walls and is used for grazing.

Description of the system

The lagoon is situated on the east side of the island, about 1 km from the ferry terminal at An Baile Thíos and can be reached by road. Its shape is an elongated triangle with the point directed SSW. It is about 200 m from the sea at its nearest point in the NE. Cliffs on all sides make the shores inaccessible from the land except for an area on the north side where the land is lower and horizontal pavement reaches the shore, and one place on the west shore which is reached by a footpath.

The lagoon is one of the deepest in Ireland, reaching at least 23 m. The shores are rocky and the lagoon bed shelves steeply. The lagoon floor consists of limestone terraces surrounding a central basin. A flat area in the north-eastern part forms a platform at 1-3m depth. A submerged vertical cliff with occasional horizontal ledges seems to extend all round the lagoon. Sediments could not be reached in most places. Some areas near the shore were shaded by thick rafts of *Enteromorpha.*

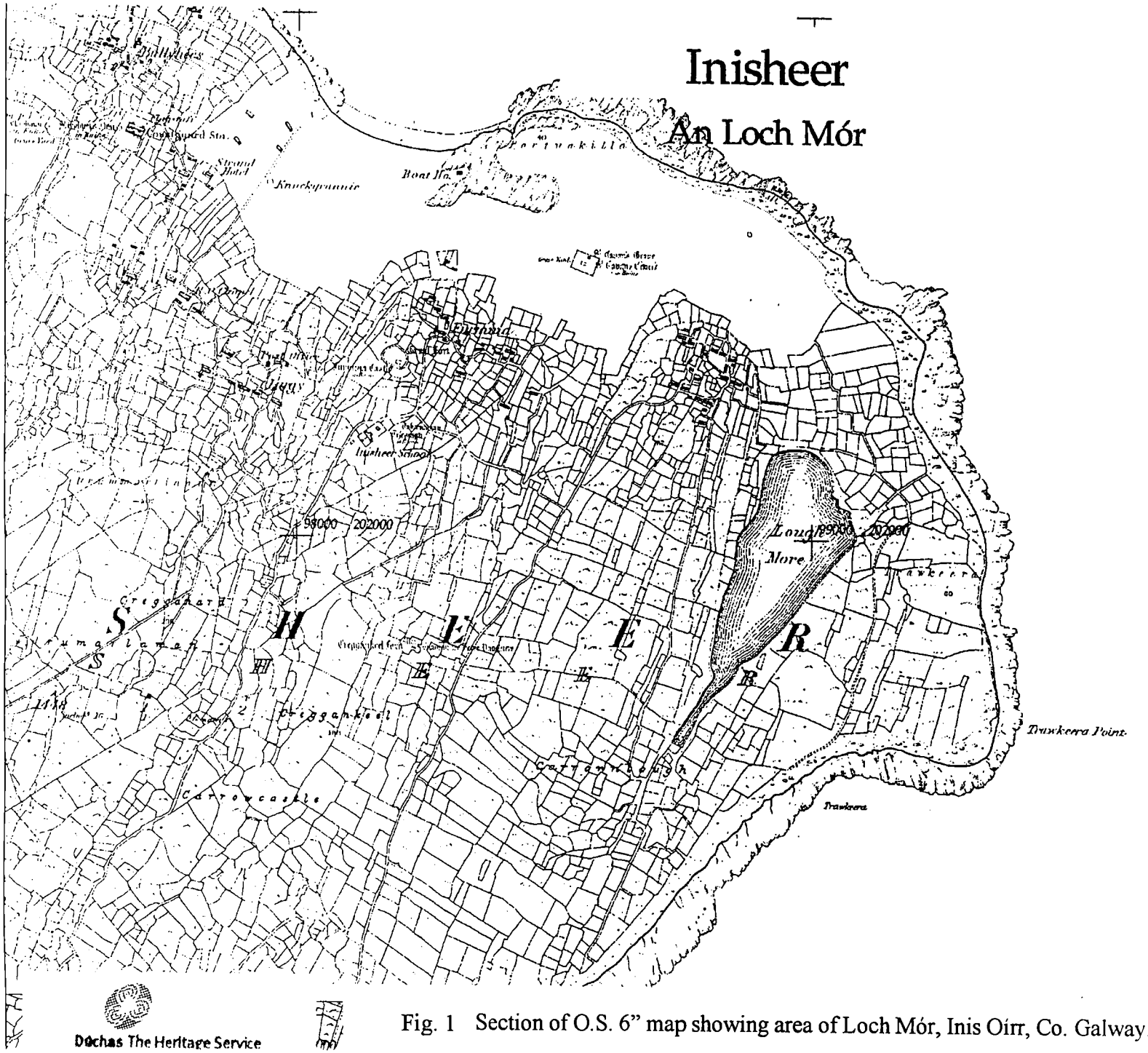

Fig. 1 Section of O.S. 6" map showing area of Loch Mór, Inis Oírr, Co. Galway.

Hydrology

This is an oligohaline lagoon with a surface salinity of 0-5‰ and little temporal or spatial variation. There was no salinity increase with depth within the top 5 m accessible for measurement with the meter cable but small lenses of freshwater were detected. A thermocline has been reported at about 6 m in depth (O'Connell, pers. comm.) but there is little change in salinity from the surface to the lagoon bed. Seawater enters by way of underground fissures. A small pool near the north-east shore contained water at 20‰ and saline water measuring 10‰ was present in surface grikes near the lagoon shore in this area. Only one point source of freshwater was identified, in a small area of *Phragmites* in the south.

Exploitation and threats

None

Conservation status

The lagoon is part of NHA No 1275. It is (?) within the Inis Oírr pcSAC.

VEGETATION

Description

This site is a deep karstic low salinity lake. The lake floor consists of stepped limestone terraces which surround a central hollow reportedly 20m deep. In turn, the lake is surrounded by bare limestone crags and pavement. There is very little development of marginal vegetation. Because of the lake's depth and isolation, it forms an ideal site for palaeo-ecological studies of the Aran Islands and Burren flora. Professor M. O'Connell of N.U.I.G. is currently conducting a major study of the lake sediments.

Underwater observations

Water clarity in Loch Mór is poor, probably due to a planktonic algal bloom. A yellowish light penetrates to a depth of about 5m. Given the depth of the lake, it is probable that higher salinity water occurs at depth but no visible sign of stratification was seen. The lake floor consists of a flat area of fissured limestone in the eastern part at a depth of 1-3m. it forms very dense stands in this area, the plants rooting in the limestone grikes. An underwater cliff terminates the zone of *P. pectinatus*. The cliff is vertical with occasional horizontal ledges. It was not possible to snorkel to the base of this cliff due to its depth (> 7m below the water surface) and the lack of light. A calcareous algal growth was well developed at the top of the cliff, while broken fragments accumulated on horizontal ledges. Below an estimated 6m the growth ceased and bare limestone rock was visible. This cliff seems to run along the circumference of the whole lake but the flat area of fissured limestone only occurs in the northeastern section.

Sampling

The site was surveyed on 24/6/1998 and 25-26/8/1998. Ten relevés of marginal vegetation were made and a map prepared (Fig. 2).
1-3 (09882016) were taken in a *P. australis* marsh (Fig. 3) at the head of the lake.
4-9 (09902020) were taken beside the lake in flat stony grassland.
The lake was explored by snorkelling. It was only possible to reach the bottom along the edge of the lake.

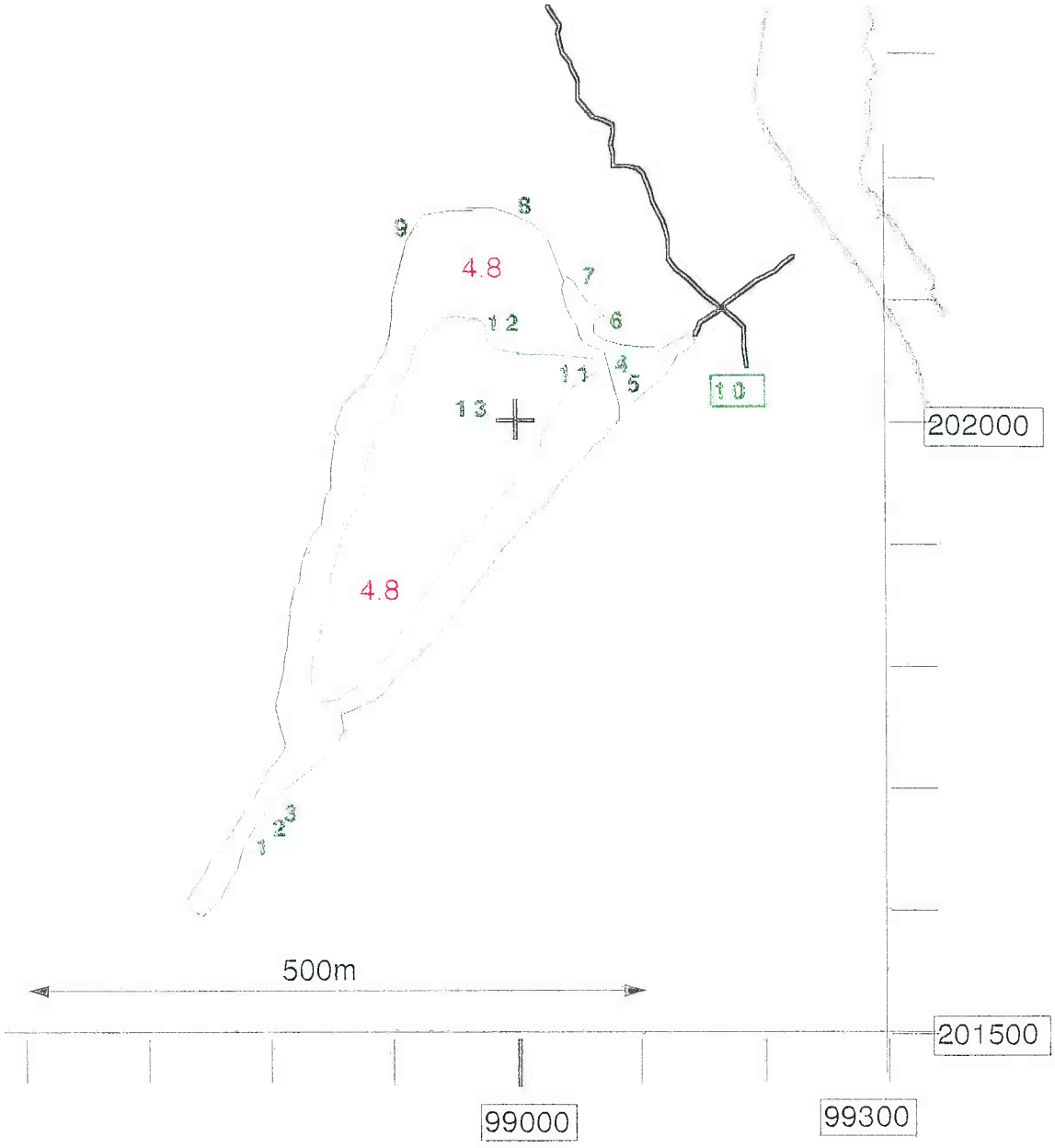

Fig. 2 Sampling stations Loch Mór, Inis Oírr, Aran Islands, Co. Galway. 1998.

11 and 12 (09902020) were taken in 1.5 m depth. The bottom was flat limestone karst with a dense vegetation of *Potamogeton pectinatus* growing in the grykes.
13 (09902020) was taken along the submerged cliff at a depth of 2-5m. A vertical limestone cliff was encrusted with calcareous algae.

A plankton sample was also taken point 11.

Results

Benthic vegetation was extremely uniform consisting of *Enteromorpha* and dense *Potamogeton pectinatus* stands. (see map) This vegetation ceases below 2-3m. Immediately below the *P. pectinatus* community a zone of hard calcareous algal nodules occurs. These nodules are 2-3 cm in diameter and have a superficial similarity to marine coralline algae. They appear to be the product of several species. Some of the nodules are attached to the limestone rock but dead or broken nodules form detritus on horizontal surfaces. The turbid water of the lake reduces light intensity and bare rock is found below about 5m.

The marginal vegetation includes open communities of rocky shores, small stands of *Phragmites, Schoenoplectus tabernaemontani* and *Scirpus maritimus* and a small area of the *Potentilla anserina* variant of the *Juncus gerardii* association.

The plankton consists of blue green and other freshwater algae.

Flora: No unusual plants were noted.

Assessment

The most unusual feature of the lake was the calcareous algal nodules which occur at 3-4m depth. No comparable algae have been recorded at other sites. They are related to the blue green algal crusts found in limestone lakes such as Lough Corrib but are much harder and larger in size. As a consequence of Prof. O'Connell's Palaeoecological investigations the site may become of great importance in helping to understand the historical development of saline lakes on the west coast of Ireland. For example, it has already been established that Loch Mór was probably a freshwater lake two millennia ago (O'Connell *pers. comm.*, O'Connell *et al.* 1997). If changes in salinity regime and even lagoonal vegetation can be dated, it will help explain the historical changes that occurred in other sites such as Lough Athola where submerged peat is found 4 m below the present saline water surface.

AQUATIC FAUNA

Description

An Loch Mór is situated in the northwest of Inis Oírr, approximately 1 km west of the harbour (Fig. 3.1). The lake is a very deep (at least 25 m) saline lake lagoon with limestone cliffs along much of the shoreline. The main body of the lake has a uniform salinity of 5 ppt between 1 and 5 m depth with lower salinity water over parts of the surface (0-3 ppt). Seawater enters from a tidal pool to the northeast of the lake from which diluted seawater (up to 20 ppt) runs into the lake through limestone fissures.

The lagoon is quite small (c. 7 ha) and has dense growths of aquatic vegetation in shallow areas, giving the appearance of eutrophication. Much of the shoreline and substrate of the shallow parts of the lake are limestone pavement and stones.

Sampling stations

The area was sampled briefly in mid June and from 24-26/8/98.
Four sampling stations were selected to reflect the influences of substrate, vegetation, freshwater and tidal inflows.

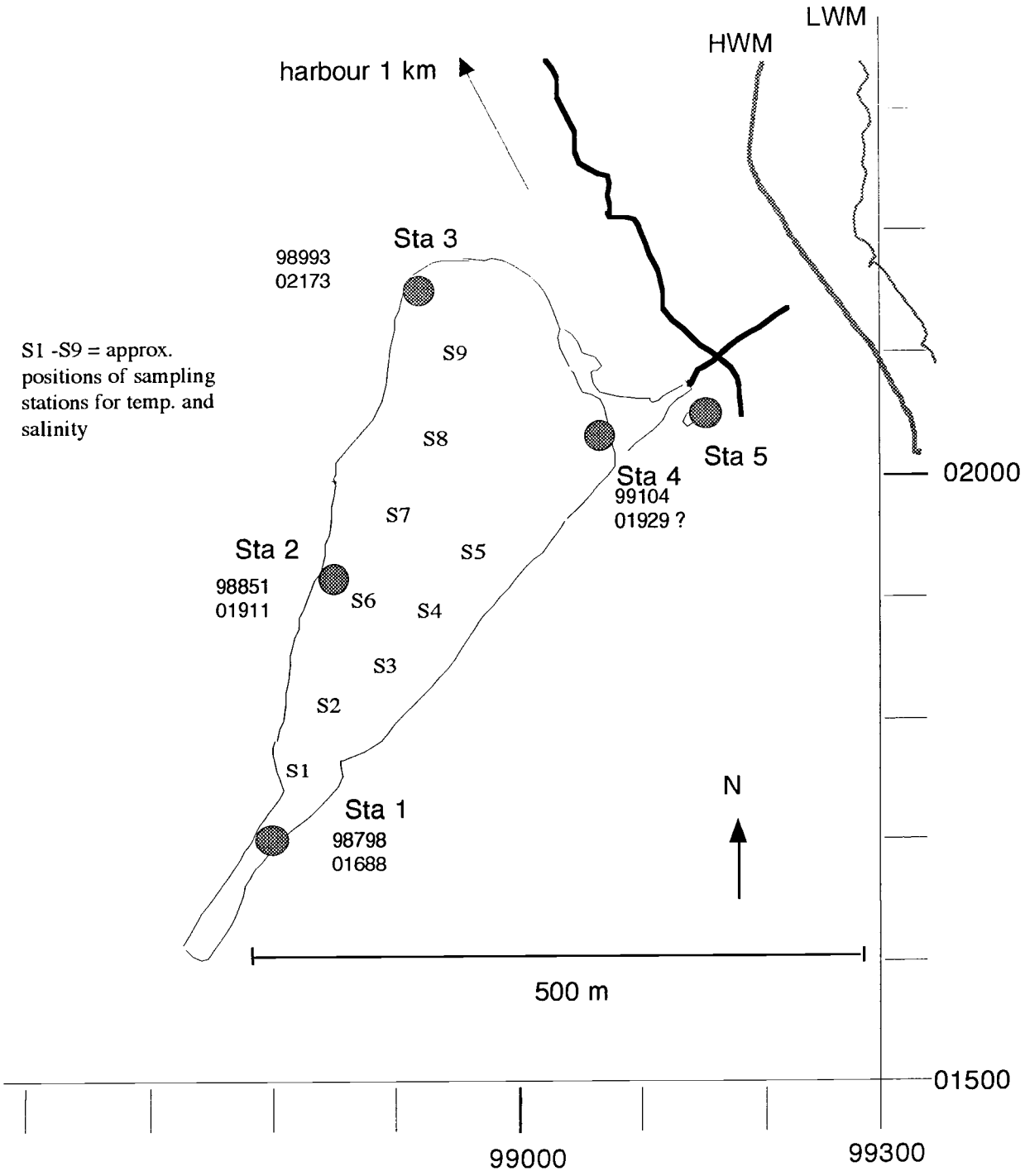

Fig. 4 Sketch map of An Loch Mór, Inis Oírr, Co. Galway, showing sampling stations used for a survey of aquatic fauna, 1998.

Station 1 (L 98798 01688) was located at the southern end of the lake where freshwater enters from a reed bed (*Phragmites*). Much of the shoreline consisted of sheer limestone faces and substrate was limestone pavement and rocks with finer sediments in crevices and sheltered areas. Water depth was up to 1m. Salinity measured 0 - 2.5 ppt over much of the surface but up to 4.9 ppt at 0.5 m and deeper.

Station 2 (L 98851 01911) was located on the west shore of the lagoon in a *Phragmites* swamp with dense growths of *Potamogeton* and rafts of *Enteromorpha.* Substrate consisted of limestone pavement and stones with finer sediments in grykes. Salinity measured 4.8 ppt and depth was up to 1m.

Station 3 (L 98993 02173) was located at the north end of the lagoon under a limestone cliff. Most of this area was a limestone shelf in water about 1m deep with a dense growth of *Potamogeton* and rafts of *Enteromorpha.* Salinity measured 4.7 - 4.9 ppt.

Station 4 (L 99104 01929?) was located in the northeast part of the lake (Plate 4.3.3) where diluted seawater enters from the tidal pool. Substrate consisted of limestone pavement, clints and grykes and loose stones. Depth varied from 0 - 1m and salinity measured 4.7 ppt over most of the area but up to 10 ppt in the grykes.

Station 5 (position not recorded) was located in the tidal pool to the northeast of, and approximately 100m from, the lake. Substrate consisted of limestone rock and large boulders. Depth was up to 2 m and water level fluctuated about 1m over a tidal cycle. The pool was covered with *Enteromorpha* and salinity measured up to 20 ppt during the sampling period but up to 28 ppt has been measured by M. O'Connell (pers comm.)

Results

Fauna

Table 1 shows the total species list for each station. The following is a list of species arranged in broad ecological categories based on the Venice system of salinity regimes (L* = lagoonal specialist in Britain, L*IR = proposed as lagoonal specialist in Ireland; * = interesting or rare species).

Marine-polyhaline

Lumbricillus sp.
Littorina saxatilis

Euryhaline

Procerodes littoralis
Gammarus duebeni
Jaera nordmanni L*IR
Potamopyrgus antipodarum
**Conopeum seurati* L*
Anguilla anguilla

Meso-oligohaline

Ischnura elegans

Oligohaline-freshwater

Corixa panzeri
Sigara concinna L*
Notonecta?glaucum.

Table 1 Aquatic fauna recorded from sampling stations in Loch Mór

		1	L.T. 1	2	L.T. 2	3	L.T. 3	4	L.T. 4	5
Turbellaria										
	Procerodes littoralis					c		a	140	
Annelida										
	Lumbricillus sp.									c
Crustacea										
Isopoda										
	Jaera nordmanni	c						c		c
Amphipoda		a	120	a	150	a	120	a	1000	c
	Gammarus duebeni	a	47	a	27		36	a	33	o
Insecta										
Odonata										
	Ischnura elegans			o	1					
Trichoptera	indet.								cases	
Heteroptera										
	Corixa panzeri	a	100	c	60	o	20	o	25	
	Notonecta ?glaucum	o		o	1			o		
	Sigara concinna			o	7			o	5	
Coleoptera	indet.								+	
Diptera	Chironomidae indet					o	4			
Mollusca	*Potamopyrgus antipodarum*	c	1	a	700	c	30	c	21	
	Littorina saxatilis									c
Bryozoa	*Conopeum seurati*							+		
Pisces	*Anguilla anguilla*							F = 3		

F = Fyke net; L.T. = light trap; + = present, o = occasional. c = common, a = abundant

Remarkably few taxa (15) were recorded in Loch Mór and only 10 identified to species. Two are regarded as lagoonal specialists in Britain, although one is of doubtful value as an indicator in Ireland. One (*J. nordmanni*) is a proposed specialist in Ireland. *Notonecta ?glaucum* was not positively identified but it is assumed that it is this species. Only one species is possibly of interest:

Conopeum seurati has been recorded at 16 of the 36 sites surveyed, but is not listed in a recent review of Irish marine Bryozoa (Wyse Jackson, 1991). Either the species is under recorded or a truly lagoonal specialist.

The fauna of the lagoon is remarkably poor despite the apparently stable and uniform conditions in the lagoon. Presumably this is due to the "island effect" and the problems of colonisation.

Salinity

Table 2 shows salinity and temperature data to 5m depth and maximum depth recorded. The lagoon is very deep (up to 23m) and remarkably uniform. Water from approximately 10m measured 10^{0} C.

Table 2 Salinity, temperature and maximum depth recordings from L. an Mór.

Sample point	OS position	Dmax	Depth	Salinity (ppt)	Temp. (C)
S1			surface	0.80	15.60
			01m	4.60	17.10
S2		6m	surface	3.90	18.10
			1m	4.60	17.50
			2m	5.00	17.20
			3m	5.00	17.20
			4m	5.10	17.00
			5m	5.30	16.40
S3	98939	20 m	surface	4.60	18.70
	01820		1m	4.80	18.70
			2m	4.80	17.10
			3m	5.00	17.10
			4m	5.10	17.00
			5m	5.20	16.70
S4	98964	23m	surface	4.60	19.00
	01892		1m	4.60	18.10
			2m	4.90	17.30
			3m	5.00	17.20
			4m	5.10	17.00
			5m	5.10	16.90
S5	99104	23m	surface	4.80	19.20
	01904		1m	4.80	19.10
			2m	4.90	17.80
			3m	5.00	17.20
			4m	5.10	17.00
			5m	5.20	16.80
S6	98951	18m	surface	4.70	18.20
	01816		1m	4.70	17.90
			2m	4.90	17.40
			3m	5.00	17.20
			4m	5.00	17.10
			5m	5.30	16.80
S7	98996	15m	surface	4.60	18.80
	01942		1m	4.70	18.30
			2m	4.90	17.50
			3m	5.00	17.30
			4m	5.00	17.10
			5m	5.20	16.90
S8	99104	25m	surface	4.70	19.10
	01929		1m	4.80	18.90
			2m	4.80	18.50
			3m	4.90	17.40
			4m	5.10	17.00
			5m	5.20	16.90
S9	99104	3m	surface	4.70	19.10
	01929		1m	4.70	19.00
			2m	4.90	18.70
			3m	4.90	18.50

Evaluation

The fauna is very poor, although some species are lagoonal specialists and one is potentially interesting. An interesting form of bacterial mat was found by the botanist (Roden, Vol. III). Faunistically, the lagoon is not of low conservation value but geomorphologically, it is unique and well deserving of protection.

ECOTONAL COLEOPTERA

Limestone karst lagoon with rock cliff or rock, boulder and cobbles shores. Emergent vegetation (Mainly *Phragmites australis*) in standing water (at least on 30.vii.1998), with the exception of the gorge to the north of the lake, in which, however, the water is fresh and freshwater mosses occur.

Sampling

There is insufficient habitat to allow comparative sampling, so a full survey was not undertaken. One area was selected for sampling on 30.viii.98.
Cobble shore (L990020). Shattered stones on this sand or silt substrate or on rock with *Enteromorpha* covering. *Ligia oceanica* and amphipods abundant.

Results

No ecotonal Coleoptera were recorded.

SUMMARY

Loch Mór is an unusual type of karst lagoon, very deep and at least 200 m from the sea. It is oligohaline and dominated by dense *Potamogeton pectinatus* and rafts of *Enteromorpha*. *Ruppia* was not found. Calcareous algal growths on submerged cliffs appear unusual but have not yet been identified. The aquatic fauna was poor with only 10 species (3 lagoonal specialists) and no ecotonal Coleoptera could be found.

The lagoon bed is currently being investigated by palaeoecologists.

References

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Wyse Jackson, P.N. 1991. Distribution of Irish marine Bryozoa, together with biographical notes relating to the chief researchers in the group. *Bull. Ir. biogeogr. Soc.* **14:** 129-18.

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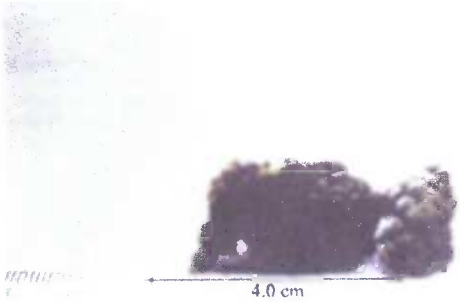

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Plate 3. Loch Mór, Inis Oírr. 1. View of lagoon looking southwest, 2. Thick raft of *Enteromorpha* at north end; 3. Tidal pool in northwest (faunal Stn. 5), 4. View from north; 5. *Potamogeton pectinatus* and *Enteromorpha*, 6. Northwest shore; 7. Calcareous algal nodules

4. LOCH AN CHARA, ÁRAINN Co. Galway

Lough Carra, Inishmore, Aran Islands

Location: L 887099; 53°06.8'N, 9°39.7'W. OS 1:25 000 Sheet "Aran Islands"
About 1 km north of Cill Rónáin.

Lagoon type	karst rock lagoon with artificial outlet
Area	±4.2 ha but varying depending on water level
Salinity regime	mainly mesohaline (6-31‰)
Maximum depth	1 m
Seawater entry	piped outlet, rock fissures
Tidal range	none
Conservation status	pcSAC, NHA No. 213

Origins and history

The lake appears to have been open to the sea until the last century when land reclamation resulted in the formation of the lagoon (Tim Robinson 1986).

Geology, geomorphology and landscape

The rock throughout the island is karstic limestone of lower Carboniferous age. The island represents the remains of a long escarpment in which the limestone strata are separated by layers of shale and dip slightly towards the SSW giving vertical cliffs on the south facing coast and a series of terraces on the north side of the island. Cracks and fissures run nearly north-south and water tends to drain northwards towards the low-lying land near the north coast where there are many lakes, turloughs and springs. Loch an Chara is just one of at least seven lagoons on this coast, but the only one with an artificial outlet.

The land is mainly divided into small fields by stone walls and around the lagoon is mostly used for grazing.

Description of the system

This is an elongated lagoon perpendicular to the coast with an artificial channel draining south-eastwards and emptying by way of a pipe under the road into a sandy bay. A road passes along the north-east shore providing easy access and a track follows the south-west shore. The shores are very gently sloping, allowing frequent flooding of surrounding land. Extensive beds of *Scirpus maritimus* fringe the south-west shore while the north-east is mainly grass. The lagoon is very shallow and depth did not exceed 1 m. The bed is mainly sandy and firm near the north-east shore but is soft organic silt in the centre and near the sedge beds. There are areas of bedrock and field walls extend into the lagoon.

Hydrology

The lagoon was mesohaline and the salinity varied spatially. Salinity readings indicate that the main source of seawater is the pipe and artificial channel, but the sea also enters through one or more rock fissures from north-west (Trá na mBuaille), a distance of some 250 m, and seawater has been seen on two occasions running down the track to the

Inishmore

L. Carra

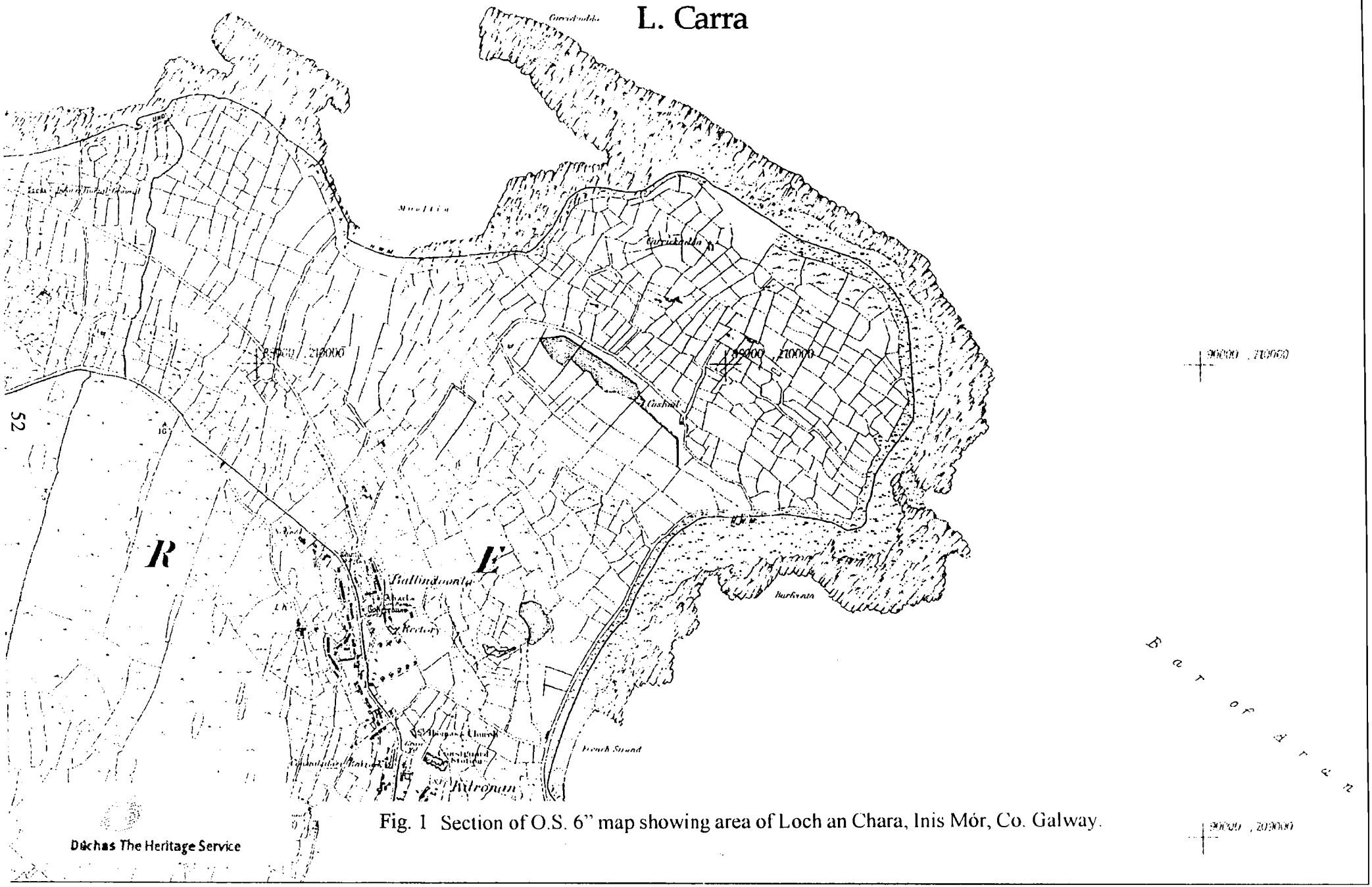

Fig. 1 Section of O.S. 6" map showing area of Loch an Chara, Inis Mór, Co. Galway.

lagoon from that direction. A spring on the north-east shore was the only point source of freshwater identified; its influence appears to be local.

Exploitation and threats

The lagoon is somewhat eutrophic and large amounts of plant debris accumulate at the lagoon edge. Cattle graze the north-eastern shore. A future increase in the extraction of groundwater may lower the water table sufficiently to affect the lagoon.

Conservation status

The island is part of the Aran Islands NHA area. It is within the Inis Mór pcSAC.

VEGETATION

Site description

Loch an Chara is a shallow lake which is linked to the sea at each end. To the southeast a man made channel drains into Cuan Chill Éinne, while at the northwest end an underground channel percolates through the limestone bedrock and presumably reaches the sea some 200m distant. The lake is surrounded by fields and pasture. The fluctuating level of the lake creates a considerable area of marginal vegetation. It appears that the lake was open to the sea until the last century when land reclamation resulted in the present situation (Robinson 1986). 500 m south of Loch an Chara two other small brackish ponds occur.

Sampling

The site was surveyed on 22/6/1998 and 20/8/1998. Marginal and benthic vegetation were sampled on foot, due to the shallowness of the site. No plankton sample was taken due to shallow depth.
Relevés 1-10 (0887 2099) were made along the margin of the lake in periodically flooded pasture. Even though bedrock outcrops frequently in the area, the lake is surrounded by soil and sand deposits.
Relevés 11 and 12 (0887 2099) were made in the lake. Water depth is 0.5 to 1.0m with a substrate of sand and mud.

Results.

This shallow lagoon supports *Ruppia* sp. and *Potamogeton pectinatus* stands. Both species of *Ruppia* were recorded. *R. maritima* was commonest in water less than 50cm while *R. cirrhosa* occurred mainly in deeper water. *P. pectinatus* occurred occasionally in deeper water. Drift and attached *Enteromorpha intestinalis* and *Cladophora vagabunda* were very common.

The marginal vegetation consists of the *Potentilla anserina* variant of the *Juncus gerardii* association, as well as extensive stands of *Scirpus maritimus*. Wymer (1984) also recorded the *J. gerardii* association at this location.

Notable plants

Both species of *Ruppia* occur. A sample of *Cladophora vagabunda* was identified by Professor C. Van den Hoek.

Assessment. The lagoon has no unusual vegetational or floristic features other than an extensive marginal vegetation with the *Potentilla anserina* community well developed. Wymer (1984) also recorded the community at this location.

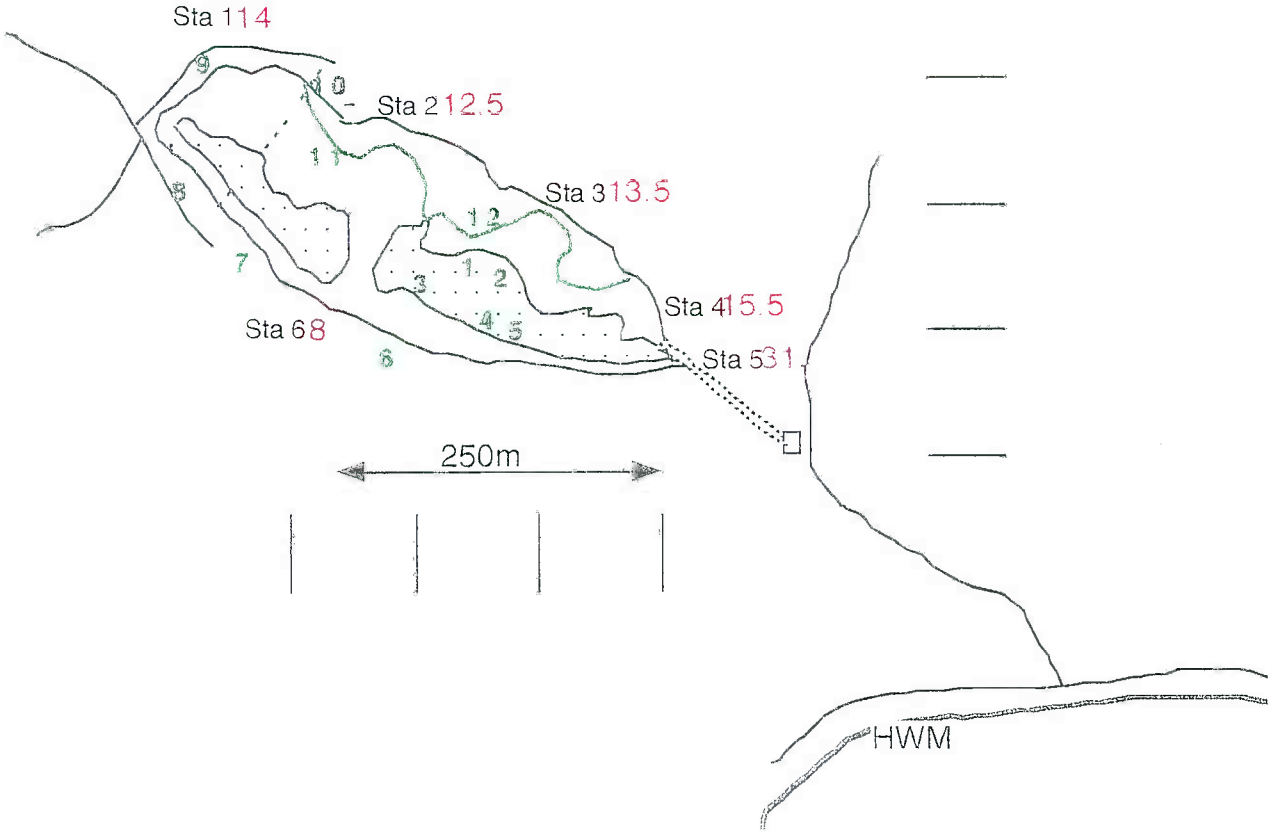

Fig. 2 Map of Loch an Chara, Inis Mór, Aran Islands, Co. Galway, showing sampling stations. 1998

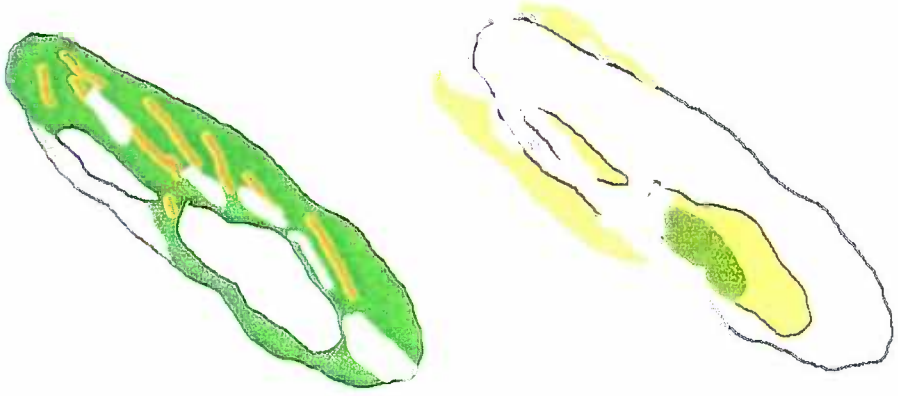

Fig. 3 Benthic and marginal vegetation of Loch an Chara,

Description

Loch an Chara is a saline lake lagoon in karst geology, situated on the north coast of Inishmore, approximately 1 km north of Kilronan. Open water covers an area of approximately 4 ha and appears to receive seawater from an underground fissure in the limestone bedrock at the north end of the lake and from a leaking sluice at the south end. According to Robinson (1986) the lake was open to the sea until the last century when land reclamation resulted in the present situation. Presumably before the road was built, water drained to the south and seawater was also able to enter freely from both directions. Attempts have been made to drain this water to the south through the sluice under the road. The lagoon is shallow (up to 1m) and salinity ranged from 6 to 20 ppt with an apparent increase from north to south. Substrate is basically limestone pavement overlain with sand and a thick layer of fine organic sediments in the central part of the lagoon. The shoreline is fringed with wet grasslands, with limestone rocks and walls.

Sampling stations

The area was sampled briefly on 22 June 98, from 20-22/8/98 and again on 18/10/98.

Six sampling stations were selected to reflect the influences of substrate, vegetation, freshwater and tidal inflows.

Station 1 (L 88603 10029) was located at the north end of the lagoon near where seawater appears to enter the lake from a limestone fissure. Substrate consisted of soft organic mud under shallow water (0 - 0.5m), surrounded by emergent vegetation and limestone walls. Salinity measured 13.1 - 15.5 ppt on two consecutive days in August and 12 ppt in September.

Station 2 (L 88704 10032) was located on the northeast shore of the lagoon. Substrate consisted of sand with finer muddy silt bordered by stone walls and grassland. Depth was up to 0.5m with dense beds of aquatic vegetation and salinity measured 12.9 - 14.5 ppt.

Station 3 (L 88805 09944) was located on the northeast shore of the lagoon to the south of Sta.2. Substrate was mostly of clean shell sand along the shore with deep finer sediments and dense beds of aquatic vegetation further into the lagoon and occasional stones. Depth 0 - 1m and salinity 13.5 -14.9 ppt on the surface, up to 20 ppt at 1m depth.

Station 4 (L 88910 09830) was located at the southern end where the drainage channel from the sluice enters the lake. Substrate was muddy sand with deep mud in places and occasional stones. Shoreline composed of rough pasture, stone walls and low peat cliffs. Depth from 0 - 0.5m and salinity 14.5 - 15.3 ppt.

Station 5 (L 8892 0980 ??) was located on the channel between the sluice and the lake. Water levels were very low at the time of sampling (0 - 30 cm) and substrate consisted of fine, soft sand and silt. Salinity was highest in this area (26 - 31 ppt).

Station 6 (L 88672 09916) was located on the western shore of the lake. A drainage channel runs to the southeast from this area, which is probably dry at times and is more of a flooded saltmarsh than a true part of the lake. Substrate consisted of fine soft mud and salinity was relatively low (11.2 ppt) suggesting seepage or overland flow from the fields to the west of the lake.

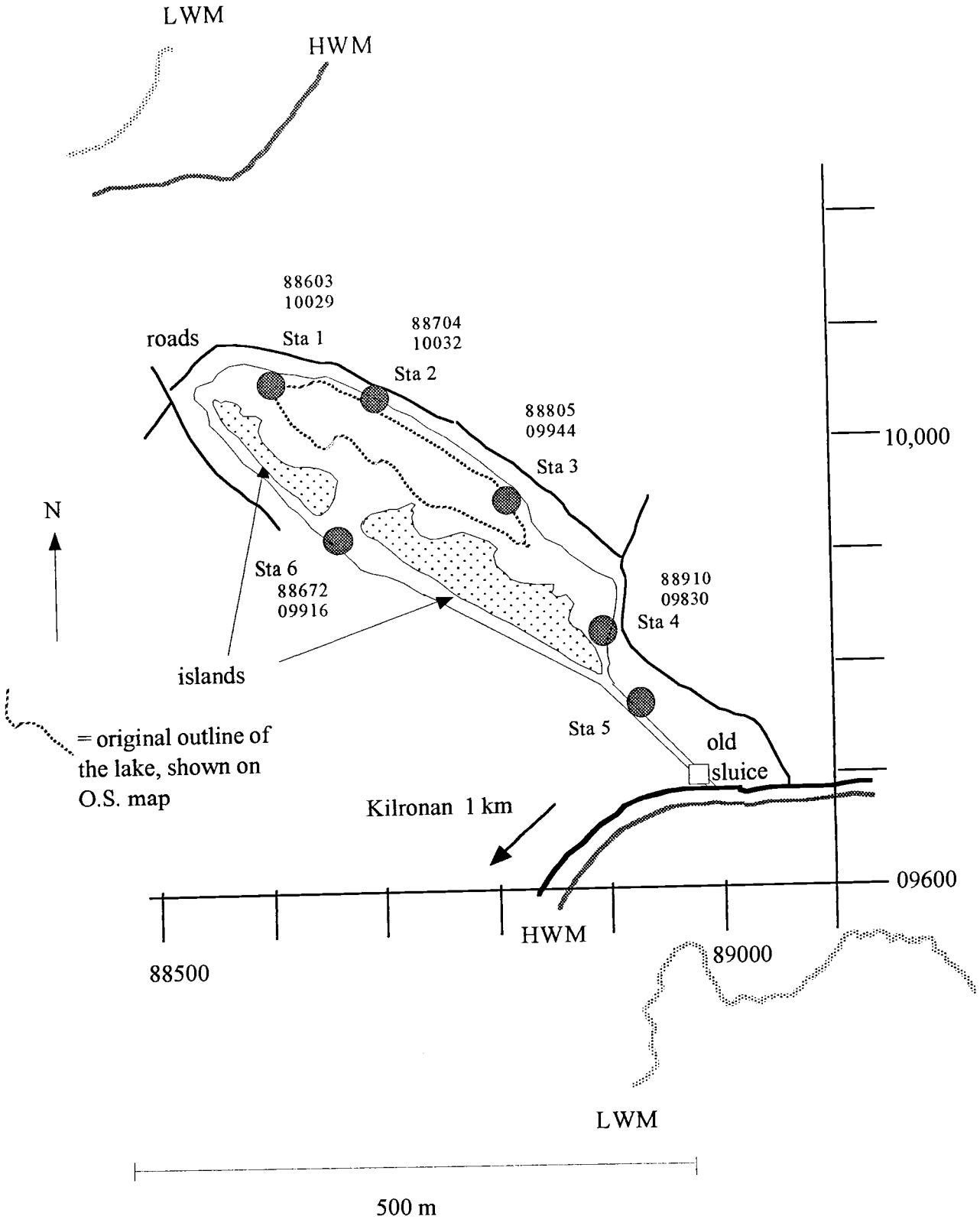

Fig. 4 Sketch map of Loch an Chara, Árainn, Co. Galway, showing sampling stations used for a survey of aquatic fauna, 1998.

Results

Table 1 shows the total species list for each station. The following is a list of species arranged in broad ecological categories based on the Venice system of salinity regimes (L* = lagoonal specialist in Britain, L*IR = proposed as lagoonal specialist in Ireland; * = interesting or rare species. Species in brackets refer to previous records).

Marine-polyhaline	
Cirratulidae indet	
Melita palmata	
(Littorina saxatilis)	
Poly-mesohaline	
**Jaera ischiosetosa*	L*IR
Hydrobia ventrosa	L*
**Sigara selecta*	L*
Ochthebius punctatus	L*
Euryhaline	
Hediste diversicolor	
Jaera nordmanni	L*IR
Gammarus duebeni	
Palaemonetes varians	L*
(Potamopyrgus antipodarum)	
Cerastoderma glaucum)	(L*)
Anguilla anguilla	
Meso-oligohaline	
Eurytemora sp	
Ochthebius dilatatus	
Sigara stagnalis	L*
Enochrus bicolor	L*
Oligohaline/limnetic	
Corixa ?panzeri	
Uncertain	
Cytherura gibba	
**Megasternum obscurum*	

A total of 22 taxa were recorded in Loch an Chara in 1998, of which 17 were identified to species; 6 of these are lagoonal specialists in Britain and 2 additional species are possible lagoonal specialists in Ireland. *Littorina saxatilis* and *Cerastoderma glaucum* were not recorded alive during the sampling period but have been recorded in the recent past (M. O'Connell *pers comm.*). *Cerastoderma glaucum* is an additional lagoonal specialist which probably occurs in the lagoon periodically, at least as spat, judging by the number of spat shells which presumably do not survive for many years. 5 species are interesting or rare:

Sigara selecta was abundant at this site and appears to be the second only Irish record. Previously only recorded from Ventry on the Dingle peninsula (McCarthy and Walton, 1980). This species is listed as a lagoonal specialist in Britain, where it tolerates higher salinities than *S. stagnalis* (Scudder, 1976). The previous record from Ventry was described by McCarthy and Walton as "difficult to explain since it has not been found at other brackish water sites recently investigated along the south coast". This record from the Aran Islands is therefore of great interest and the large population of this rare lagoonal specialist at this site is very significant for conservation purposes.

Jaera ischiosetosa was also recorded at L.Athola, and Maghery L., during this survey and at Moorlagh, L. Murree and Furnace L. in 1996. The only previous record appears to be for L. Hyne, Co. Cork (Goss Custard *et al.*, 1979).

Enochrus bicolor was also recorded at Ballyteige, L. Phort Chorrúch, and L. an Aibhnín during this survey, at six sites during the 1996 survey and also from Port na Curra, Inishmaan in 1998 and in samples collected at the North Slob in 1991 (Galvin 1992). There are few other records for the country.

Megasternum obscurum was also recorded at Ballytiege during this survey and at Furnace L., L. an tSáile, L. Murree and Corragaun. during the 1996 survey but is otherwise described as rather rare in Ireland (Foster *et al.*, 1992).

Ochthebius punctatus was recorded at Corragaun, Farranamanagh and Bridge L. during the 1996 survey. It is listed as a lagoonal specialist for Britain, but not common. Since 1988, recorded at several brackish sites in Antrim and Down (Nelson *et al.* 1998. Several large corixid nymphs and females were assumed to be *C. panzeri.*

Table 1. Aquatic fauna recorded in Loch an Chara, Arainn, Co. Galway, 1998.

Taxa		1	L.T. 1	2	L.T. 2	3	L.T. 3	4	L.T. 4	5	6
Annelida	Cirratulidae indet.									1	
	Hediste diversicolor							o		o	
Crustacea											
Copepoda	*Eurytemora sp.*							+			
Ostracoda	*Cytherura gibba*							+			
Isopoda											
	J. nordmanni	c		+				c		+	
	Jaera ischiosetosa	1									
Amphipoda		+		+		+		o		o	o
	Gammarus duebeni										2
	Melita palmata			4				1		5	
Decapoda	*Palaemonetes varians*	a	200	a	250	c	55	c	130	+	
Insecta											
Trichoptera	(cases)					+		a			
Heteroptera	Corixidae sp.	+	21	+	550	+	6	+	3	+	+
	Corixa ?panzeri				4						
	Gerris sp.										+
	Sigara selecta	c	21	a	200	o	6	o		a	o
	S. stagnalis			o	3						
Coleoptera						o		o		o	
	Enochrus bicolor	1				1		2		1	
	Megasternum obscurum	3									
	Ochthebius dilatatus	1									
	O. punctatus									1	
Diptera	Chironomidae indet.	+		+		+		+		+	+
Mollusca											
Prosobranchia	Hydrobiidae	+		+		+		c		+	+
	Hydrobia ventrosa			+	7	+	3	+	2	+	+
	(Littorina saxatilis)									shells	
	Potamopyrgus antipodarum										
Bivalvia	*(Cerastoderma glaucum)*					shells					
Pisces	*Anguilla anguilla*									1	

L.T. = light trap; + = present, o = occasional. c = common, a = abundant, ( ) = previous record.

Evaluation

Although geomorphologically the site is not particularly striking, it is nevertheless an interesting type of karstic lagoon which appear to be rare in a European context.

It is interesting to compare the fauna of this lagoon with the nearby lagoon L. Phort Chorrúch which has a far less interesting fauna. *Gasterosteus aculeatus* is extremely abundant at that site but was not recorded here, whereas on the other hand, *Palaemonetes varians* was extremely abundant in L. an Chara but not recorded in Phort Chorrúch. It is difficult to imagine why both species have not colonised both lagoons. Possibly this is due to the fact that neither of these karstic lagoons has a direct communication with the sea.

The species list is low but contains a large number of lagoonal specialists and five rare species. This site could easily be disregarded as of no significance based on morphology but it is the best example of a lagoonal community in the Aran Islands, and has a thriving population of a rare lagoonal specialist. The site should be protected for these reasons alone.

ECOTONAL COLEOPTERA

This is a karst lagoon with a sand causeway /barrier at one end, but it is also fed and drained via grykes. It was drained in the past but is now revegetated with *Bolboschoenus maritimus*. The shore ecotone was mostly relatively abrupt (at the time of sampling) from grassland to *B. maritimus* in standing water. The area floods to the roadway in winter, according to a local landowner.

Sampling

Two areas were selected for sampling on 26/8 – 19/9/98:

(1) A relatively sparse sward of *Agrostis stolonifera. Juncus gerardii, Glaux maritima, Triglochin maritima*, and sparse *Bolboschoenus maritima*, 2-8 m wide, between *B. maritima* in standing water offshore, and limestone grassland (*Trifolium pratense, Centaurea nigra, Juncus articulatus*, etc.) inshore. The area had been grazed, but not very recently. Offshore (0.5 m) salinity was 12 ‰ (16 ix 1998).

(2) An area similar to that above, but with a more dense sward with insignificant *B. maritimus*.

Results

A total of five species of carabid and eleven species of staphylinid were recorded, none of which are regarded as indicator species (Tables 2 and 3).

TABLE 2 Staphylinidae from karst lagoon shores at Loch Chara and Loch Phort Chorrúch, Inis Mór (Co. Galway). The same sampling techniques and effort were used at each site, with the exception of L. Phort Chorrúch where barrier overwash litter was sieved. Indicator species are marked with an asterisk.

	Loch Phort Chorrúch	Loch Chara
Amischa analis (Grav.)	1	-
Anotylus rugosus (Fab.)	4	-
Atheta amplicollis (Muls. Rey)	17	1
Atheta clientula (Er.)	6	-
Atheta fungi (Grav.)	1	-
Atheta graminicola (Grav.)	21	1
Atheta orbata (Er.)	1	-
Atheta vestita (Grav.)	1	-
Brundinia meridionalis (Muls. Rey) *	1	-
Carpelimus corticinus (Grav.)	1	3
Cordalia obscura (Grav.)	15	-
Gabrius nigritulus (Grav.)	23	-
Gyrohypnus fracticornis (Müll.)	5	-
Heterothops binotatus (Grav.) *	2	-
Mycetoporus splendidus (Grav.)	5	-
Quedius maurorufus (Grav.)	7	-
Rugilus orbiculatus (Payk.)	1	-
Sepedophilus nigripennis (Steph.)	2	1
Stenus brunnipes Steph.	1	3
Stenus canaliculatus Gyll.	25	131
Stenus clavicornis (Scop.)	14	4
Stenus fulvicornis Steph.	9	3
Stenus juno (Payk.)	8	1
Stenus ossium Steph.	12	-
Tachinus signatus Grav.	49	-
Tachyporus nitidulus (Fab.)	1	-
Xantholinus jarrigei Coiffait	3	-
Xantholinus longiventris Heer	5	-
Stenus cicindeloides (Schall.)	-	5
Stenus nanus Steph.	-	1

TABLE 3. Carabidae from karst lagoon shores at Loch Chara and Loch Phort Chorrúch, Inis Mór (Co. Galway). The same sampling techniques and effort were used at each site, with the exception of L. Phort Chorrúch where barrier overwash litter was sieved. Indicator species are marked with an asterisk.

	Loch Phort Chorrúch	Loch Chara
Bembidion assimile Gyll.	5	-
Bembidion mannerheimi Sahl.	3	-
Demetrias atricapillus (L.)	1	-
Pterostichus strenuus (Panz.)	2	-
Dyschirius globosus (Herbst)	-	1
Elaphrus cupreus Dufts.	-	1
Pterostichus niger (Schall.)	-	3
Pterostichus nigrita (Payk.)	-	1
Pterostichus crenatus (Duft.)	-	1

Evaluation

Conservation value was not indicated at this site because no indicator species were found. The dominance of a single species, *Stenus canaliculatus*, may indicate excessive disturbance by flooding by saline water. The site is also rather isolated, surrounded by dry limestone soils which would not act as a refuge for wetland fauna.

SUMMARY

Loch an Chara is a shallow, mesohaline, karst lagoon, partly overgrown with *Scirpus maritimus*, but with a surprisingly rich fauna. Both species of *Ruppia* were present and also *Potamogeton pectinatus*. 17 species of aquatic fauna included 8 lagoonal specialists and 5 rare species. The water bug *Sigara selecta* was very abundant. This is only the second Irish record of this lagoonal species. No indicator species of ecotonal Coleoptera were found.

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Wymer, E.D. (1984) The phytosociology of Irish saltmarsh vegetation. Unpublished M.Sc. thesis, National University of Ireland.

Plate 4. Loch an Chara, Árainn. 1. Aerial view of lagoon, Kilronan on the left, 2 Northeast shore, 3 Southwest shore, 4. North end (faunal Stn. 1), 5 Drainage channel (faunal Stn. 5).

5. LOCH PHORT CHORRÚCH, ÁRAINN, Co. Galway

Port Cowrugh Lough, Inishmore, Aran Islands

Location: L 857112; 53^{0}08.2'N, 9^{0}42.5W. OS 1:25 000 Sheet "Aran Islands"
North shore of Inis Mór, about 3 km west of Cill Rónáin

Lagoon type	karst rock/sedimentary lagoon
Area	4 ha
Salinity regime	oligohaline (0-4.5‰)
Maximum depth	1 m
Seawater entry	grikes, overwash, percolation
Tidal range	none
Conservation status	pcSAC, NHA No. 213

Origins and history - nothing known.

Geology, geomorphology and landscape

The rock throughout the island is karstic limestone of lower Carboniferous age. The island represent the remains of a long escarpment in which the limestone strata are separated by layers of shale and dip slightly towards the SSW giving vertical cliffs on south facing coast and a series of terraces on the north side of the island. Cracks and fissures run nearly north-south and water tends to drain northwards towards the low-lying land near the north coast where there are many lakes, turloughs and springs. Loch Phort Chorrúch is just one of at least seven lagoons on this coast, several of which have cobble barriers.

The land is mainly divided into small fields by stone walls and around the lagoon is mostly used for grazing.

Description of the system

The lagoon is situated on a small peninsula about 3 km from Cill Rónáin and is easily reached by road. It is separated from the sea by small grass fields to the north and east, and by a broad barrier of cobbles and gravel backing a sandy beach to the west. The barrier measures a good 50 m across and was sparsely vegetated.

The lagoon is very shallow with a maximum depth of 1 m and the shores are very gently sloping. Pavement rock forms parts of the shore in the north and north-east and a low stone wall has been built at the waters edge to prevent the access of cattle in the east. On the landward side, a floating scraw of *Phragmites* and *Scirpus maritimus* has developed and the nearby substrate is semi-liquid mud with a strong smell of hydrogen sulphide. The substrate is gravelly in parts of the north but elsewhere consists mainly of very soft, deep silt with a high organic content. The lagoon is highly eutrophic, probably as a result of large quantities of drift seaweed washed or blown over the cobble barrier during storms (M. Ó'Connell, pers. comm.).

Hydrology

This is an oligohaline lagoon receiving only small influxes of seawater, chiefly through fissures in the limestone. Salinities of 0.5-4.5‰ were recorded. Seawater appears to enter mainly in the north-west where the salinity was slightly higher. The sea also washes over the barrier during storms (observed in winter 1998-99 by M. Ó'Connell) but there is no evidence that higher salinities are ever persistent. A well, or spring, provides a

Inishmore

Portcowrugh

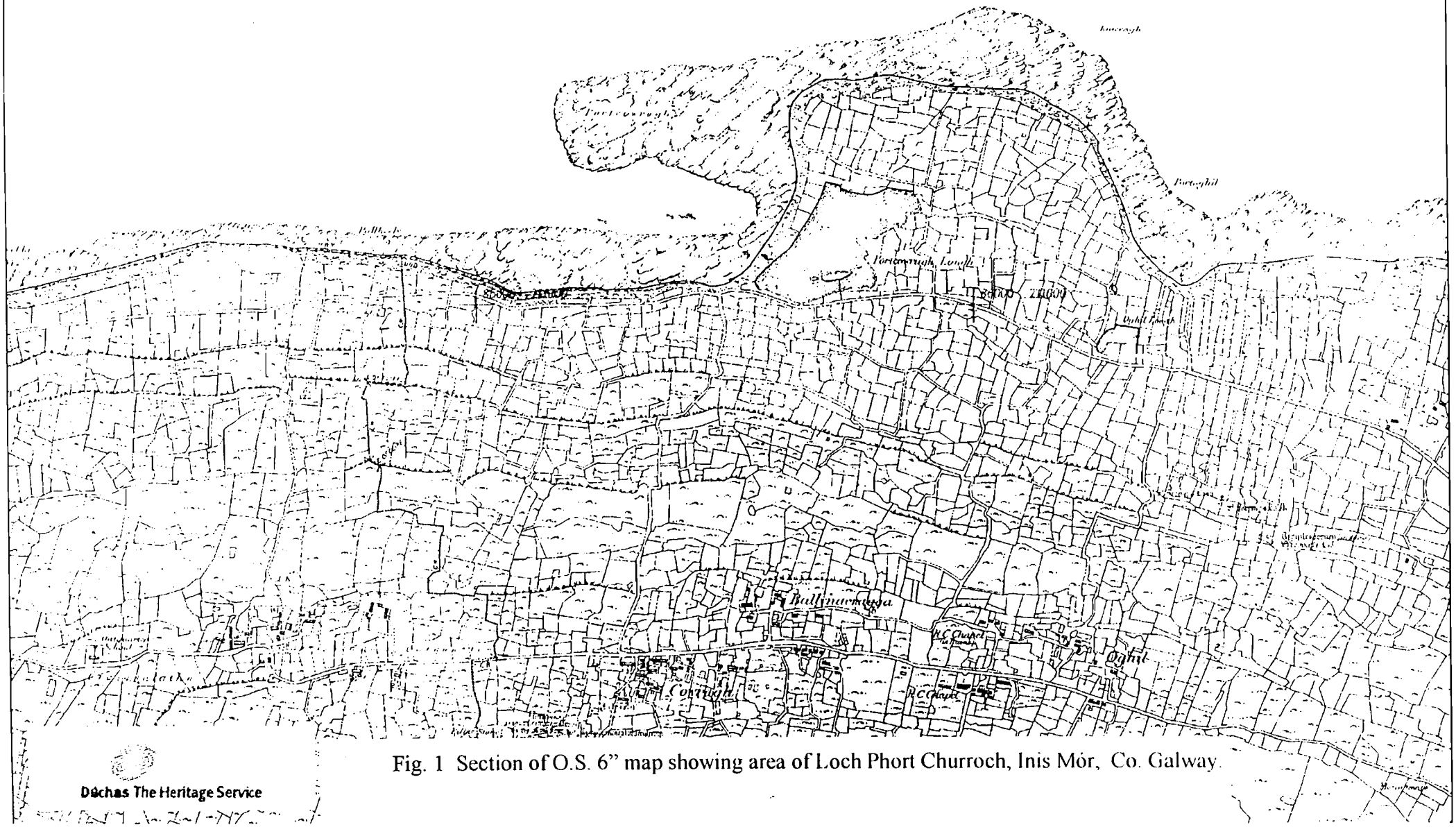


Fig. 1 Section of O.S. 6" map showing area of Loch Phort Churroch, Inis Mór, Co. Galway.

point source of freshwater on the south shore but its effect on salinity was confined to a small area only a few metres across.

Exploitation and threats

Eutrophication appears to be mainly due to natural processes. Pressures for increased extraction of groundwater could affect water levels in coastal lagoons of the region.

Conservation status

The island is part of the Aran Islands NHA area. It is within the Inis Mór pcSAC.

VEGETATION

Description

The lake has developed behind a large and impressive shingle barrier. The surrounding ground consists of grassland on thin soil and outcropping limestone pavement. A small spring or well discharges into the lake below the road on the southern side. On the landward side of the barrier a floating scraw of *Phragmites australis* and *Scirpus maritimus* has developed. According to Dr M. Ó'Connail of Kilronan large quantities of drift seaweed are tossed over the barrier during winter storms. The weeds decay causing a noticeable smell of hydrogen sulphide. In winter 1998/99 the barrier was partially overtopped during storms.

This lake is very shallow with no part exceeding 1.5m depth. The western section adjoining the *Phragmites* scraw consists of fine semi-liquid organic mud. In the centre of the lake a dense growth of *Ruppia cirrhosa* occurs, the eastern part is floored by submerged limestone karst.

Sampling

The site was surveyed on 22/6/1998 and 19/8/1998.

Relevés 1-9 (08562111) were taken in the *Phragmites* scraw, 10 was taken in a *S. tabernaemontani* stand , and 11-12(08582112) were made in pasture.

The centre of the lake was explored by snorkelling.

Relevé 13 was taken in 1m depth on a sandy bottom while 14 was taken on a submerged karst/ sand bottom in 1m depth.

One plankton sample was taken at point 13 .

Results

The lake is a shallow low salinity lagoon. Both species of *Ruppia* and *Potamogeton pectinatus* form stands on firmer substrates. *Ruppia* sp. grows on sandy mud while *P. pectinatus* grows in the limestone grykes. The western part of the lagoon was mainly a semi liquid mud. *Enteromorpha intestinalis* covers outcropping limestone rocks.

Marginal vegetation includes the dense scraw of *Phragmites australis* and *Scirpus maritimus* growing behind the cobble barrier. This vegetation has a distinctly maritime facies (relevés 1-9). It differs from other stands of *P.australis* in the presence of maritime species including *Aster tripolium*. Single species stands of *S. tabernaemontani* (10) and *S. maritimus* occur around the lake. The *Potentilla anserina* variant of the *Juncus gerardii* association was well developed on the north and east side of the lake (11 and 12). Wymer (1984) also recorded it here. However he did not take relevés with *E. uniglumis*. Webb (1980) recorded it as occasional in brackish habitats on Aran.

The plankton sample was almost exclusively comprised of zooplankton.

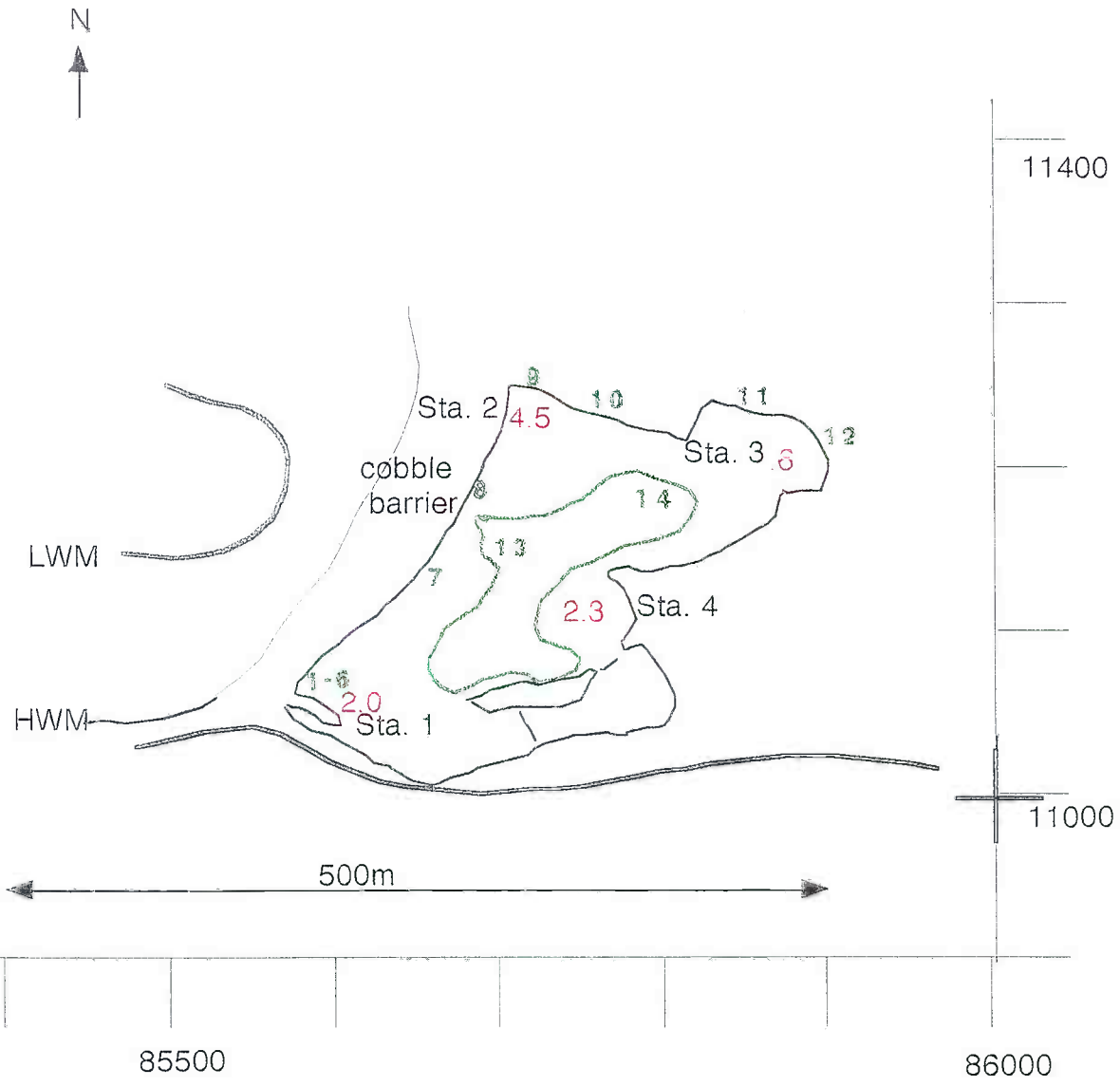
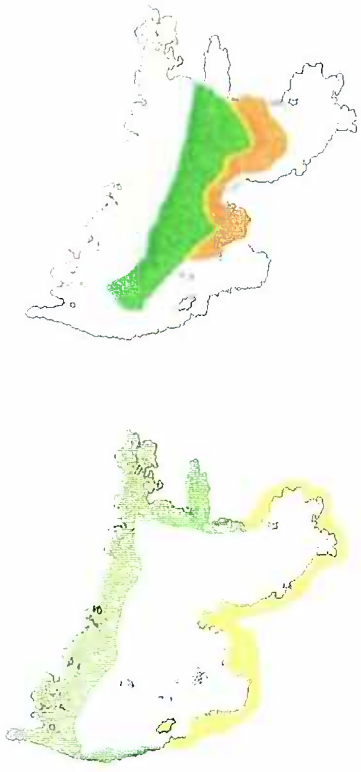


Fig. 2 Sampling stations in Port Chorrúch, Inishmore, Co. Galway. July -September, 1998.

Fig. 3 Benthic and marginal vegetation of Loch Phoirt Chorruch



Notable species

Both species of *Ruppia* occur.

Assessment

The most interesting feature of the lagoon is the natural eutrophication caused by seaweed detritus which appears to provide nutrients for the malodorous *Phragmites/Scirpus* scraw.

AQUATIC FAUNA

Description

Loch Phort Chorrúch is a natural sedimentary lagoon with a long, unbroken cobble barrier. The lagoon is 4 ha and lies on the north coast of Inishmore, 2.5 km west of Kilronan (Fig. 1). Seawater enters by percolation through the barrier and presumably by overtopping the barrier during storms and possibly through limestone fissures in the northwest. The lagoon is shallow (approx. 1m) and salinity was 0 - 4.5 ppt during the period of sampling. However, water levels were exceptionally high during the sampling period due to heavy rainfall the previous day and salinity may be higher under normal circumstances. The bed of the lake is basically limestone pavement with a thick deposit of fine muddy silt, especially in the western and southern parts of the lagoon. Reedbeds run along the inside of the barrier and also cover parts of the north and south shores; elsewhere the shoreline is fringed with wet grasslands, with limestone rocks and walls.

Sampling stations

The area was sampled briefly in mid June, from 19- 20/8/98 on 23/8/98 and briefly in October 1998.

Four sampling stations were selected to reflect the influences of substrate, vegetation, freshwater and tidal inflows (Fig. 2).

Station 1 (L 85580 11042) was located at the southwestern end of the lagoon where seawater appears to percolate through the barrier and where freshwater also appears to enter the lake from a nearby spring. Substrate consisted of cobbles from the barrier with a thick layer of fine organic mud and patches of *Phragmites*. The sediment in this area was extremely fine and unstable and at least 1m deep. Water depth varied from 20-30 cm and salinity measured 2 ppt.

Station 2 (L 85710 11251) was located on the northwest of the lagoon in a *Phragmites* swamp. Substrate consisted of limestone pavement and stones overlain with finer sediments. Salinity measured 4.5 ppt in this area and though no percolation through the barrier was visible it appears that this area is the most saline part of the lagoon. Depth was up to 0.5m.

Station 3 (L 85896 11240) was located at the northeast end of the lagoon. Substrate was mostly of bare limestone pavement and grykes with emergent vegetation and wet grassland along the water's edge. Water was almost fresh in this area (0.6 ppt, suggesting freshwater seepage from surrounding land, and up to about 1m deep.

Station 4 (L 85687 11070) was located on the eastern shore of the lake and was very similar to Sta. 3. Substrate consisted of limestone pavement, grykes and loose stones. Depth varied from 0 - 1m and salinity measured 2.3 and 2.9 ppt on the 21/8/98 and 23/8/98, respectively.

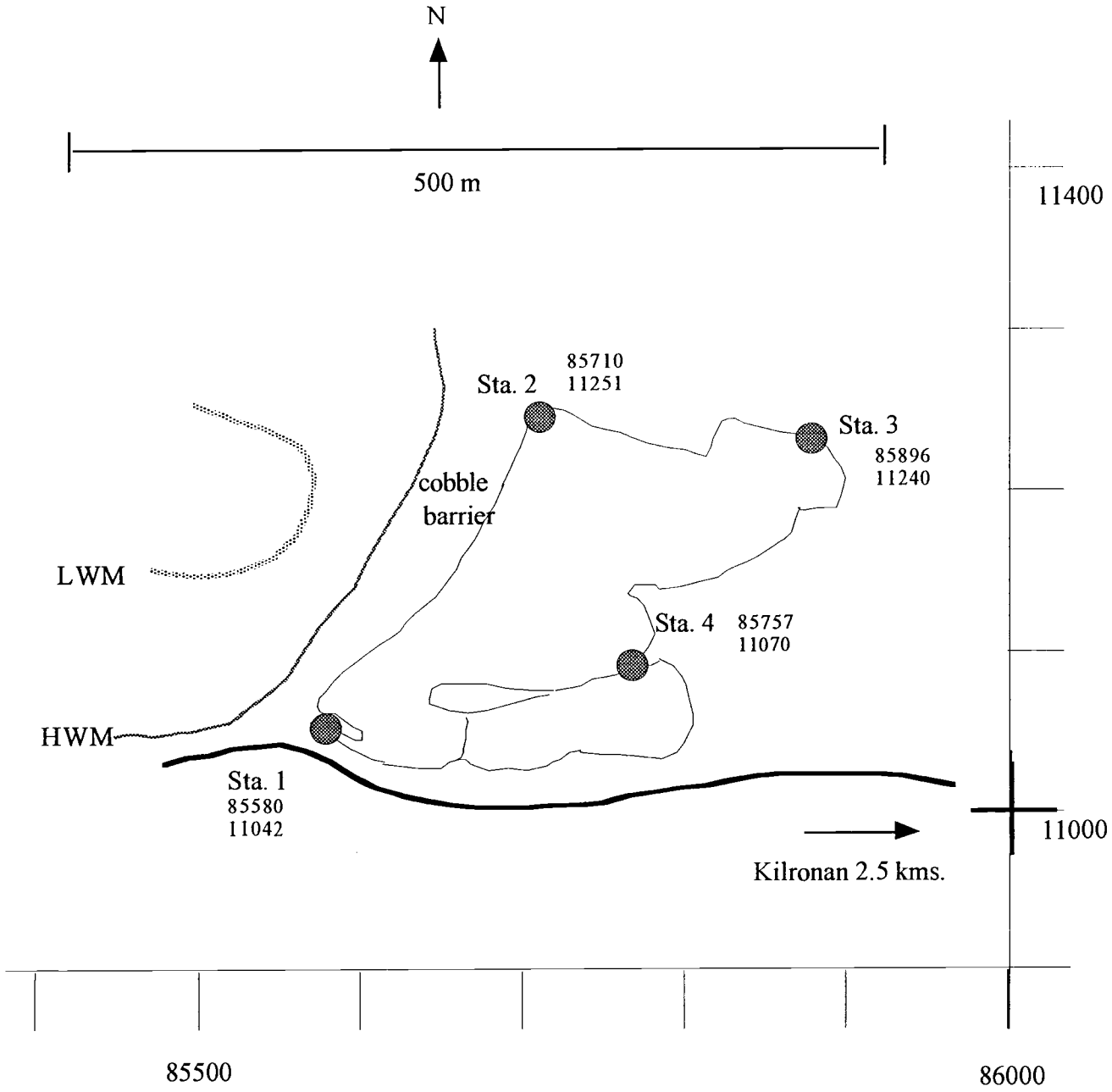


Fig. 4 Sketch map of Loch Phort Chorrúch, Árainn, Co. Galway, showing sampling stations used for a survey of aquatic fauna, 1998.

Results

Table 1 shows the total species list for each station. The following is a list of species arranged in broad ecological categories based on the Venice system of salinity regimes (L* = lagoonal specialist in Britain, L*IR = proposed as lagoonal specialist in Ireland; * = interesting or rare species):

Marine-polyhaline		
	Gammarus locusta	
Euryhaline	*Jaera nordmanni*	L*IR?
	Procerodes littoralis	
	Gammarus duebeni	
	Potamopyrgus antipodarum	
	**Conopeum seurati*	L*
	Gasterosteus aculeatus	
	Anguilla anguilla	
Meso-oligohaline		
	Ischnura elegans	
	Sigara stagnalis	L*
	**Enochrus bicolor*	L*
	Ochthebius dilatatus	
Oligohaline-freshwater		
	Corixa panzeri	

A total of 19 taxa were recorded, of which 13 were identified to species and 3 species are regarded as lagoonal specialists in Britain and one additional species is possibly a lagoonal specialist in Ireland. The number of taxa is very low and would be even lower without the relatively high number of Dipteran groups. 2 species are of particular interest:

Conopeum seurati has been recorded at 16 of the 36 sites surveyed, but is not listed in a recent review of Irish marine Bryozoa (Wyse Jackson, 1991). Either the species is under recorded or a truly lagoonal specialist.

Enochrus bicolor was also recorded at Ballytiege, L. an Chara and L. an Aibhnín during this survey and at 6 sites during the 1996 survey. There are very few other records for the country.

It is interesting to compare the fauna of this lagoon with the nearby lagoonal habitat of Loch an Chara which although not geomorphologically very interesting has a far richer fauna of both lagoonal and rare species. *Gasterosteus aculeatus* is extremely abundant at this site but does not occur in L. an Chara whereas on the other hand, *Palaemonetes varians* is extremely abundant in L.an Chara but does not occur at this site. It is difficult to imagine why both species have not colonised both lagoons. Possibly this is due to the fact that neither of these karstic lagoons have a direct communication with the sea.

Evaluation

Loch Phort Chorrúch is a fine example of a sedimentary lagoon with an impressive cobble barrier and a good example of a karstic lagoon.

The fauna is disappointing and might be expected to be higher. It is possible that eutrophication and resulting anoxia limit the faunal richness. There are only 2 species of any interest and neither of these is rare in lagoonal habitats.

Table 1 Aquatic fauna recorded at sampling stations in Phort Chorrúch, 1998.

Taxa:		1	L.T. 1	2	L.T. 2	3	L.T. 3	4	L.T. 4
Turbellaria	*Procerodes littoralis*					+		+	
Crustacea									
Ostracoda	indet.	a	a	a	a	a	a	c	c
Isopoda	*Jaera nordmanni*		1			a	1	c	
Amphipoda		c	10	a	160	a	100	a	75
	Gammarus duebeni	c	10	26	59	5	54	26	
	G. locusta							2	
Insecta									
Odonata									
	Ischnura elegans	0	1	+					
Trichoptera	indet			cases					
Heteroptera			1600		700		500		120
	Corixa panzeri						1		
	Sigara stagnalis	a	a	a	a	a	a	c	c
Coleoptera	*Enochrus bicolor*			7		1			
	Ochthebius dilatatus	1							
Diptera	Chironomidae indet.	+	1	+		+	+	+	
	Ephydridae indet..	c		c					
	Syrphidae indet.	c							
	Culicidae indet.					+			
Mollusca	*Potamopyrgus antipodarum*	0		0		0	3	0	+
Bryozoa	*Conopeum seurati*	+							
Pisces	*Anguilla anguilla*			F=6				F=5	
	Gasterosteus aculeatus	a	400	a	310	c	7	a	174

F = Fyke net; L.T. = light trap; + = present, o = occasional. c = common, a = abundant

ECOTONAL COLEOPTERA

Description

This is a coastal brackish lagoon with a shingle barrier and subterranean or subaquatic karst channel connections to and from the sea. Overtopping of the barrier also occurs. There is little apparent tidal response, but the water level fluctuates seasonally. The lake shore has organic-rich silty and sandy margins, and pasture shores grazed by cattle. There are some *Bolboschoenus maritimus* stands and more extensive *Phragmites australis* beds

Sampling

Four areas were selected for sampling from 29/6 –27/8/98:
(1) (L 856111- 857112) A sward of *Agrostis stolonifera* and *Potentilla anserina* with sparse *Bolboschoenus maritima, Carex obtrubae, Elymus* sp. and *Phragmites australis*. This lies between the shingle barrier and *Phragmites* in standing water, and is sheltered to the south-east by a stone wall. Offshore (0.5 m) salinity was 2‰ (27 viii 1998).
(2) (L856110) An area of *Bolboschoenus maritimus* with *Potentilla anserina* and *Agrostis stolonifera*, on c. 50 mm sand over organic sediment near the outflow stream from the shingle barrier.
(3) (L856110) An area of shore with single cobbles on sand/silt, near *Bolboschoenus maritimus* stands in water.
(4) (L856110) An area of the cobble / pebble shingle barrier with overwash seaweed debris and a small fraction of sand supporting 50 - 100% cover of Chenopodiaceae.

Results

Four species of carabid and twenty-eight species of staphylinid were recorded, two of which are regarded as indicator species (Tables 2 and 3).

TABLE 2 Staphylinidae from karst lagoon shores at Loch Chara and Loch Phort Chorrúch, Inis Mór (Co. Galway). The same sampling techniques and effort were used at each site, with the exception of L. Phort Chorrúch where barrier overwash litter was sieved. Indicator species are marked with an asterisk.

	Loch Phort Chorrúch	Loch Chara
Amischa analis (Grav.)	1	-
Anotylus rugosus (Fab.)	4	-
Atheta amplicollis (Muls. Rey)	17	1
Atheta clientula (Er.)	6	-
Atheta fungi (Grav.)	1	-
Atheta graminicola (Grav.)	21	1
Atheta orbata (Er.)	1	-
Atheta vestita (Grav.)	1	-
Brundinia meridionalis (Muls. Rey) *	1	-
Carpelimus corticinus (Grav.)	1	3
Cordalia obscura (Grav.)	15	-
Gabrius nigritulus (Grav.)	23	-
Gyrohypnus fracticornis (Müll.)	5	-
Heterothops binotatus (Grav.) *	2	-
Mycetoporus splendidus (Grav.)	5	-
Quedius maurorufus (Grav.)	7	-
Rugilus orbiculatus (Payk.)	1	-
Sepedophilus nigripennis (Steph.)	2	1
Stenus brunnipes Steph.	1	3
Stenus canaliculatus Gyll.	25	131
Stenus clavicornis (Scop.)	14	4
Stenus fulvicornis Steph.	9	3
Stenus juno (Payk.)	8	1
Stenus ossium Steph.	12	-
Tachinus signatus Grav.	49	-
Tachyporus nitidulus (Fab.)	1	-
Xantholinus jarrigei Coiffait	3	-
Xantholinus longiventris Heer	5	-
Stenus cicindeloides (Schall.)	-	5
Stenus nanus Steph.	-	1

TABLE 3. Carabidae from karst lagoon shores at Loch Chara and Loch Phort Chorrúch, Inis Mór (Co. Galway). The same sampling techniques and effort were used at each site, with the exception of L. Phort Chorrúch where barrier overwash litter was sieved. Indicator species are marked with an asterisk.

	Loch Phort Chorrúch	Loch Chara
Bembidion assimile Gyll.	5	-
Bembidion mannerheimi Sahl.	3	-
Demetrias atricapillus (L.)	1	-
Pterostichus strenuus (Panz.)	2	-
Dyschirius globosus (Herbst)	-	1
Elaphrus cupreus Dufts.	-	1
Pterostichus niger (Schall.)	-	3
Pterostichus nigrita (Payk.)	-	1
Pterostichus crenatus (Duft.)	-	1

Evaluation

The presence of two indicator species, and the occurrence of the overwash seaweed debris 'soil' on the inner slope of the barrier (a feature associated with the geomorphological process of a lagoon), indicate this site to have significant conservation value.

SUMMARY

Loch Phort Chorrúch is a rather poor lagoon in terms of vegetation and fauna but is interesting as an example of a eutrophic karst lagoon with a cobble barrier, subject to sea overwash. The water was oligohaline during all sampling sessions in 1998, but because the lagoon is so shallow, overwash during storms could raise the salinity significantly. Communities of both *Potamogeton pectinatus* and *Ruppia* were present, the former growing in grikes. A *Phragmites* scraw occupied the shore near the barrier, trapping weed washed or blown over. The aquatic fauna was poor, dominated by euryhaline species; none were of interest. Two indicator species of ecotonal Coleoptera were found, however, one halophilous, the other halotolerant.

References

Webb, D.A. and Scannell, M.J.P. 1982. *Flora of Connemara and the Burren*. Royal Dublin Society and Cambridge University Press, Cambridge.

Wymer, E.D. 1984. *The phytosociology of Irish saltmarsh vegetation*. Unpublished M.Sc. thesis, National University of Ireland.

Wyse Jackson, P.N. 1991. Distribution of Irish marine Bryozoa, together with biographical notes relating to the chief researchers in the group. *Bull. Ir. biogeogr. Soc.* 14: 129-18.

Plate 5. Loch Phort Chorrúch, Árainn. 1. Northeast shore (faunal Stn. 3), 2. looking west towards barrier; 3. *Phragmites* beds in southwest (faunal Stn. 1); 4. Looking south along barrier, 5. North shore, 6. Northeast shore, (faunal Stn. 3). 7. Barrier, lagoon on the left.

6. LOCH FHADA COMPLEX, CONNEMARA, Co. Galway

Including Loch Fhada, Loch an Ghadai (L. Áth an Ghadaí), and unnamed pools. Lough Atinnyadda; Lough Aughagaddy.

Location: L 939305, L 935303, L 933299; 53°18.6'N, 9°35.5W. OS Sheet 45. North of the road between An Cheathru Rua Thoir (Carraroe West) and Béal an Deaingin (Bealadangan).

Lagoon type	saline lake lagoons with indirect inlets
Area	total about 15 ha
Salinity regime	oligo-mesohaline-polyhaline (2.9-31.5‰)
Maximum depth	7 m (L. Fhada)
Seawater entry	overwash, indirect inlet
Tidal range	none?
Conservation status	none, not an NHA

Origins and History

The lagoons are largely natural although peat cutting may have contributed to the formation of connections between them. They are the result of severe glaciation which scoured the rocks, and the absence of drift deposits.

Geology, geomorphology and landscape

The rock is Galway granite of lower-mid Devonian age, a pink to grey coloured granite with large, pink feldspar crystals. L. Fhada and the upper lakes lie in a geological fault (Max *et al.*, 1978). The landscape is mostly low-lying blanket bog with many lakes and rock outcrops.

Description of the system

The complex consists of a group of four lagoons: (1) a small pool with rocky banks beside a road junction, connecting with (2) a larger, shallow pool of complex shape in saltmarsh on peat, (3) a natural (?) channel passing along a peaty valley to L. Fhada, (4) L. an Ghadaí, a lagoon of approximately 5 ha with peat and rock surrounds, connected to (3) by a channel under a road, and (5) L. Fhada, a long, narrow lagoon, area about 10 ha, in a valley between low hills. An outlet from L. Fhada leads by way of a narrow channel, bordered by saltmarsh, about 500 m long, to L. an Aibhnín.

The upper pool is 3 m deep with rocky sides. Pool 2 is shallow and surrounded by halophytic vegetation on peat.

L. an Ghadaí is shallow, surrounded by pastures, heath and a great deal of exposed granite. The lagoon bed consists of granite outcrops and muddy areas.

L. Fhada is deep, reaching 7 m, with shores of rock and peat and some small gravelly bays. The rocky littoral zone is narrow and the bed shelves steeply in places. The central area shelves gently and has a muddy bottom.

L. an Ghadaí and the upper pools are easily accessible from roads. The south end of L. Fhada can be reached by walking along the edge of the connecting stream although there is no proper track. Steep banks with dense heather around this lagoon make progress along the shores difficult and other sampling stations were reached by swimming or boat.

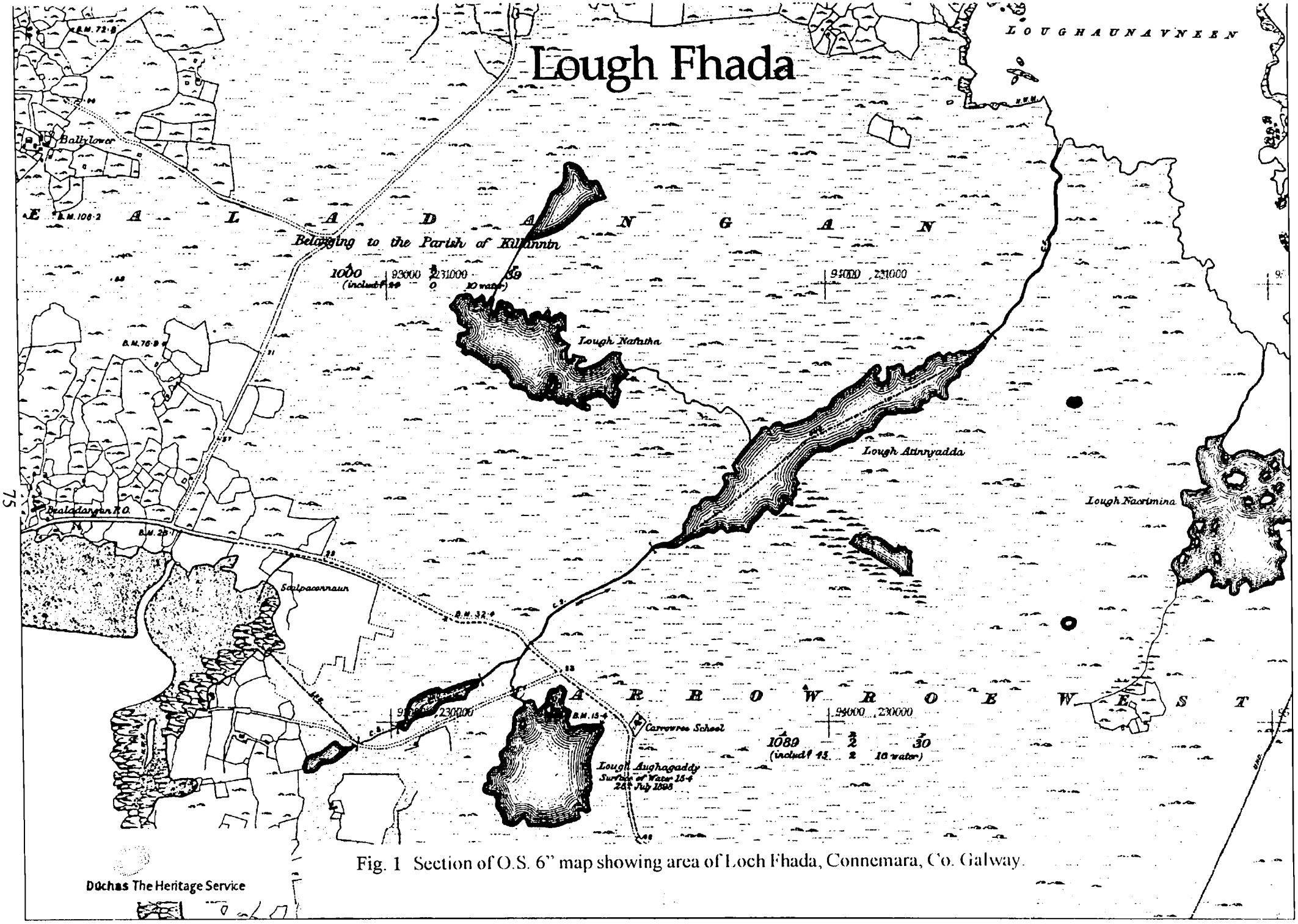


Fig. 1 Section of O.S. 6" map showing area of Loch Fhada, Connemara, Co. Galway.

Hydrology

The complex receives seawater from both ends: from Camus Bay in the north by way of L. an Aibhnín, and by overwash into Pool 2 from the coast of Greatman's Bay south of Béal an Deaingin in the north-west. Salinities of 22.5-31.5 in pool 2, 2.9-3.3 in L an Ghadaí, 7.7-25 in L Fhada, and 24-27 in L. an Aibhnín indicate that the main source of seawater is probably overwash into Pool 2. The lower salinity in L Fhada is due to inflows from Loch an Oileáinín (L. Nafatha) and smaller sources marked by *Phragmites* beds, as well as runoff and release from surrounding peat. L. Fhada was stratified with a halocline between 2 and 3 m.

Sampling took place during a period of heavy rain and recorded salinities may not have been typical. The aquatic vegetation suggests that salinity is normally higher, e.g. extensive *Lamprothamnium* in L. an Ghadaí and *Fucus spiralis* in L. Fhada. Furthermore, the presence of the marine fish *Taurulus bubalis* in L. an Ghadaí, a species not normally found in brackish waters, suggests that considerable volumes of seawater can enter the system.

Exploitation and threats

There is no exploitation and no immediate threats are apparent. The upper pools and L. an Ghadaí lie between the villages of An Cheathru Rua Thoir and Béal an Deaingin; the few houses in the area may contribute nutrients from septic tanks. Cattle roam the land around L. an Ghadaí.

Conservation status

The lagoon does not lie within an NHA and the surrounding land is not of interest.

VEGETATION

Description

This group of four lagoons and interlinking channels lie on granite bedrock between Camus Bay and Greatman's Bay. While the lagoons are linked to Camus Bay via Loch an Aibhn'n, local residents report that water also enters from Greatmans Bay during spring tides. The surrounding countryside is mainly blanket bog with smaller areas of heath and cultivated land. Maps in Max *et al.*, 1978) show that the lagoons have developed along a series of geological faults.

Loch Fhada is surrounded by rock and cliffs with a narrow and shallow exit channel flowing north east to Loch an Aibhnín. It is connected to the remaining three lagoons by a southwest directed channel. The two smallest lagoons (see map appear to lie along the same geological fault as Loch Fhada, they are also narrow, deep and surrounded by higher ground. Loch an Ghadaí differs, it is an oval shallow lake surrounded by pasture, heath and a great deal of exposed granite.

Underwater observations

(i) Loch an Ghadaí; This a shallow lake with very large areas of flat outcropping granite bedrock. Water visibility is average. The lake bottom is a combination of granite outcrops and flat muddy areas. The entire lake bed is covered by vegetation. *Ruppia* sp. and *L. papulosum* form a dense sward in the centre while flat slabs of granite are covered with *Cladophora linum*.

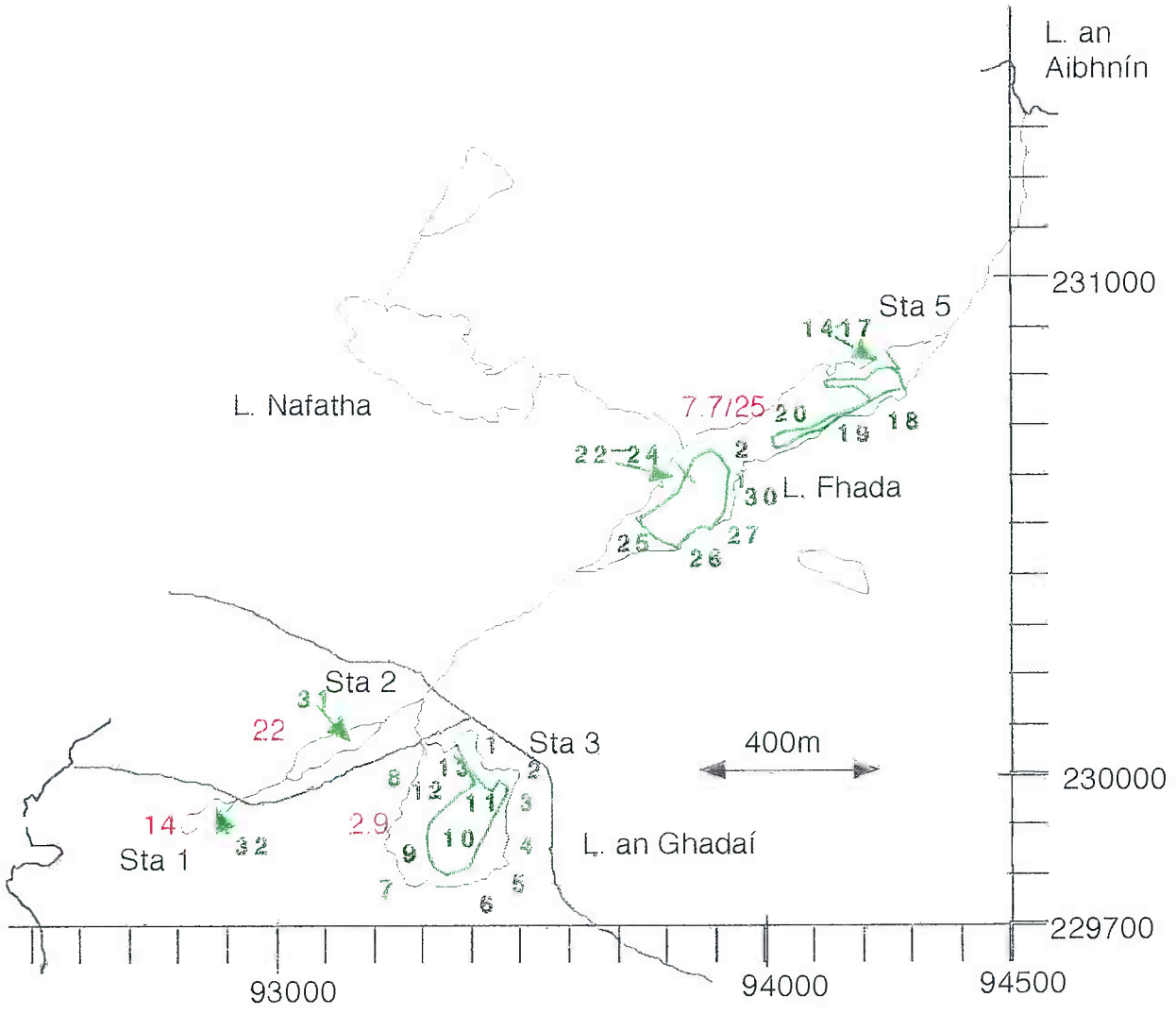


Fig. 2 Sketch map of L. Fhada complex, Connemara, Co. Galway, showing sampling stations used during 1998.

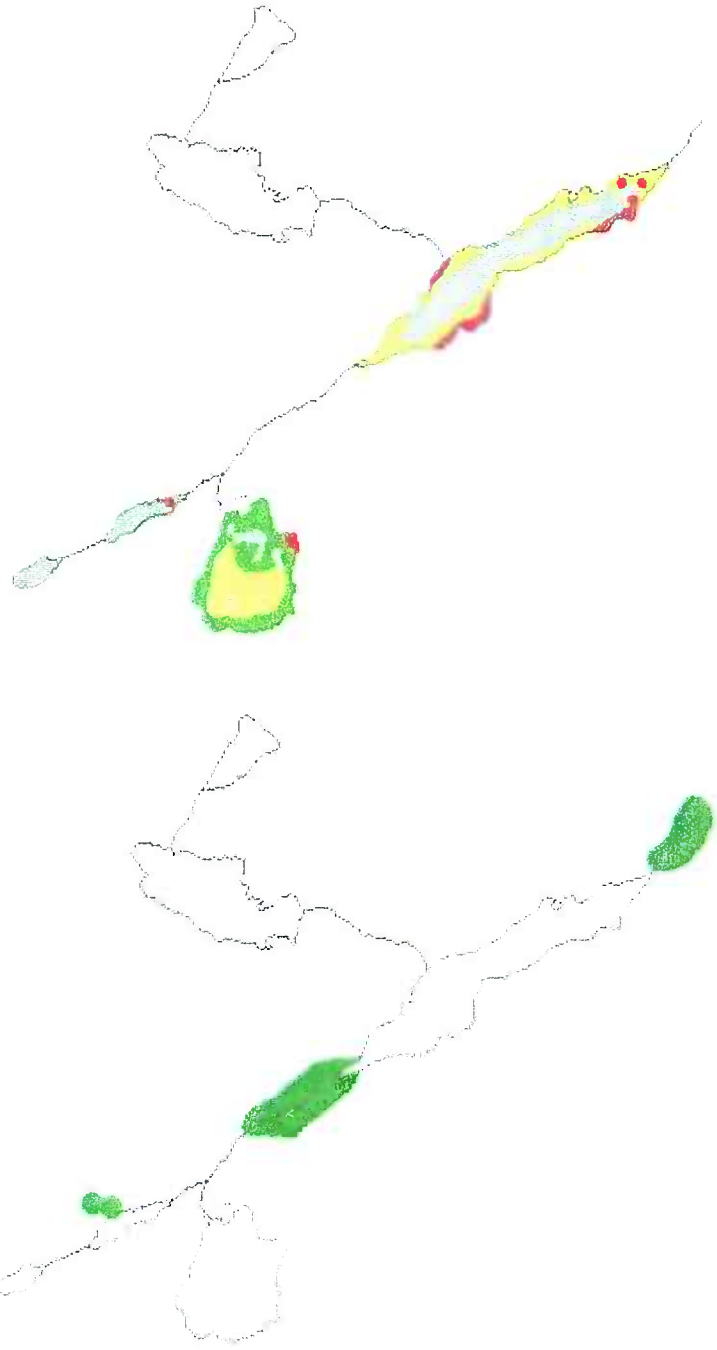


Fig. 3. Benthic and marginal vegetation of Loch Fhada complex.

(ii) Loch Fhada is a long deep lake (>6m) with rocky sides and a gently shelving muddy bottom. Visibility is quite good. A very noticeable halocline occurs at about 3m. The halocline is marked by a population of dwarf (1-2cm) *Aurelia aurita*, which seem to keep position along the discontinuity. Densities were estimated to be 1-2 per square metre. Below the halocline very little vegetation was seen. White mats of *Beggiatoa* suggest anoxic conditions. Above the halocline a strikingly dense layer of *Chaetomorpha linum* occurs. Above this layer stands of *Ruppia* sp. and other macrophytes occur.

The lagoon complex was sampled on six days (14/6/98, 28-30/6/98,3/8/1998 and 23/10/98). Shore samples and a snorkelling survey were carried out. Two plankton samples were taken one each from Loch Fhada and Loch an Ghadaí.
Relevés 1-8 (09342298) were taken around the shore of Loch an Ghadai. The marginal vegetation zone is narrow and interspersed with large slabs of granite bedrock.
Samples 9-13 (09342298) were taken in the sublittoral of Loch an Ghadaí.
14-21 (09422307) were taken in the sublittoral of Loch Fhada in the northern part.
22-30 (09392305) were taken in the sublittoral of Loch Fhada in the southern part.
31(09322300) and 32 (09292299) were grapnel samples from the two small lagoons.

Results

Blue green algal cushions occurred in the splash zone of Loch Fhada. *Fucus vesiculosus* and *Enteromorpha* sp grow on rocks. Charophyte communities occur in the shallow sublittoral of both larger lakes. *Ruppia* and *Ruppia* and *Lamprothamnium* communities occur over the entire sublittoral of Loch an Ghadaí and around the circumference of Loch Fhadá.

Chaetomorpha linum occurs in great quantity at depth in Loch Fhada and was also collected by grapnel from the two smallest lagoons. It also grows along with *Cladophora vagabunda* on exposed rock in Loch an Ghadaí.

The floor of Loch Fhada is bare mud with occasional patches of *Beggiatoa*.
A small number of red algae were recorded at the north east end of both Loch Fhada and one of the small lagoons (point 32).

Marginal vegetation is not well developed as the surrounding terrain is rocky and steeply sloping. Communities recorded included, large stands of *Juncus maritimus* southeast of Loch Fhada, *Eleocharis* communities around Loch an Ghadaí, while maritime lichens occur on rocks around all the lakes. Stands of *Schoenoplectus* tabernaemontani, *Phragmites australis* and *Cladium mariscus* occur occasionally.

Both Loch Fhada and Loch na Ghadaí have diverse planktonic communities of brackish water dinoflagellates.

Notable plants

Both species of *Ruppia* occur as well as large populations of *Lamprothamnium papulosum. Cladium mariscus* was only recorded from this site during the survey. *Cladophora vagabunda*, *Cladophora liniformis* and *C. rupestris* were confirmed as occurring by Prof. Van den Hoek.

Assessment

The four lakes contain excellent examples of vegetation typical of intermediate salinity lagoons. The depth of Loch Fhada allows the development of vertically zoned communities, while Loch na Ghadaí has extensive *Ruppia/Lamprothamnium*. communities. *Cladium* was not recorded from other lagoons in this survey. It appears that *Cladophora liniformis* has not previously been recorded from Ireland.

Description

The Loch Fhada complex is a group of lakes to the north of the road from Costelloe, approximately 1 km east of Bealadangan (Fig 1). Seawater enters the lakes from high tides flooding through saltmarsh channels in the northwest to enter the smallest lakes which have no names on the O.S. maps (Sta. 1 & 2). From this area saline water flows to the northeast under the main road into Loch Fhada after dilution with lower salinity water flowing from L. Aughagaddy to the south. Water continues to flow north through L. Fhada and is further diluted from fresh water flowing from Loch Nafatha to the west. Eventually water flows from L. Fhada through a long narrow channel through saltmarsh vegetation into Loch an Aibhnín, which itself is brackish. It is possible that seawater also enters Loch Fhada from the north through L. an Aibhín but the major input appears to be from the south. Environmental parameters vary throughout the complex and are described under the appropriate station numbers below. In general, the open water areas cover a total of 15 hectares and salinity during the sampling period ranged from 3 to 31.5 ppt with pronounced stratification in the deeper areas of water. According to local information the area in the southwest is subject to extreme tidal flooding.

Sampling stations

The area was sampled briefly on 14/7/98, from 27-30/7/98 and again on 22/9/98 (Sta. 4). Five sampling stations were selected to reflect the influences of substrate, vegetation, freshwater and tidal inflows (Fig. 4).

Station 1 (L 92889 29906) was located at the small pool at the southwest. Seawater appeared to enter from flooding over the saltmarsh to the north and entered the pool at times of high water. The water in the pool was 3m deep and stagnant and is presumably only renewed from rainfall and overland flow and from periodic flooding with seawater. Substrate was mostly peat and soft organic silt and salinity varied from 12.4 ppt at the surface to 29.5 ppt at 3m depth. The pool was covered with a dense growth of *Chaetomorpha* and contained wrecks of cars and domestic refuse.

Station 2 (L93177 30090) was located in the larger of the two small lakes in the southwest. Substrate consisted mostly of soft peat with coarse sand and gravel in places and scattered granite rocks. This pool appeared to receive the most saline water but was relatively shallow (up to 2.5 m) and also received freshwater from rainfall and runoff from surrounding land. Salinity at the time of sampling ranged from 18 to 22.9 ppt at the surface, and up to 31.5 at 2.5m depth. The loch was bordered by saltmarsh, rough grazing and granite rocks.

Station 3 (L 93304 29905) was located in Loch an Ghadaí in the southern part of the complex. Seawater flowed into this loch at times of high tides and storms from the channel which normally drains to the north, under the road towards L. Fhada. The loch was very shallow (mostly less than 1m) and what saline water flowed into the lake was very much diluted by the larger amount of freshwater that it received. At the time of sampling salinity measured 2.9 - 3.3 ppt but measured 6-10 ppt in June and is probably higher for most of the year. Substrate was mostly granite rocks, bedrock, coarse gravel with patches of fine sediments with *Chaetomorpha* in sheltered areas. The Loch was bordered by granite rocks, bedrock, rough grazing and small areas of *Phragmites* reed bed.

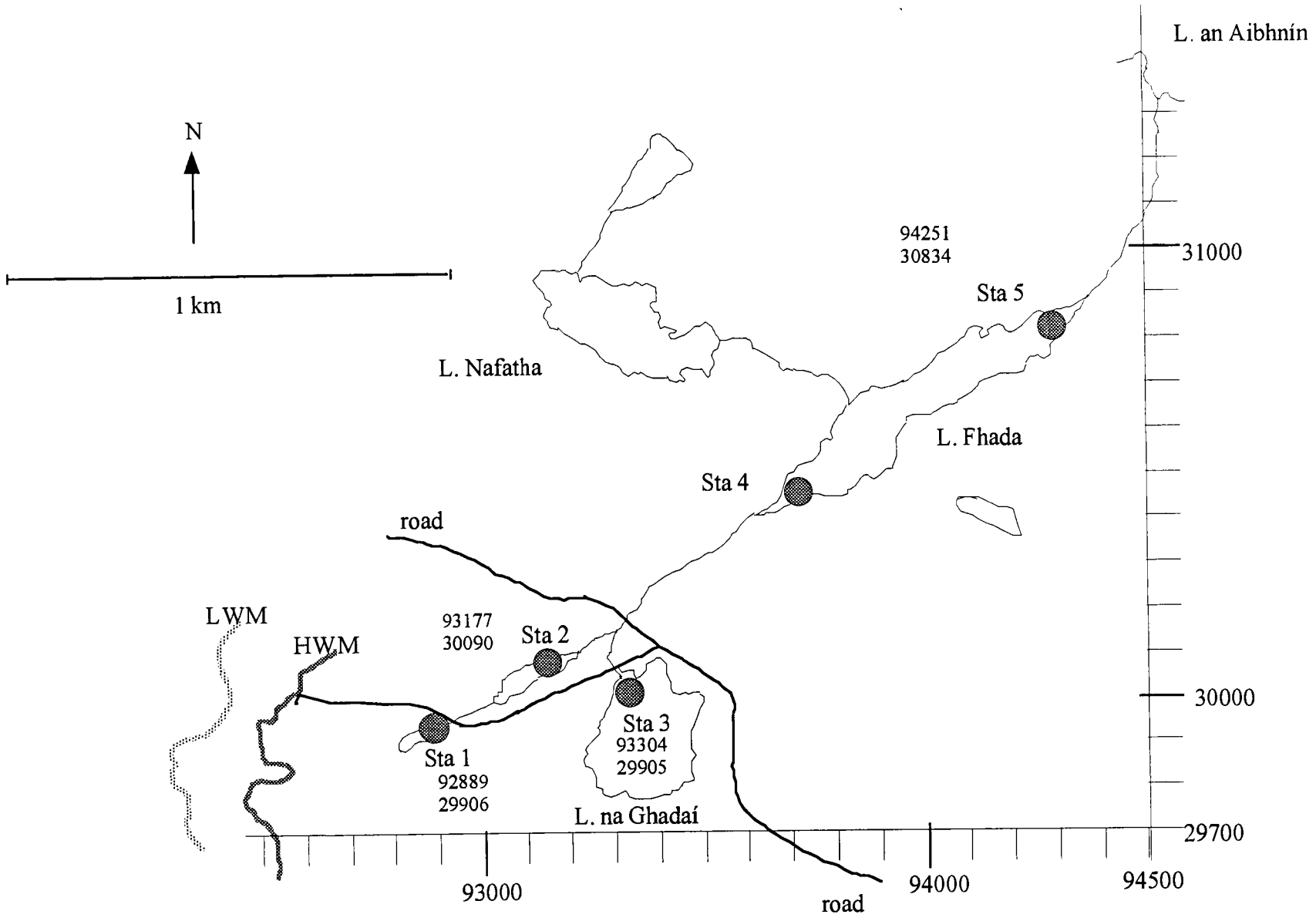


Fig. 4 Sketch map of Loch Fhada complex, Connemara, Co. Galway, showing sampling stations used for a survey of aquatic fauna, 1998.

Station 4 (GPS not recorded) was located at the southwestern end of Loch Fhada. Substrate consisted of rocks and gravelly sand with very little silt. The area was surrounded by moorland with granite rocks. Depth was 0-1m.

Station 5 (L 94251 30834) was located at the southern end of Loch Fhada where it drains through a channel to L. an Aibhnín. The loch was deep in this area (up to 7m) with a narrow shoreline of granite rocks and bedrock, with patches of stony, coarse gravel and sand and small patches of *Phragmites* reed bed. Water in the loch was stratified with a noticeable halocline at 3m and a salinity and temperature gradient below this depth. In one area lower salinity water (15.5 ppt) was measured at 5m depth, as if diluted by an underground spring of freshwater.

Depth (m)	salinity (ppt)	temperature (^{0}C)
0	7.6	17.9
1	7.7	17.6
2	7.7	17.6
3	20.4	16.8
4	23.9	15.0
5	25.1	12.5

Results

Table 1 shows the total species list for each station. The following is a list of species arranged in broad ecological categories based on the Venice system of salinity regimes (L* = lagoonal specialist in Britain, L*IR = proposed as lagoonal specialist in Ireland; * = interesting or rare species).

Marine
- *Aurelia aurita*

Marine-polyhaline
- *Clava multicornis*
- *Arenicola marina*
- **Jaera forsmani*
- *Corophium volutator*
- *Melita palmata*
- *Microdeutopus gryllotalpa*
- *Praunus flexuosus*
- *Hydrobia ulvae*
- *Mya arenaria*
- *Rissostomia membranacea*
- *Taurulus bubalis*

Poly-mesohaline
- *Hydrobia ventrosa* L*
- **Littorina "tenebrosa"* L*
- *Cerastoderma glaucum* L*
- Mugilidae
- *Pomatoschistus microps*

Euryhaline
- *Hediste diversicolor*
- *Idotea chelipes* L*
- *J. nordmanni* L*IR
- *Lekanesphaera hookeri* L*
- *Gammarus zaddachi*
- *G. duebeni*
- *Carcinus maenas*
- *Palaemonetes varians* L*
- *Crangon crangon*
- *Neomysis integer* L*IR
- *Mytilus edulis*
- *Potamopyrgus antipodarum*
- **Conopeum seurati* L*
- *Anguilla anguilla*
- *Gasterosteus aculeatus*

Meso-oligohaline
- *Ischnura elegans*
- *Sigara stagnalis* L*

Uncertain
- *Gerris sp.*
- *Trichoptera*

Table 1 Aquatic fauna recorded at sampling stations in Loch Fhada Complex, 1998

		1	L.T. 1	2	L.T. 2	3	L.T. 3	L.T.3b	4	5	L.T.5a	L.T.5b
Cnidaria	*Aurelia aurita*									c		
	Clava multicornis								o			
Turbellaria	planarian indet.									+		
Annelida	*Arenicola marina*			+								
	Hediste diversicolor			o								
Crustacea												
Ostracoda						a						
Mysidacea	*Neomysis integer*					+			o	o		
	Praunus flexuosus	o	2	a	77	a	450	30	+	c	53	38
Isopoda	*Idotea chelipes*	c	6	+	27				o	+	6	2
	Jaera forsmani	o		+					+			
	J. nordmanni					+	4	1	+	+		
	Lekanesphaera hookeri			c	10	a	45	30	a	a	120	38
Amphipoda		c	20	c	4	a	20	10	a	a	54	
	Corophium volutator			o				2	1			
	Gammarus duebeni						2					
	G. zaddachi			11		2	18	4	28	77	25	
	Microdeutopus gryllotalpa		17		2							
	Melita palmata	5								2		
Decapoda	*Carcinus maenas*	c		o								
	Crangon crangon				1							
	Palaemonetes varians			o		o	3					
Insecta												
Odonata	*Ischnura elegans*					+						
Trichoptera						cases						
Heteroptera	Corixidae					o	1					
	Gerris sp.	+								+		
	Sigara stagnalis					o						
Diptera	Chironomidae indet.	+								+		
Mollusca												
Prosobranchia	Hydrobidae	a		+	71		23	+		+		6
	Hydrobia ulvae	c		a	71							
	H. ventrosa	c										
	Littorina"tenebrosa"	c							+			1
	Potamopyrgus antipodarum					a						
	Rissostomia membranacea								+			
Bivalvia	*Cerastoderma glaucum*	a		spat		spat			spat			
	Mya arenaria								c	+		
	Mytilus edulis			o		o			+	+		
Bryozoa	*Conopeum seurati*	+		+		+			+	+		
Pisces	*Anguilla anguilla*					F=6, 7				F=1		
	Gasterosteus aculeatus		1		1		11		+	+		2
	Mugilidae			+		+						
	Pomatoschistus microps			c			1		+	+		
	Taurulus bubalis					F=1						

F = Fyke net; L.T. = light trap; + = present, o = occasional. c = common, a = abundant

A total of 38 taxa were recorded, of which 8 are regarded as lagoonal specialists in Britain and 2 additional species are proposed lagoonal specialists in Ireland. 3 species are interesting or rare:

Littorina "tenebrosa" was also recorded during this survey at L. an Aibhnín and L. an tSaile and during the 1996 survey in Lettermullen Pool, L.Tanaí, L. Murree and from the North Slob. These are the only known sites in Ireland. The status of this taxon is still under dispute but appears to be morphologically and ecologically distinct and is listed as a lagoonal specialist for Britain.

Conopeum seurati has been recorded at 16 of the 36 sites surveyed, but is not listed in any review of Irish marine Bryozoa (Wyse Jackson, 1991). Either the species is under recorded or a truly lagoonal specialist.

Jaera forsmani was previously recorded at Drongawn L. in the 1996 survey and during this survey at Kilmore L., L. an Aibhnín, Kinvarra saltmarsh and L. Athola. The only other Irish record of the species located is for L.Hyne, Co. Cork, (De Grave and Holmes, 1998).

The fauna of this complex is quite rich with a high proportion of lagoonal specialists reflecting the range of salinities and substrates available. Euryhaline and Marine/polyhaline species dominate the fauna with very few low salinity species present.

Evaluation

Although individually the lagoonal habitats may not be too impressive, as a complex they comprise a wide range of salinity regimes and associated fauna. The species list is not particularly high but contains one of the highest numbers of lagoonal specialists in the country and 3 rare species; therefore worthy of protection.

ECOTONAL COLEOPTERA

Description

This is a bayhead saline lake lagoon with a granite outcrop, boulder and till shores and scoured peat cliffs. The peat shores at either end of the lake have *Juncus maritimus* and peat shore pastures. The western end is grazed heavily.

Sampling

Two areas (L944340 and L945311) were selected for sampling on 11/8- 3/9/98:
(1) A stand (c. 0.12 ha) of *Juncus maritimus* with *Triglochin maritima* and *Samolus valerandi*, grading into heath pasture with sparser *J. maritimus, Festuca rubra, Eriophorum* sp., *Agrostis stolonifera, Plantago maritima*, and occasional *Danthonia decumbens* and *Molinia caerulea*. Areas of higher peat were of *Erica* and *Calluna* heath. The salinity of pool water in this area was 3‰ (11 viii 1998).
(2) An area of *Juncus maritimus* grading into grass-dominated sward on the southern sheltered bay of the lake, although with more irregular and, in places, more sloping topography. This area was similar in vegetation structure and composition to that sampled at L. Tanaí in 1996, but less sheltered from the west. The immediate hinterland consisted of heath rather than intact blanket bog and with most of the sward in standing water at the time of sampling and probably more susceptible to flooding because of the greater water level fluctuation that would be associated with L. an Aibhnín.

Results

A total of two species of carabid, nine species of staphylinid and two species of pselaphid were recorded, one of which is regarded as an indicator species (Tables 2 and 3).

TABLE 2. Staphylinidae and Pselaphidae from saline lake peat shores with *Juncus maritimus* and grasses in Na Dhá Sháile area, Connemara (Co. Galway): Loch an Aibhnín; L. Fhada; L. Cara na gCaorach; L. Cara Fionnla. The same sampling techniques and effort were used at each site. Indicator species are marked with an asterisk.

	Aibhnín	Fhada	Cara na gCaorach	Cara Fionnla
Atheta aquatica (Thoms.)	1	-	-	
Brachygluta helferi (Schm.)	21	7	24	1
Drusilla canaliculata (Fab.)	3	-	-	2
Paederus fuscipes Curt.	9	-		
Sepedophilus nigripennis (Steph.)	1	1		
Stenus brunnipes Steph.	1	1	-	1
Stenus juno (Payk.)	3	1	-	-
Stenus ossium Steph.	1	-	-	-
Euaesthetus bipunctatus (Ljungh)	-	5	-	7
Reichenbachia juncorum (Leach)	-	3	-	43
Stenus clavicornis (Scop.)	-	2	-	-
Stenus fulvicornis Steph.	-	1	-	5
Stenus fuscipes Grav.	-	2	-	-
Stenus lustrator Er. *	-	2	2	2
Stenus nitidiusculus Steph.	-	1	-	1
Atheta vestita (Grav.)	-	-	2	-
Cordalia obscura (Grav.)	-	-	1	7
Tachyporus dispar (Payk.)	-	-	1	1
Xantholinus longiventris Heer	-	-	1	-
Atheta amplicollis (Muls. Rey)	-	-	-	1
Oxypoda elongatula Aubé	-	-	-	3
Quedius fulginosus (Grav.)	-	-	-	1
Quedius molochinus (Grav.)	-	-	-	1
Stenus tarsalis Ljungh	-	-	-	2
Tachyporus nitidulus (Fab.)	-	-	-	1

TABLE 3. Carabidae from saline lake peat shores in Na Dhá Sháile area, Connemara (Co. Galway): Loch an Aibhnín; L. Fhada; L. Cara na gCaorach; L. Cara Fionnla. The same sampling techniques and effort were used at each site, with the exception of L. an Aibhnín where *Zostera* shore refuse was sieved. Indicator species are marked with an asterisk.

	Aibhnín	Fhada	C. na gCaorach	Cara Fionnla
Bradycellus harpalinus (Serv.)	1	-	-	-
Dyschirius globosus (Herbst)	3	-	-	-
Bembidion mannerheimi Sahlb.	-	1	-	-
Pterostichus niger (Schall.)	-	1	-	5
Bembidion assimile Gyll.	-	-	1	-
Loricera pilicornis (Fab.)	-	-	-	1
Notiophilus palustris (Dufts.)	-	-	-	1

Evaluation

The presence of only one indicator species indicates only a low conservation value for this site. Also, it could be argued that the most undisturbed and extensive areas of suitable shore habitat are as much part of Lough an Aibhnín as they are of Lough Fhada because they occur at the outflow from Lough Fhada, not in the lake *sensu stricto*. Most of the lake shore of L. Fhada is rocky, wave-eroded and abrupt, and the peat shores at the western end are narrower and more heavily grazed by cattle and sheep with a relatively close-cropped sward. This is less likely to be of value as a habitat compared to the denser *Juncus maritimus* swards at the eastern end.

SUMMARY

The Loch Fhada Complex contains a range of different salinity regimes, with the main lagoon stratified, and different vegetation communities and faunal assemblages. Aquatic vegetation includes fucoid algae, *Chaetomorpha, Lamprothamnium* and *Ruppia* (both spp). The fauna was moderately diverse with 10 lagoonal specialists. Ecotonal Coleoptera included one indicator species.

The complex drains into L. and Aibhnín and should be included with it, and with L. Tanaí, as a single conservation unit.

References

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Max, M.D. Long, L.B. & Geoghan, M.A. (1978) The Galway Granite. Geological Survey, Ireland Bulletin 2. 223-233.

Wyse Jackson, P.N. 1991. Distribution of Irish marine Bryozoa, together with biographical notes relating to the chief researchers in the group. Bull. Ir. biogeogr. Soc. 14: 129-18.

Plate 6. Loch Fhada Complex, Connemara. 1. Upper pool (1), (faunal Stn 1), 2. Upper pool (2), (faunal Stn 2); 3. Stream connecting Loch na Ghadai to Loch Fhada, 4. Outlet from Loch na Ghadai; 5. Loch na Ghadai, 6. Loch Fhada, north end (faunal Stn 4), 7. Upper pool (2)

7. LOCH AN AIBHNÍN, CONNEMARA, Co. Galway

Loughaunavneen

Location: L 947315; 53°19.5'N 09°34.5'W. OS Sheet 45
South side of Camus Bay, south-west of Muiceanach Idir Dha Sháile.

Lagoon type	saline lake lagoon with silled inlet
Area	about 55 ha
Salinity regime	polyhaline-euhaline (18-27‰)
Maximum depth	4 m
Seawater entry	silled inlet
Tidal range	10-20 cm (?)
Conservation status	none, not an NHA

Origin and history

The lagoon and its inlet appear to be natural. There appears to have been some modification of the outlet in the north-east which is not as shown on the maps.

Geology, geomorphology and landscape

The rock is Galway granite of lower-mid Devonian age, a pink to grey coloured granite with large, pink feldspar crystals. The landscape is mostly low-lying blanket bog, extensively cutaway on the east side, and there is an area of small fields in the north-west.

Description of the system

This large lagoon is shown on the 1:50,000 map as having a significant intertidal zone and it was assumed in 1996 that it was a tidal bay. In fact, there is only a narrow inlet with a rocky sill estimated to be above mean tide level. Below the sill a narrow outlet with rapids opens onto a sheltered rocky shore. The 6 inch map shows a second outlet to the east but this appears not to be tidal and the outflow through it is probably small. The shores are rock and peat with numerous movable rocks near the inlet, and there are small sandy bays and areas of saltmarsh on the banks. The lagoon is 1-2 m in depth except for a deeper hole near the outlet reaching 4 m. The bed is mostly sandy and firm enough to walk out on except where there are accumulations of decomposing *Zostera* and *Ruppia.* The channels connecting the lagoon to L. Fhada and L. Tanaí are narrow with vertical peat banks and beds of unconsolidatd peat.

The lagoon is reached by a track to the inlet from the end of a road in the north-west.

Hydrology

The lagoon may receive seawater over the sill at most high tides but significant amounts only during springs. Water from L Tanaí would be of about the same salinity while that from L. Fhada is lower. There are no recognisable point sources of freshwater. Salinity was more or less uniform throughout the lagoon and conditions appear stable.

Exploitation and threats

The lagoon appears to be in pristine condition. There is some fishing for domestic consumption, and some turf cut from the bog to the east is transported across the lagoon by boat. There are no houses close to the shores and only low level agriculture in the north-west.

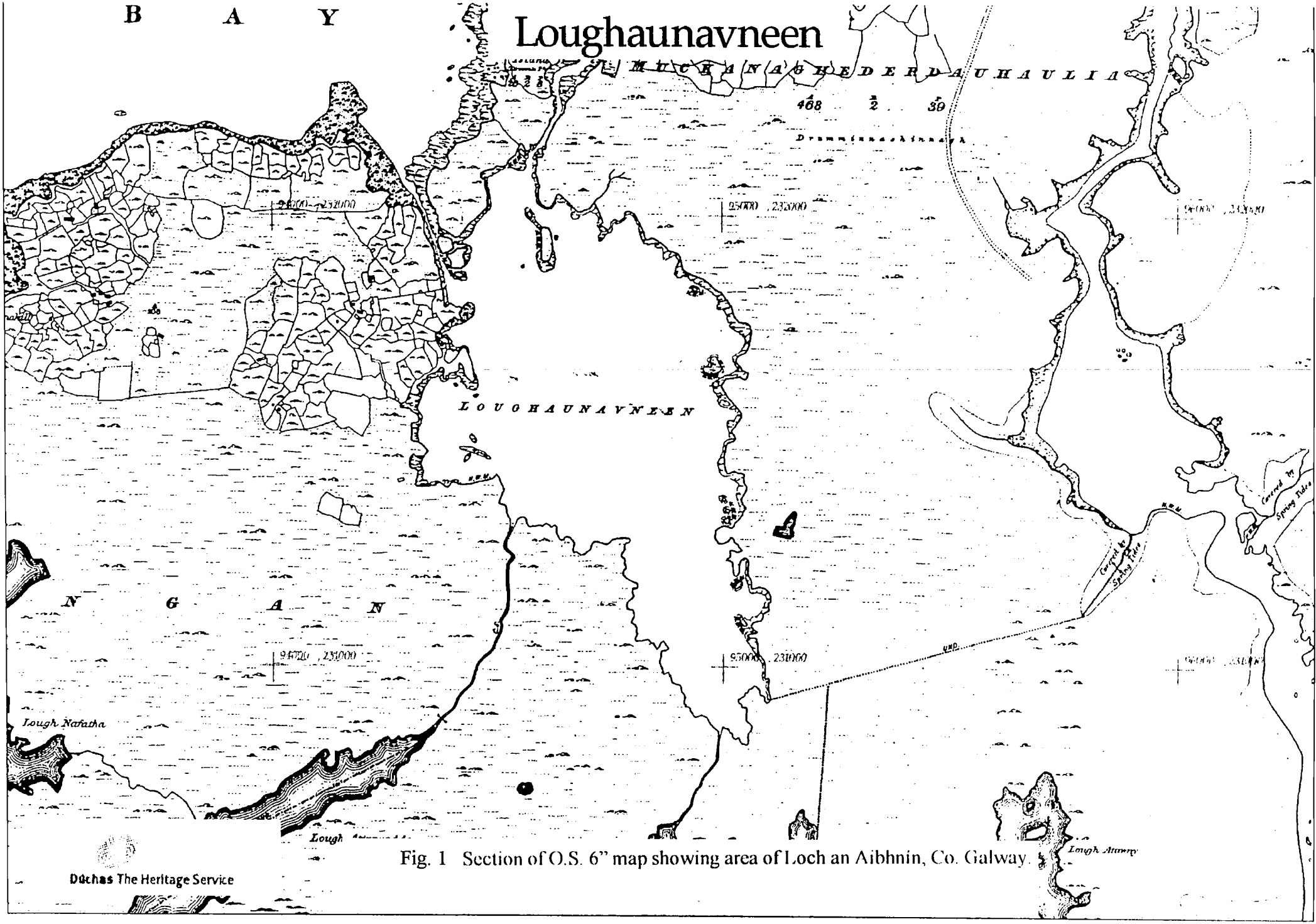

Fig. 1 Section of O.S. 6" map showing area of Loch an Aibhnin, Co. Galway.

Conservation status

None. Not an NHA.

Intrinsic appeal

The lagoon has great attraction for collectors of fauna and flora, being easy to sample with easily accessible rocks and macrophytes. The rapids, not sampled during this survey are likely to be rewarding, as other parts of Kilkieran Bay are known to be rich. The presence of large numbers of red tunicates give this site extra appeal.

Research

Together with the L. Fhada series of lagoons, L. an Aibhnín has become a focus for studies of *Littorina "tenebrosa"*, a controversial "species" which has distinct morphological, behavioural and ecological characteristics, but which is said to be genetically is indistinguishable from the common sea shore species *L. saxatilis.* Unusually, both forms occur together in L. an Aibhnín and their genetics are being studied by Dr E. Gosling of Galway-Mayo Institute of Technology as part of an international programme.

VEGETATION

Site description

Loch an Aibhnín is a large saline lake separated from Camus Bay by a shallow sill which is exposed even during neap low tides of 1.65 m O.D. There is no obvious intertidal zone, however salinity is comparatively high (24-27‰).The lake is situated on granite bedrock, glaciation has left a number of very large and impressive erratic boulders scattered around the lake circumference. Much of the hinterland is cut over blanket bog and small areas of cultivation on the northern side. An old track and quay on the north side was used to unload turf which was cut in the bogs south of the lake and then shipped across. The shoreline is varied, ranging from eroded peat cliffs to gravel and rock. In general the marginal vegetation zone was narrow but in place large stands of Juncus maritimus occur.

Underwater observations

This very large lake is the most visually appealing of the surveyed sites. Visibility is very good and the bottom topography is varied. Just before the outflow stream (sample point 22) a 4m deep hole is found. It is floored with granite gravel and is overhung on the western side by a submerged cliff of peat. The southern and western sides slope upwards to the main body of the lake. In this region a very varied algal flora occurs along with many animals. The western part of the lake consists of soft sand or mud and is covered with communities of *Zostera marina*, *Ruppia cirrhosa* and *L. papulosum*. The bright orange ascidian, *Ciona intestinalis,* growing on green *Zostera* plants gives these communities a striking appearance. The abundance of *L. papulosum* in the southern part of the lake adds to the unusual underwater scene. A large area of almost bare mud occurs in slightly deeper water (3m) in the eastern part of the lake. This mud patch is bounded to the east by a small cliff of granite which runs north south. The cliff supports a variety of unusual marine algae.

Sampling

The lake was surveyed on 28/7/1998,14/8/1998,17-18/8/1998, 26-27/8/1998 and 24/9/1998.. Marginal vegetation was sampled, benthic vegetation was examined by

snorkelling and a phytoplankton sample taken.
Relevés 1-4 (0943 2315) were made in the narrow shore zone on the northeast of the lake.
5-8 (0950 2308) were taken in a *Juncus maritimus* stand
9-11 (0950 2308) on a rocky shore.
12-17 (0943 2316) were made on soft sediments in the western sublittoral, 18 (0948 2318) in the north and 19 (0948 2318) in the south.
20 (0950 2312) was made on flat rock, 21 (0950 2312) was made along a rocky submerged cliff, 22 (0943 2315) was made in the deep hole inside the sill.

Results

This large high salinity lagoon contains several vegetation types. Soft sediment communities include:
(1) Peripheral vegetation in shallow water (<1m) includes *Ruppia* sp. along with a small form of *Z. marina, Fucus vesiculosus* and dense epiphytic Ectocarpaceae.
(2) Stands of *Ruppia cirrhosa* with or without *Lamprothamnion papulosum* occur in the southern part of the lake. This community grades into a *Zostera marina/Ruppia cirrhosa* community with rare *L. papulosum*.
(3) The centre of the lagoon is occupied by a *Zostera marina* community with occasional *Spermathocnus paradoxus.*
(4) In slightly deeper water (3m) on the eastern side, a large area of bare mud occurs.
(5) Exposed rocks support several algal communities. In shallower water *Furcellaria lumbricalis* and *Chyllocladia verticillata* occur on sloping rock.This community is close to OB23/OB24 of Covey and Thorpe (1994). Horizontal rocks are covered by coils of *Chaetomorpha linum* with attached *Chondrus crispus*, Crustose non calcareous red algae and *Phyllophora pseudoceranoides.*
(6) At greater depths on mud, loose lying *Gracilaria graciliis* and other species occur.
(7) In a deep hole near the rock sill *Phyllophora crispa, Coccotylus truncata* and other species occur.

The phytoplankton consists of brackish water dinoflagellates.

The marginal vegetation includes small areas of saltmarsh with the Puccinellietum and *Juncus gerardii* associations around the lakes circumference.
In two places the *Blysmus rufus* association was noted. The best developed communities are stands of *Juncus maritmus.* These are most extensive along the channel linking Loch Fhada and Loch an Aibhnín. A little *Festuca rubra* grassland was noted (11). Maritime lichens were common on rocks.

Interesting species

Both species of *Ruppia* occur as well as *Lamprothamnion papulosum*
The *Zostera marina* which grows close to the shore is very small and could be mistaken for *Z. angustifolia.* Several unusual or local algae are recorded. *Codium vermillaria* is known from Cork Clare and Antrim. *Cladophora coelothrix* is rarely recorded from Ireland (Burrows 1991); one plant was found. *Coccotylus truncatus* is mainly found in the North of Ireland and Scotland. *Chondria capillaris* is rare in the south and west of Ireland.

Assessment

Loch an Aibhnín has the best and most extensive development of the *Zostera/Ruppia /Lamprothamnion* community encountered in the survey. The macro algal community is diverse and very different from that of the open coast. The large size of Loch an Aibhnín enhances the value of the vegetation.

AQUATIC FAUNA

Description

Loch an Aibhín is a large (55 ha) saline lagoon on the south side of Camus Bay, 2 km to the northwest of Bealadangan. Seawater enters through narrow rapids from Camus Bay on spring tides and the lagoon receives diluted seawater from the L. Fhada complex and from L. Tanaí (Oliver and Healy, 1998) and freshwater from a number of small streams and long-term seepage from surrounding peatland. The lagoon is uniformly shallow (c2m) apart from a deeper area near the outlet (3-4 m) and average salinity was 18 ppt on the surface and 25 ppt at 1m depth. Substrate is mostly peat, granite rocks and coarse sand and gravel with dense beds of *Ruppia* and *Zostera* where substrate allows. The lagoon is bordered by peat bog, granite rocks, bedrock and rough pasture.

Sampling stations

The area was sampled from 26-28/8/98 and 22-23/9/98
Eight sampling stations were selected to reflect the influences of substrate, vegetation, freshwater and tidal inflows.

Station 1a (L 94354 31890) was located at the north end of the lagoon inside the rapids which flow into Camus Bay. Substrate consisted of granite rocks and coarse sand with peat deposits in sheltered areas and crevices with dense growths of marine algae. The area was bordered by large granite rocks, moorland and rough grazing. Depth varied from 0 - 1.5 m and salinity measured 18.7ppt at the surface and 24.5ppt at 0.5m.

Station 1b (L94472 32077) was also located at the north end of the lagoon, very near Sta. 1a where a smaller inlet to the lagoon to the east of a small island has been partly blocked by a stone causeway. In general the environmental parameters were the same as those for 1a except that there was a larger area of shallow water with a coarse sand substrate.

Station 2 (L 94849 31982) was located on the northwest shore of the lagoon about 300m from the rapids. Substrate consisted of soft peat with scattered granite stones. Depth varied from 0 - 1m. and salinity measured 24.5 ppt.. The area was bordered by moorland with peat cliffs and granite boulders.

Station 3 (L 95044 31685) was located on the east shore of the lagoon where a small stream enters. Substrate consisted of soft peat with granite rocks and boulders. Depth varied from 0 - 1m and salinity measured 24.5 - 26.2 ppt. The area was bordered by moorland with peat cliffs and granite rocks.

Station 4 (L 95055 31088) was located at the southeast end of the lagoon below a granite hill. Depth was slightly greater in this area (up to 2m) and salinity measured 24.5 - 26 ppt. Substrate consisted of peat with granite rocks and the area was bordered by moorland, granite rocks and patches of *Juncus*.

Station 5 (L 94990 30825) was located at the southern end of the lagoon where the channel enters from L. Tanaí to the south. Depth was 0 -1m and salinity measured 18 ppt on the surface and 25.6 ppt at 1m depth. Substrate consisted mostly of peat near the channel with rocks and coarse sand along the shore of the lagoon and in deeper water

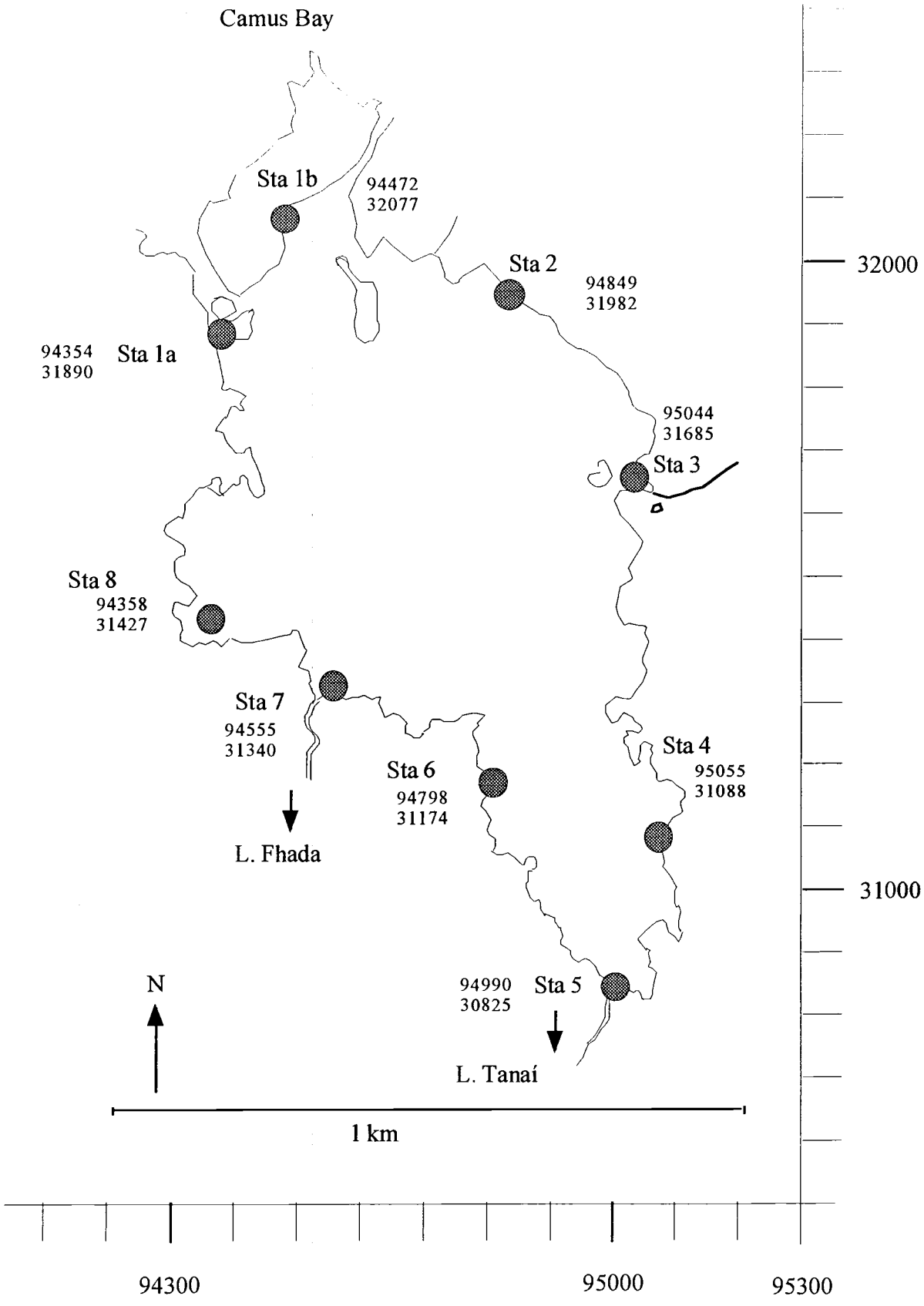

Fig. 4 Sketch map of Loch an Aibhnín, Connemara, Co. Galway, showing sampling stations used for a survey of aquatic fauna, 1998.

away from the channel. The area was bordered by moorland with peat cliffs and granite rocks.

Station 6 (L 94798 31174) was located on the southwestern shore of the lagoon to the south of a stony headland between the inflow channels from L. Tanaí and L. Fhada. Depth was 0 -1m and salinity measured 25.0 ppt. Substrate consisted of peat with rocks, coarse sand and finer silty sediments in sheltered areas. Fyke nets were used at this station but otherwise it was sampled only briefly.

Station 7 (L 94555 31340) was located on the western shore of the lagoon where the channel from L. Fhada enters. Depth was 0 - 1m and salinity measured 20 - 25 ppt. Substrate consisted mostly of peat and peaty silt with occasional rocks.

Station 8 (L 94358 31427) was located on the western shore of the lagoon in a large bay bordered by peat, saltmarsh and granite rocks. The area was relatively shallow (0-0.5 m) with a substrate of soft unconsolidated peat along the shore giving way to rocks further out into the lagoon. Much of the area was covered with a dense growth of filamentous algae.

Results

Table 1 is a list of species arranged in broad ecological categories based on the Venice system of salinity regimes. Table 2 shows the total species list for each station.

A total of 107 taxa were recorded, of which 9 are regarded as lagoonal specialists in Britain and one additional species is a proposed lagoonal specialist in Ireland. 7 species are interesting or rare:

Gonothyrea loveni is listed as a lagoonal specialist in Britain. There is a record of its occurrence in the Belmullet Canal, Co. Mayo from material collected by P. Hayward in 1971 (B. Picton *pers. comm.*) but there appear to be no other records of its occurrence in Ireland.

Jaera forsmani was previously recorded at Drongawn L. in the 1996 survey and during this survey at Kilmore L., L Fhada, Cara na gCaorach and L. Athola. The only other Irish record of the species located is for L.Hyne, Co. Cork, (De Grave and Holmes, 1998).

Lembos longipes was also recorded at Kilmore L. and possibly Sally's L. during this survey and at Drongawn L. and Furnace L. during the 1996 survey. There are only 3 previous records for Ireland (Costello *et al.* 1989).

Cercyon littoralis was previously recorded at Bridge L and Mill L. and during this survey at L. Fhada: driftline species with few recent records in Ireland.

Enochrus bicolor was recorded at Ballyteige, Phort Chorrúch, and an Chara during this survey, at six sites during the 1996 survey, and also from Port na Curra, Inis Meann in 1998, and in samples collected from the North Slob in 1991 (Galvin 1992). There are only two recent records from Northern Ireland (Nelson *et al.* 1998).

Littorina "tenebrosa" was also recorded during this survey at L Fhada and L. an tSaile and during the 1996 survey in Lettermullen Pool, L.Tanaí, L. Murree and also from the North Slob. These are the only known sites in Ireland. The status of this taxon is still under dispute but appears to be morphologically and ecologically distinct and is listed as a lagoonal specialist for Britain.

Conopeum seurati has been recorded at 16 of the 36 sites surveyed, but is not listed in a recent review of Irish marine Bryozoa (Wyse Jackson 1991). Either the species is under recorded or a truly lagoonal specialist.

Table 1. List of species arranged in broad ecological categories (L* = lagoonal specialist in Britain, L*IR = proposed as lagoonal specialist in Ireland * = interesting or rare species. Species in brackets refer to previous records).

Marine

Axinellidae indet.
Leucosolenia botryoides
L. complicata
Sycon ciliatum
Anthopleura ballii
Aurelia aurita
Lineus spp.
Circeis spirillum
Eumidia sanguinea
Eupolymnia nebulosa
Flabelligera affinis
Harmothöe imbricata
Orbinia sp.
Polyophthalmus pictus
Scoloplos armiger
Spirorbidae sp 2
Tanais dulongi
Praunus ?inermis
Limnoria lignorum
Ampithoe ramondi
Caprella acanthifera
Dexamine spinosa
**Lembos longipes*
Melita obtusata
Cancer pagurus
Liocarcinus depurator
Gibbula umbilicalis
Littorina obtusata
Pusillina sarsi
Akera bullata
Cadlina laevis
Diodora graeca
Runcina coronata
Scaphander lignarius
Anomia ephippium
Cerastoderma edule
Chlamys varia
Hiatella arctica
Modiolarca tumida
Modiolus modiolus
Monia patelliformis
Musculus discors
Mysella bidentata
Paphia aurea
Amathia lendigera
Callopora lineata
Phaeostachys lineata
Polycarpa pomaria
Leptosynapta inhaerens
Botryllus schlosseri
Botrylloides leachi

Marine-polyhaline

Halichondria panicea
Actinia equina
Anemonia viridis
Platynereis dumerili
Praunus flexuosus
**Jaera forsmani*
Melita palmata
Crangon crangon
Palaemon elegans
P. serratus
Lepidochitona cinereus
Gibbula cinereus
Hydrobia ulvae
Littorina littorea
L. saxatilis
Patella vulgata
Rissostomia membranacea
Skeneopsis planorbis
Mya arenaria
Mytilus edulis
Ostrea edulis
Bowerbankia gracilis
Amphipholis squamata
Ascidiella aspersa
A. scabra
Ciona intestinalis
Clavelina lepadiformis
Crenilabrus melops
Gobius niger

Poly-mesohaline

**Gonothyraea loveni*	L*
**Enochrus bicolor*	L*
**Littorina "tenebrosa"*	L*
Onoba aculeus	L*
Cerastoderma glaucum	L*
Mugilidae	
Pomatoschistus microps	

Euryhaline

? Procerodes littoralis	
Neomysis integer	L*IR
Idotea chelipes	L*
Lekanesphaera hookeri	L*
Gammarus duebeni	
Carcinus maenas	
Palaemonetes varians	L*
**Conopeum seurati*	L*
Anguilla anguilla	
Gasterosteus aculeatus	
Pleuronectes flesus	

Meso-oligohaline

Ochthebius dilatatus
O. viridis

Strandline

**Cercyon littoralis*

Table 2. Aquatic fauna recorded at stations in Loch an Aibhnín, Co. Galway. 1998.

Taxa		Stations																
		1	L.T. 1	1B	2	L.T. 2	3	L.T.3	4	L.T. 4	5	L.T. 5	6	L.T. 6	7	L.T. 7	8	L.T.8
Porifera	Axinellidae indet.	+																
	Halichondria panicea	+		+			+		+				+					
	Leucosolenia botryoides	+											+					
	L. complicata	+																
	Suberites sp						+											
	Sycon ciliatum	+									+		+					
Cnidaria	*Actinia equina*	1																
	Anemonia viridis	+			+													
	Aurelia aurita	+																
	Anthopleura ballii	+			+		+		+		+		+					
	Gonothyraea loveni	+		+			+		+		+				+			
Turbellaria	indet.	+																
Nemertea	*Lineus sp.*	+			+		+				+		+		+		+	
	Nem. sp.1								+									
	Nem. sp 2								+									
Annelida																		
Polychaeta	*Circeis spirillum*	+																
	Eumidea sanguinea	+																
	Eupolymnia nebulosa	+																
	Flabelligera affinis	c		c							a							
	Harmothöe imbricata	c		+														
	Orbinidae indet.				1													
	Platynereis dumerili	+		+	+													
	Polyophthalmus pictus	+	8								+				+			
	Scoloplos armiger																+	
	Spirorbidae indet.	+		+	+		+		+		+		+		+			
Oligochaeta	Tubificidae indet			1														
	L.T. = light trap. + = present, o = occasional, c = common, a = abundant.																	

Table 2 (cont.) Aquatic fauna recorded at stations in Loch an Aibhnín, Co. Galway. 1998.

Taxa		1	L.T. 1	1b	2	L.T. 2	3	L.T.3	4	L.T. 4	5	L.T. 5	6	L.T. 6	7	L.T. 7	8	L.T.8
Sipuncula	indet.																+	
Crustacea																		
Tanaidacea	*Tanais dulongi*	+			+		a		a		+		+		+			
Mysidacea	*Neomysis integer*						o											
	Praunus flexuosus	c	10				a	35	c	23	a	59			a	89	a	400
	P. ?inermis									4						?		
Isopoda	*Idotea chelipes*				+		+		o	3	o	5					a	9
	Jaera forsmani	+		+	+		+		+									
	Lekanesphaera hookeri										o				o	1	+	
	Limnoria lignorum		1							1								
Amphipoda	*Ampithoe ramondi*	a		1			2				1				1			
	Caprella acanthifera	c	3	c	c		c	2	a	1	2		1		5			
	Dexamine spinosa	4																
	Gammarus duebeni	2																
	Lembos longipes			1	3										3			
	Melita obtusata			4											1			
	M. palmata	2					3		2									
Decapoda	*Cancer pagurus*	1																
	Carcinus maenas	F=6			F=9						F=7		F=3				+	
	Crangon crangon	o		o														
	Liocarcinus depurator	1																
	Palaemon elegans	o		o													+	
	P. serratus	o		o			+											
	Palaemonetes varians						+				o							
Insecta	Chironomidae indet.	+			+		+		+				+				+	
	F = Fyke net; L.T. = light trap. + = present, o = occasional, c = common, a = abundant.																	

Table 2 (cont.) Aquatic fauna recorded at stations in Loch an Aibhnín, Co. Galway. 1998.

Taxa		1	L.T. 1	1B	2	L.T. 2	3	L.T.3	4	L.T. 4	5	L.T. 5	6	L.T. 6	7	L.T. 7	8	L.T.8
Coleoptera	*Cercyon littoralis*	6																
	Enochrus bicolor	2																
	Ochthebius dilatatus																1	
	O. viridis																1	
Mollusca																		
lyplacophora	*Lepidochitona cinereus*	+									+							
rosobranchia	*Diodora graeca*	+																
	Gibbula cinerea			+							+							
	Gibbula umbilicalis	+		+														
	Hydrobia ulvae	o			+													
	Littorina littorea			+														
	L. obtusata	+																
	L. saxatilis	+		+													+	
	L. "tenebrosa"				+		+		+		+							
	Onoba aculeus				o		o				+		+		+		o	
	Patella vulgata	+																
	Pusillina sarsi	+																
	Rissostomia membranacea	+			+		+		+		+		+		+			
	Skeneopsis planorbis	+			+				+		+				+		+	
Opisthobranc	*Akera bullata*	+		+	o		+		+								o	
	Cadlina laevis	+																
	Runcina coronata	+		+	1				+								+	
	Scaphander lignarius	+					+				c		o		+			
Bivalvia	*Anomia ephippium*	+																
	Cerastoderma glaucum	+		+	+		+		+		+		+		+		+	
	C. edule						+											
	Chlamys varia	+																
	Hiatella arctica	+																
	indet.									5		2						
	L.T. = light trap. + = present, o = occasional, c = common, a = abundant.																	

Table 2 (cont.) Aquatic fauna recorded at stations in Loch an Aibhnín, Co. Galway. 1998.

		Stations																
Taxa		1	L.T. 1	1B	2	L.T. 2	3	L.T.3	4	L.T. 4	5	L.T. 5	6	L.T. 6	7	L.T. 7	8	L.T.8
	Modiolarca tumida	+																
	Modiolus modiolus	1																
	Monia patelliformis	+																
	Musculus discors	c		c	c		c		c		c		c				a	
	Mya arenaria						+											
	Mysella bidentata	+		+														
	Mytilus edulis	+																
	Ostrea edulis	+																
	Paphia aurea			+														
Bryozoa	*Amathia lendigera*	+		+														
	Bowerbankia gracilis				+						+		+		+			
	Callopora lineata	+		+	+		+		+		+		+		+		+	
	Conopeum seurati	+															+	
	Phaeostachys spinifera	+																
Echinoderma	*Amphipholis squamata*	+					+						+		+			
	Leptosynapta inhaerens				+		+				+				a			
Tunicata	*Ascidiella aspersa*	+													+			
	A. scabra				+										+			
	Botryllus schlosseri	+		+											+			
	Botrylloides leachi	+																
	Ciona intestinalis	+			+		+		+		+		+				+	
	Clavelina lepadiformis	+			+		+				+		+					
	? Polycarpa pomaria	+																
Pisces	*Anguilla anguilla*	F=3			F=15						F=9		F=5					
	Crenilabrus melops	F=2											F=1					
	Gasterosteus aculeatus						+		0	1						1		
	Gobius niger	F = 1																
	Mugilidae						+											
	Pleuronectes flesus				F=1													
	Pomatoschistus microps				+		+		+									
	F = Fyke net; L.T. = light trap. + = present, o = occasional, c = common, a = abundant.																	

Evaluation

Loch an Aibhnín is an extremely good example of a saline lake lagoon with a very rich fauna in the marine to euryhaline range, comprising a high number of lagoonal specialists and rare species. This site is extremely valuable and should be protected.

ECOTONAL COLEOPTERA

Description

This is a large saline lake with a rocky channel to the sea, a small tidal response, and fluctuating but high surface water salinity (up to 31‰). The lake shore has eroded cliffed peat margins, boulders and outcropping rock, especially on the exposed eastern shore, but also has extensive areas of *Juncus maritimus* and *Agrostis stolonifera* on the more sheltered northern and western shores. Peat cuttings are evident in the surrounding bog, and the gradient between land and sea is steeper on the western than on the eastern shore. *Zostera* wrack was present on the northern shore after gales.

Sampling

Three areas were selected for sampling from 12/8 – 16/9/98:
(1) An area of moderately to heavily grazed *Juncus maritimus*, *Agrostis stolonifera*, and, *Festuca rubra* and *Juncus maritimus* dominated sward on peat below the outflow from L. Tanaí. There are extensive (c. 0.5 ha) areas of this type of shore vegetation in the vicinity. The area is grazed by sheep and cattle.
(2) An area of ungrazed *Agrostis stolonifera, Festuca rubra* and *Juncus maritimus* dominated sward on a small peat bank isolated from the surrounding peat (and livestock) by narrow (c. 1m width) flooded cuttings.
(3) (L 944 320) An area of *Zostera marina* wrack, with a lesser amount of *Fucus vesiculosus*, in the early stages of decomposition on a sheltered (from north and west) shore on granite rock and shallow peaty soil. The water salinity immediately (0.5 m) offshore was 31‰ (12 viii 1998).

Results

In total, two species of carabid, nine species of staphylinid and one species of pselaphid were recorded, none of which are regarded as indicator species (Tables 3, 4 & 5).

TABLE 3. Staphylinidae and Pselaphidae from saline lake peat shores with Juncus maritimus and grasses in Na Dhá Sháile area, Connemara (Co. Galway): Loch an Aibhnín; L. Fhada; L. Cara na gCaorach; L. Cara Fionnla. The same sampling techniques and effort were used at each site. Indicator species are marked with an asterisk.

	Aibhnín	Fhada	Cara na gCaorach	Cara Fionnla
Atheta aquatica (Thoms.)	1	-	-	-
Brachygluta helferi (Schm.)	21	7	24	1
Drusilla canaliculata (Fab.)	3	-	-	2
Paederus fuscipes Curt.	9	-	8	-
Sepedophilus nigripennis (Steph.)	1	1	1	-
Stenus brunnipes Steph.	1	1	-	1
Stenus juno (Payk.)	3	1	-	-
Stenus ossium Steph.	1	-	-	-

Euaesthetus bipunctatus (Ljungh)	-	5	-	7
Reichenbachia juncorum (Leach)	-	3	-	43
Stenus clavicornis (Scop.)	-	2	-	-
Stenus fulvicornis Steph.	-	1	-	5
Stenus fuscipes Grav.	-	2	-	-
Stenus lustrator Er. *	-	2	2	2
Stenus nitidiusculus Steph.	-	1	-	1
Atheta vestita (Grav.)	-	-	2	-
Cordalia obscura (Grav.)	-	-	1	7
Tachyporus dispar (Payk.)	-	-	1	1
Xantholinus longiventris Heer	-	-	1	-
Atheta amplicollis (Muls. Rey)	-	-	-	1
Oxypoda elongatula Aubé	-	-	-	3
Quedius fulginosus (Grav.)	-	-	-	1
Quedius molochinus (Grav.)	-	-	-	1
Stenus tarsalis Ljungh	-	-	-	2
Tachyporus nitidulus (Fab.)	-	-	-	1

TABLE 4. Staphylinidae from *Zostera* debris on the seaward shore of Loch an Aibhnín, Connemara (Co. Galway).

Atheta vestita (Grav.)	25
Omalium laevisuculum Gyll.	27

TABLE 5. Carabidae from saline lake peat shores in Na Dhá Sháile area, Connemara (Co. Galway): Loch an Aibhnín; L. Fhada; L. Cara na gCaorach; L. Cara Fionnla. The same sampling techniques and effort were used at each site, with the exception of L. an Aibhnín where *Zostera* shore refuse was sieved. Indicator species are marked with an asterisk.

	Aibhnín	Fhada	Cara na gCaorach	Cara Fionnla
Bradycellus harpalinus (Serv.)	1	-	-	-
Dyschirius globosus (Herbst)	3	-	-	-
Bembidion mannerheimi Sahlb.	-	1	-	-
Pterostichus niger (Schall.)	-	1	-	5
Bembidion assimile Gyll.	-	-	1	-
Loricera pilicornis (Fab.)	-	-	-	1
Notiophilus palustris (Dufts.)	-	-	-	1

Evaluation

No indicator species were recorded at this site. However, the subsites sampled were either moderately to heavily grazed by sheep or ungrazed but isolated on a peat cutting surrounded by water (Most *Juncus maritimus/Agrostis stolonifera* swards, not heavily grazed, were flooded at the time of sampling). Furthermore, Carabidae were poorly represented in traps from this part of Connemara, which may be an effect of season and year, rather than site. In terms of the connectivity of populations, the site must be taken as a part of the larger area of Na Dhá Sháile inlets, and species like *Stenus nigritulus* would be expected to occur at some points of the Loch an Aibhnín shore (cf. L. Fhada).

SUMMARY

Loch an Aibhíin is an exceptional lagoon, large, unspoilt, shallow and easy to sample, and rich in flora and fauna. While not supporting the range of habitats found in L. an tSáile, the communities are extensive and important. Vegetation includes several distinct assemblages of red algae as well as large areas of *Lamrothamnium* and *Zostera* communities. The fauna was the richest of any lagoon apart from Kilmore L. but unlike the latter was not dominated by marine species but contained a mix of marine and brackish species, a high proportion of lagoonal specialists, and several rare species. The abundance of the red form of the sea squirt *Ciona intestinalis* (associated with peat) clinging in clusters on *Zostera* gives the site extra appeal. Only in relation to ecotonal Coleoptera was this site not rated highly.

Loch Tanaí and the Loch Fhada complex drain into this lagoon. All should be included as a single conservation unit.

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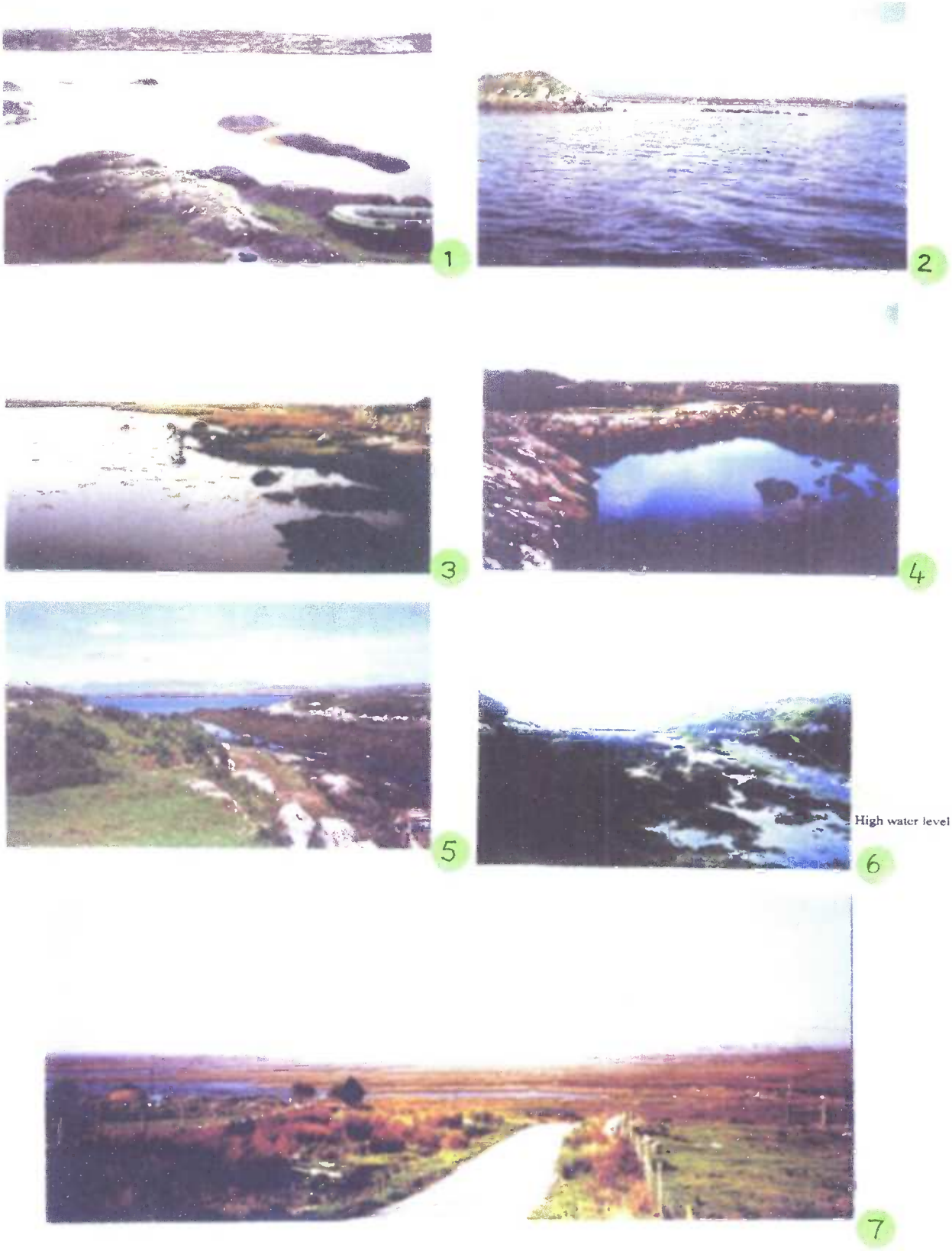

Plate 7a. Loch an Aibhnín, Connemara 1. View from east shore (faunal Stn. 3), 2. looking north from west shore, 3. West shore (faunal Stn. 8), 4. Wall across secondary outlet (faunal Stn. 1b), 5. Outlet and rapids at low tide, 6. Outlet at low tide showing high tide mark, 7. View of lagoon from the west, sea on the left.

Plate 7b. Loch an Aibhnín, Connemara. 1 *Furcellaria Polyides* community in shallow water, 2 *Phyllophora crispa* in the 4 m hole near the outlet, 3 *Furcellaria Polyides* community at 2 m, 4 *Ruppia Lamprothamnium*, 5 *Ruppia Lamprothamnium Zostera*, 6 *Zostera* with *Ciona intestinalis*.

8. LOCH CARA FIONNLA, CONNEMARA Co. Galway

Lough Carafinla, Lough Carrafinla

Location: L 963290 53°18.0'N, 9°33.0'W. OS Sheet 45
About 1.5 km north of Casla beside the road R336 to Maam Cross.
Cara na gCaorach (L 964305) was briefly investigated as part of the system.

Lagoon type	saline lake lagoon with inlet
Area	about 15 ha
Salinity regime	widely fluctuating
Maximum depth	4 m
Seawater entry	unsilled inlet through peat
Tidal range	(?)
Conservation status	none, adjoining an NHA No. 2075.

Origin and history

The lagoon appears to be natural but peat cutting may have contributed to the formation of the inlet.

Geology, geomorphology and landscape

The rock is Galway granite of lower-mid Devonian age, a pink to grey coloured granite with large, pink feldspar crystals. The lake and its inlet appear to lie along a fault (Max *et al.* 1978; Springer 1999). The landscape around the loch is mostly low-lying blanket bog, with many lakes. Extensive saltmarshes and *Juncus maritimus* swards border the northern parts of the inlet.

Description of the system

The lagoon is situated at the head of a long 4 km inlet which is an extension of the head of Camus Bay. The Bay first narrows to form an inlet 100-150 m across with mud flats exposed at low tide; this then broadens into a long lagoon, Cara na gCaorach, where the tidal range is reduced. From this, a long narrow inlet, nearly 1 km in length, leads to L. Cara Fionnla. The system has been described elsewhere as a bayhead.

L. Cara Fionnla is a shallow lagoon surrounded by undulating, rocky blanket bog. The shores are of rock and peat, vertical in places, with gravelly bays, and a *Phragmites* bed at the southern end. The maximum depth is 3-4 m near the inlet, grading to 1 m in the south-west. The bed has a flat bottom of fine peaty mud with occasional granite boulders.

A road provides easy access to the east shore.

Cara na gCaorach is very shallow, <1 m except for the main north-south channel which is 2-3 m. The floor of the inlet consists of large granite boulders, large areas of peat, and dense stands of macrophytes in places.

Hydrology

The lagoon receives considerable amounts of freshwater from lakes. Loch ui Chadhain, from which water flows into the south of L. Cara Fionnla, is linked to a string of connected lakes, and water from another group of lakes flows into the south-west. The brown colour of the lagoon water indicated a considerable input of water draining from peat. Other lakes empty into Cara na gCaorach and the inlet, possibly diluting inflowing seawater. Although L. Cara Fionnla was oligohaline, and in places even fresh, when surveyed on 8.9.98, higher salinities were recorded in 1996 and 1997, and almost full

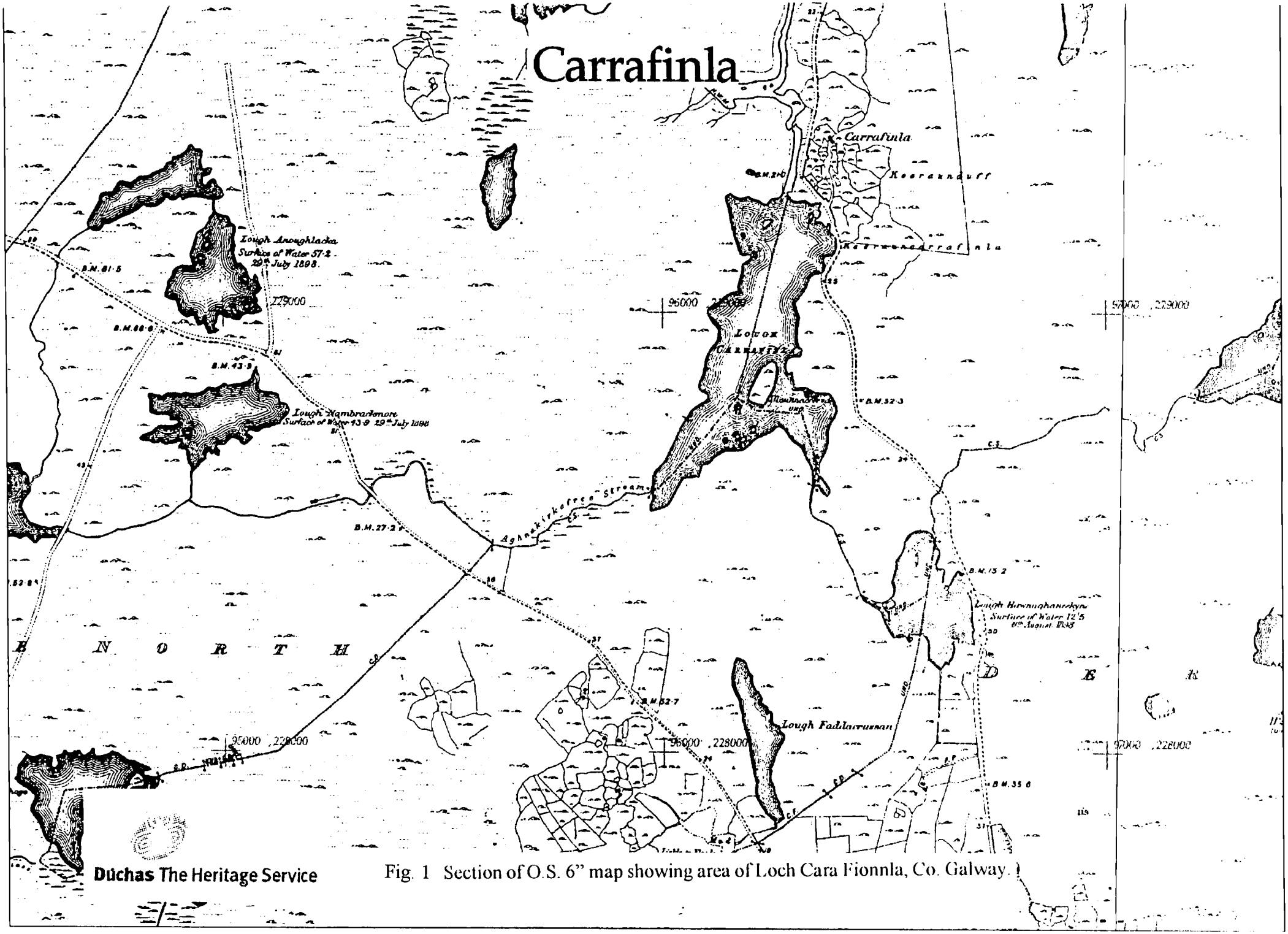

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Fig. 1 Section of O.S. 6" map showing area of Loch Cara Fionnla, Co. Galway.

seawater was flowing into the lagoon on one occasion. In May 1997, 24‰ was recorded near the inlet (faunal station 2) and 6-7‰ near the south end.

Exploitation and threats - none identified.

Conservation status

The area around the inlet and Cara na gCaorach is an NHA, comprising the Cinn Mhara salt marsh.

VEGETATION

Site description

This lake lies at the head of a 4km long narrow inlet. The inlet meets tidal water at Camus Bay, itself separated from the open sea by Kilkieran Bay. The surrounding countryside is a flat granite plain now covered in large part by blanket bog. The lake and inlet appear to lie along a series of geological faults (Max *et al.*, 1978; Springer, 1999). While Cara Fionnla lake has been treated as a separate unit in this survey, a rapid examination of the inlet to the north showed that lagoonal conditions obtain in much of the inlet, termed Cara na gCaorach by Robinson (1990). Both lake and inlet have shorelines marked for the most part by small cliffs (1-2m) of rock or peat.

Salinity of the site was very low (0-2 p.p.t.) during sampling and visibility reduced due to turbid freshwater runoff.

Underwater observations

This large lake had very poor visibility on the three occasions it was surveyed. The brown colour of the water suggested peat stained freshwater runoff, a possibility strengthened by its low salinity. The lake has a flat bottom of fine peaty mud with occasional granite boulders protruding. The sides are steeply sloping and rocky. Depth varies from 3-4m at the N. end to less than 1m in the SW section. There is a very sparse vegetation on the lake floor. The rocky sides support dense stands of *P. pectinatus* and *Fucus ceranoides.*

The inlet at Cara na gCaorach is very shallow (<1m), except for the main north/south channel which is 2-3m in depth. The floor of the inlet consists of large granite boulders and large areas of peat, with dense stands of macrophytes in places.

Sampling

This lake was sampled on 21/6/98,24/6/98 and 26/6/1998. The adjoining lagoon of Cara na gCaorach was examined on 22/9/1998. Marginal vegetation was sampled and snorkelling was used to survey the benthic flora. A phytoplankton sample was taken.
Relevés 1-10 (096229) were taken along the shore in the narrow zone of vegetation lying between the surrounding blanket bog and the steep shelving shore.
11-13 and 16-20 (09602285) were taken on the lake bed in the southern part of the lake.
14,15 (09602290) were taken in shallow, 5m depth water with a peaty gravel bottom.
21 and 22 (09602305) were taken on the floor of the lake in the northern part.

Results

Small areas of *Chara aspera* were found at the southern end of the lake. The greater part of the lake supported communities of *Ruppia* sp. and *Potamogeton pectinatus. Lamprothamnium* occurred only in the centre of the lake growing sparsely on bare mud or with *Ruppia* sp. at a depth of 1-2m. The rocky sides supported a *Fucus ceranoides,*

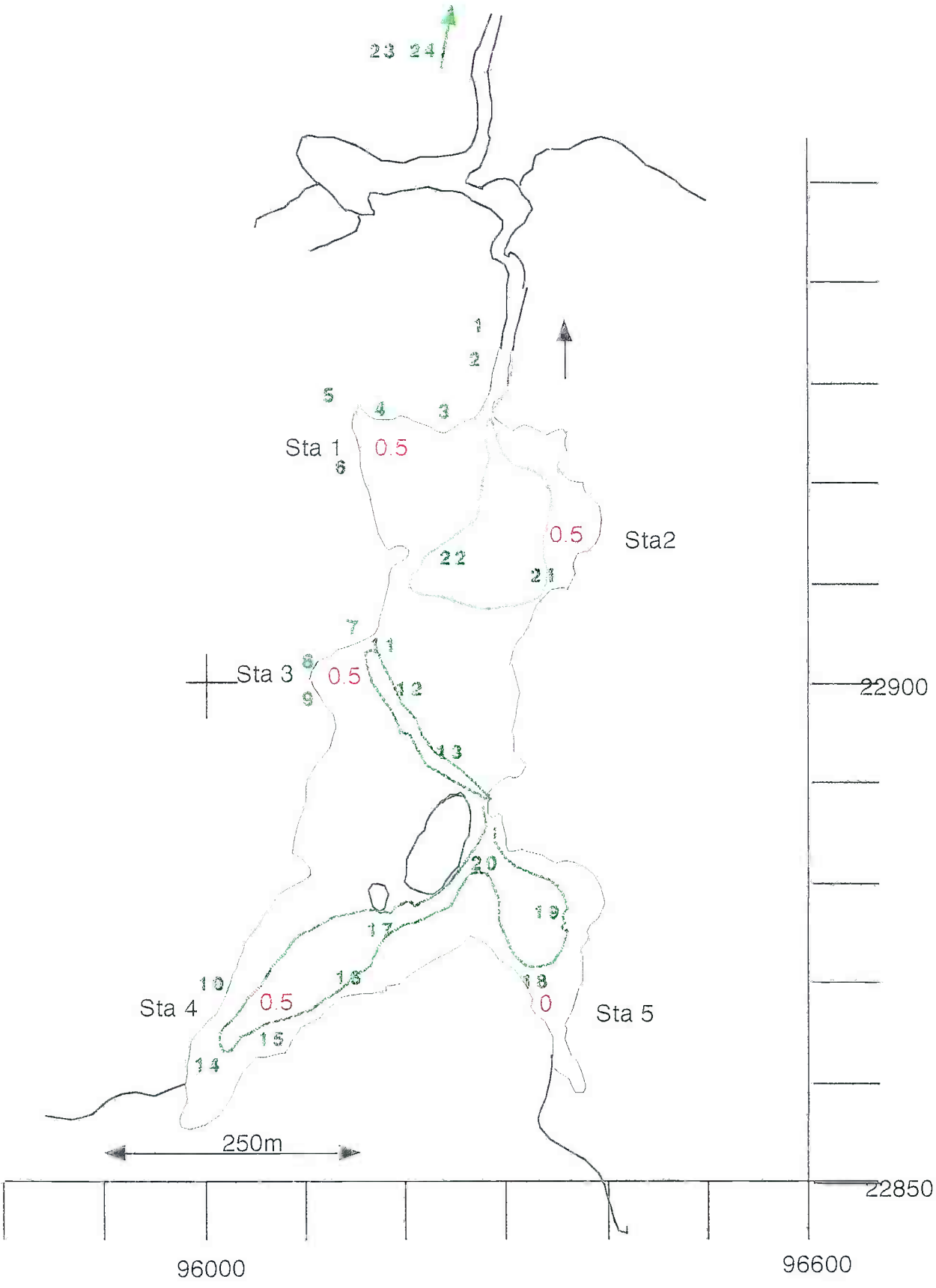

Fig. 2 Sketch map of Cara Fionnla, Connemara, Co. Galway. showing sampling stations during survey. 1998

Enteromorpha sp. community intermixed with *Potamogeton pectinatus* and *Ruppia* sp. A cyanophyte formed green cushions 1-3mm in size in the splash zone.

Cara na gCaorach had a uniform vegetation of *Ruppia* sp. with a little *Zostera angustifolia* and *Chaetomorpha linum*. The deeper part of the main channel was exposed peat.

Marginal vegetation includes maritime lichens on bare rock, *Juncus maritimus* communities, *Eleocharis uniglumis* communities, the *Samolus valerandii* variant of the *Juncus gerardii* association and stands of *Phragmites australis* and *Schoenoplectus maritimus*. However as the zone of marginal vegetation is extremely narrow none of these communities are extensive.

The plankton community was very sparse in detritus rich water.

Notable species

The *Lamprothamnium* grows in an unusual habitat, in low salinity water and at depth. The habit of the plant is atypical. *Zostera angustifolia* was not recorded in other lagoons.

Assessment

Cara Fionnla is a site for the rare charophyte *Lamprothamnium papulosum*. It is a good example of an intermediate salinity lagoon- to judge by flora and vegetation.

AQUATIC FAUNA

Description

Loch Cara Fionnla is a natural saline lake lagoon which drains into the south side of Camus Bay, through a long channel which runs through Kinvarra saltmarsh (Fig. 1). The loch covers an area of 13.5 ha and lies beside the main road 1.5 km north of Costelloe. The lagoon is shallow (mostly 1-2m), and at the time of sampling was relatively fresh with a maximum salinity of 1.1 ppt at 2m depth in August and 1.9ppt in September and most of the surface water measuring 0-0.5 ppt although 3.5 ppt was measured near the inflow on 24/9/98. However, there are obviously extreme variations in salinity as 24 ppt was measured near the inflow in may 1997. Substrate is mostly granite rocks, coarse sand and gravel with peaty silts in sheltered areas. The lake is bordered by moorland, peat bog and granite rocks.

Cara na gCaorach lies to the north of Cara Fionnla surrounded by Kinvarra saltmarsh and is included with this site as it forms a gradation of the lagoonal habitat between the lagoon and the open sea of Camus Bay.

Sampling stations

The area was sampled in 1996, briefly in June 98 and from 7-10/8/98 and on 9/9/98 Five sampling stations were selected to reflect the influences of substrate, vegetation, freshwater and tidal inflows.

Station 1 (L 96137 29325) was located at the northwest end of the lagoon. Substrate consisted of granite rocks and stones, coarse gravel with peaty silt in sheltered areas. Water depth was 0-1m, the water was coloured peaty-brown and salinity measured 0.4 ppt at the surface and 1.4ppt at 1m depth. The area is bordered by low peat cliffs, saltmarsh, *Phragmites*, peat bog, moorland and granite rock.

Station 2 (L 96384 29231) was located on the northeast shore of the loch, beside the main road and close to the inflow from Kinvarra saltmarsh. Substrate consisted of gravel, and sand with stones and rocks. Depth varied from 0 - 1.m and salinity measured

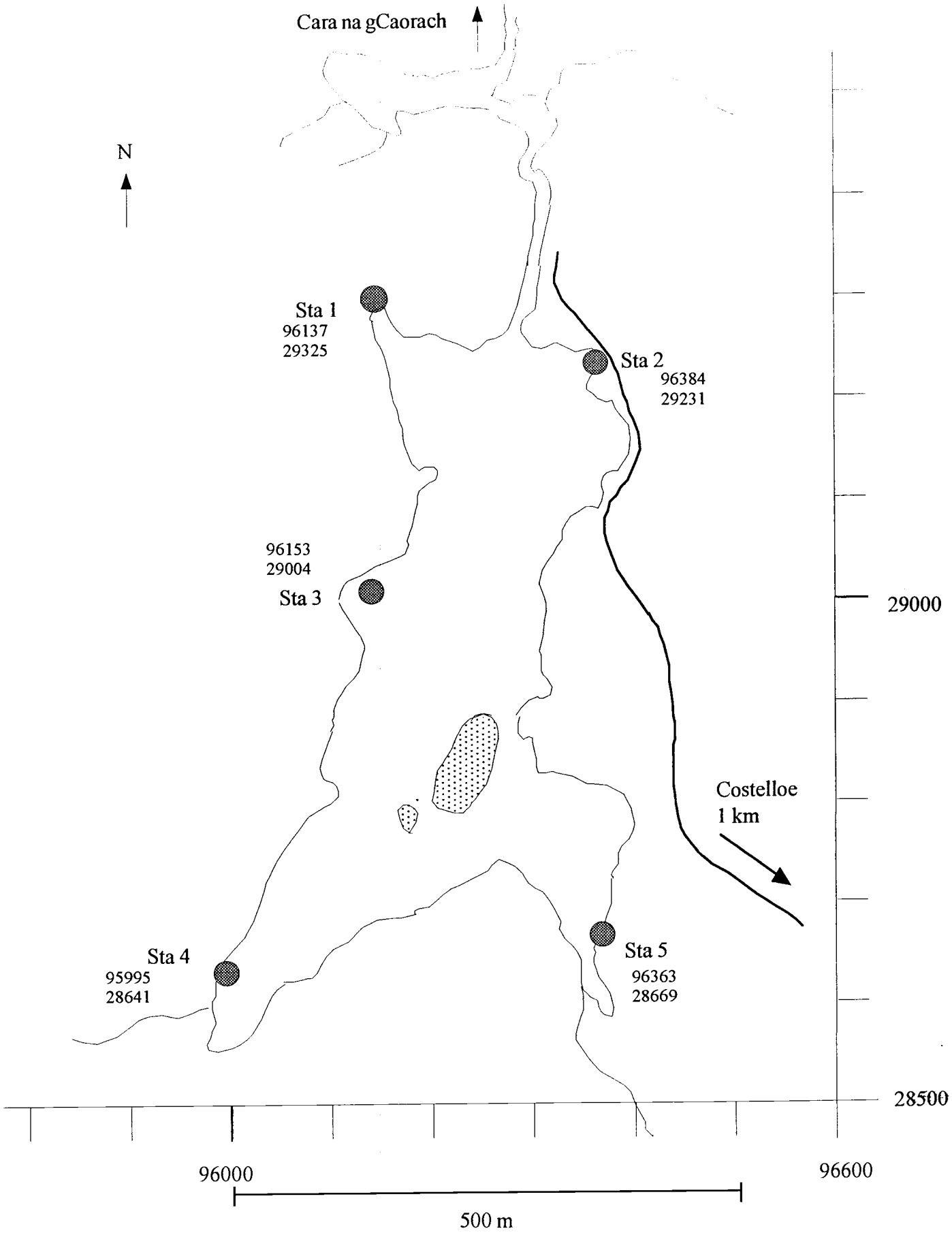

Fig. 4 Sketch map of Loch Cara Fionnla, Connemara, Co. Galway, showing sampling stations used for a survey of aquatic fauna, 1998.

0.5 ppt in August but 3.5ppt was recorded on 24/9/98 and 24 ppt in May 1997. Patches of *Phragmites* bordered the loch in this area but it was mostly bordered by moorland and granite in the narrow strip between the road and the loch.

Station 3 (L96153 29004) was located on the west shore of the loch. Depth varied from 0 - 1.3m and salinity measured 0.5ppt at the surface and 0.8ppt at 1.3 m. The area was bordered by moorland with peat cliffs and granite rocks.

Station 4 (L 95995 28641) was located at the southwest end of the lagoon where a stream enters. Depth was 0 - 1.5m and salinity measured 0.6 - 1.3 ppt. Substrate consisted of soft peat with granite stones and the area was bordered by moorland, granite rocks and patches of *Juncus* and *Phragmites.*

Station 5 (L 96363 28669) was located at the southeastern end of the loch where another stream enters. Depth was 0 -1.5m and salinity measured 0-0.6 ppt during the sampling period but 6 ppt in May 1997. The area was very similar to Sta. 4 but it appears that a greater volume of fresh water entered through this stream, salinity is lower and the *Phragmites* more extensive.

Results

Table 1 shows the total species list for each station. The following is a list of species arranged in broad ecological categories based on the Venice system of salinity regimes (L* = lagoonal specialist in Britain, L*IR = proposed as lagoonal specialist in Ireland; * = interesting or rare species):

Marine-polyhaline	
Praunus flexuosus	
Poly-mesohaline	
Chaetogammarus marinus	
Corophium volutator	
Pomatoschistus microp	
Euryhaline	
Neomysis integer	L* IR?
Jaera nordmanni	L* IR?
Lekanesphaera hookeri	L*
Gammarus duebeni	
G. zaddachi	
Palaemonetes varians	L*
Potamopyrgus antipodarum	
**Conopeum seurati*	L*
Anguilla anguilla	
Gasterosteus aculeatus	
Pleuronectes flesus	
Salmo trutta	
Meso-oligohaline	
Ischnura elegans	
Hydrometra stagnorum	
Oligohaline-freshwater	
Sympetra sp.	
Corixa ?panzeri	
Gerris lacustris	
G. odontogaster	
Uncertain	
Trichoptera indet.	

Table 1 Aquatic fauna recorded at stations in Loch Cara Fionnla, 1998.

		1	L.T. 1	2	L.T. 2	3	L.T. 3	4	L.T. 4	5	L.T.5
Crustacea											
Mysidacea	*Neomysis integer*	c	46	o	16	c	35	c	29	o	8
	Praunus flexuosus	1									
Isopoda	*Jaera nordmanni*			+							
	Lekanesphaera hookeri	+	10	+	22	o	6				
Amphipoda		o	2	+	18	o	7			2	1
	Chaetogammarus marinus			1							
	Corophium volutator			o	1						
	Gammarus duebeni	o	2		8		3				1
	G. zaddachi			1							
Decapoda	*Palaemonetes varians*	o		+	2	o			1		
Insecta											
Odonata	Anisoptera indet.							1			
	Ischnura elegans			o						o	
Trichoptera		+									
Heteroptera											
	Corixa ?panzeri	o	4							o	1
	Gerris lacustris			2		+					
	G. odontogaster					+				3	
	Hydrometra stagnorum	4						+			
Coleoptera	Larvae	1	1	o	1	o	3	2		0	
Diptera	Culicidae indet.	+				+			4		
	Chironomidae indet.	+				+		+			
Mollusca	*Potamopyrgus antipodarum*	a	120	c	85	a	150	o	3	c	95
Bryozoa	*Conopeum seurati*			+							
Pisces	*Anguilla anguilla*	F=6				F=5	1			F=4	
	Pleuronectes flesus	F=2				F=1		F=1		F=4	
	Pomatoschistus microps	o	1				1				
	Salmo trutta	F=1									
	Gasterosteus aculeatus	o		o	1			+			

F = Fyke net; L.T. = light trap; + = present, o = occasional. c = common, a = abundant

A total of 26 taxa were recorded, of which 3 are regarded as lagoonal specialists in Britain and an additional 2 species are proposed lagoonal specialists in Ireland. Only one species is possibly interesting or rare:

Conopeum seurati has been recorded at 16 of the 36 sites surveyed, but is not listed in a recent review of Irish marine Bryozoa (Wyse Jackson, 1991). Either the species is under recorded or a truly lagoonal specialist.

The corixids were all large females and assumed to be *Corixa panzeri*

A single specimen of *Sigara selecta* was found in a light-trap, but was assumed to be a contaminant from the previous site, L. an Chara. However, it is possible that this rare species does occur at this site.

Evaluation

Loch Cara Fionnla is a saline lake lagoon in good natural condition. Relatively few species were recorded but several of these are lagoonal specialists. It is not a site of particularly high importance but a good example of its type in an area of scenic value.

Cara na gCaorach

Cara na gCaorach lies between L. Cara Fionnla and Camus Bay and is included as it forms a continuum of lagoonal habitats between the two areas. Table 2 shows the total species list for three stations. The following is a list of species arranged in broad ecological categories based on the Venice system of salinity regimes (L* = lagoonal specialist in Britain, L*IR = proposed as lagoonal specialist in Ireland; * = interesting or rare species):

Marine

Marine/polyhaline

- *Arenicola Marina*
- **Jaera forsmani*
- *Corophium volutator*
- *Praunus flexuosus*
- *Hyale sp.*
- *Hydrobia ulvae*
- *Crangon crangon*
- *Ascidia sp.*
- *Pomatoschistus microps*

Euryhaline

- *Hediste diversicolor*
- *Neomysis integer* L*IR
- *Idotea chelipes* L*
- *J. nordmanni* L*IR
- *Lekanesphaera hookeri* L*
- *Gammarus duebeni*
- *G. zaddachi*
- *Carcinus maenas*
- *Palaemonetes varians* L*
- *Potamopergus antipodarum*
- **Conopeum seurati* L*
- *Anguilla anguilla*
- *Pleuronectes flesus*

Meso/oligohaline

- *Hydrometra stagnorum*

Uncertain

- *Notonecta sp.*
- Chironomidae
- Culicidae
- *Anacaena lutescens*
- *Stictonectes lepidus*

A total of 30 taxa were recorded, of which 4 are regarded as lagoonal specialists in Britain and an additional 2 species are proposed lagoonal specialists in Ireland. The fauna differs from Cara Fionnla in the slightly higher number of euryhaline and Poly/mesohaline

taxa, an additional lagoonal specialist and one rare marine/polyhaline species. It is quite possible that these additional species also occur in Cara Fionnla, at least periodically.

Conopeum seurati has been recorded at 16 of the 36 sites surveyed, but is not listed in a recent review of Irish marine Bryozoa (Wyse Jackson, 1991). Either the species is under recorded or a truly lagoonal specialist.

Jaera forsmani was previously recorded at Drongawn L. in the 1996 survey and during this survey at Kilmore L., L. Fhada, L. an Aibhnín and L. Athola. The only other Irish record of the species located is for L.Hyne, Co. Cork, (De Grave and Holmes, 1998).

The notonectid was not positively identified but may well be *N. viridis* in view of the brackish nature of the site.

Evaluation

Relatively few species were recorded but several of these are lagoonal specialists. It is not a site of particularly high importance but a good example of its type in an area of scenic value, with at least one rare species. In itself it is not of very high importance as a lagoonal habitat but should be regarded as an important gradation of a lagoonal habitat from Cara Fionnla to the open sea of Camus Bay.

ECOTONAL COLEOPTERA

Description

This is a bayhead saline lake lagoon surrounded by heath on glacial deposits with rock outcrops and boulders. The lake inlet has a partial rock barrier. The lake shore is of exposed granite rock, boulders, cobbles and pebbles and peat cliffs. The inlet has a small area (c.0.2 ha) of ungrazed grass, and there are *Phragmites* and *Schoenoplectus* beds at the inflow to the lake.

Sampling

Two areas were selected for sampling from 18/8 –16/9/98:
(1) (L 963 292) The ungrazed grass bank of the outflow channel which is on peat, with *Agrostis stolonifera, Festuca rubra*, and *Juncus gerardii* grading into rough grassland with *Molinia caerulea*, etc. The area is flooded at high spring tides.
(2) (957 317) The bank of a pool (with *Schoenoplectus tabernaemontani*) on wet peat with a relatively sparse cover (c. 70%) of *Plantago maritima, Carex* sp., *Anagallis tenella, Leontodon autumnalis, Hydrocotyle vulgaris, Samolus valerandi, Agrostis stolonifera* and *Eleocharis* sp., grading into *Schoenus nigricans*- and *Molinia caerulea*-dominated vegetation. The pool was fed by a peat flush (with *Drosera officinalis*, etc.).

Results

Three species of carabid, fourteen species of staphylinid and two species of pselaphid were recorded, one of which is regarded as an indicator species (Tables 2 and 3).

Prior to the coastal lagoon survey (1996) there were three Irish records of *Stenus lustrator* (Anderson, 1984), which appears to be local in Europe (Horion, 1963). The species is tyrphophilous (associated with peat), but also occurs on marshy shores and flood meadows, according to Koch (1989). The pre-1996 Irish records are from bogs (Anderson, 1984), and the species appears to be characteristic of lagoons and saline lakes with well-developed peat shore habitat, being recorded from eight sites in the 1996 and 1998 survey.

TABLE 2. Staphylinidae and Pselaphidae from saline lake peat shores with *Juncus maritimus* and grasses in Na Dhá Sháile area, Connemara (Co. Galway): Loch an Aibhnín; L. Fhada; L. Cara na gCaorach; L. Cara Fionnla. The same sampling techniques and effort were used at each site. Indicator species are marked with an asterisk.

	Aibhnín	Fhada	Cara na gCaorach	Cara Fionnla
Atheta aquatica (Thoms.)	1	-	-	
Brachygluta helferi (Schm.)	21	7	24	1
Drusilla canaliculata (Fab.)	3	-	-	2
*Paederus fuscipes*Curt.	9	-		
Sepedophilus nigripennis (Steph.)	1	1		
Stenus brunnipes Steph.	1	1	-	1
Stenus juno (Payk.)	3	1	-	-
Stenus ossium Steph.	1	-	-	-
Euaesthetus bipunctatus (Ljungh)	-	5	-	7
Reichenbachia juncorum (Leach)	-	3	-	43
Stenus clavicornis (Scop.)	-	2	-	-
Stenus fulvicornis Steph.	-	1	-	5
Stenus fuscipes Grav.	-	2	-	-
Stenus lustrator Er. *	-	2	2	2
Stenus nitidiusculus Steph.	-	1	-	1
Atheta vestita (Grav.)	-	-	2	-
Cordalia obscura (Grav.)	-	-	1	7
Tachyporus dispar (Payk.)	-	-	1	1
Xantholinus longiventris Heer	-	-	1	-
Atheta amplicollis (Muls. Rey)	-	-	-	1
Oxypoda elongatula Aubé	-	-	-	3
Quedius fulginosus (Grav.)	-	-	-	1
Quedius molochinus (Grav.)	-	-	-	1
Stenus tarsalis Ljungh	-	-	-	2
Tachyporus nitidulus (Fab.)	-	-	-	1

TABLE 3 Carabidae from saline lake peat shores in Na Dhá Sháile area, Connemara (Co. Galway): Loch an Aibhnín; L. Fhada; L. Cara na gCaorach; L. Cara Fionnla. The same sampling techniques and effort were used at each site, with the exception of L. an Aibhnín where *Zostera* shore refuse was sieved. Indicator species are marked with an asterisk.

	Aibhnín	Fhada	C. na gCaorach	Cara Fionnla
Bradycellus harpalinus (Serv.)	1	-	-	-
Dyschirius globosus (Herbst)	3	-	-	-
Bembidion mannerheimi Sahlb.	-	1	-	-
Pterostichus niger (Schall.)	-	1	-	5
Bembidion assimile Gyll.	-	-	1	-
Loricera pilicornis (Fab.)	-	-	-	1
Notiophilus palustris (Dufts.)	-	-	-	1

Evaluation

The presence of only one indicator species, and the small area of suitable shore habitat at Loch Cara Fionnla, indicates low conservation interest for this site. However, the inlet to the site could be regarded as part of Na Dhá Sháile inlets as a whole, and there may be a greater potential conservation interest at this scale.

SUMMARY

Loch Cara Fionnla is of interest as part of the large brackish system with features of both estuaries and lagoons, extending over 5 km from Camus Bay. The lower reaches are bordered by the Cinn Mhara saltmarshes and include the large area of brackish water, Cara na gCaorach. Cara Fionnla is subject to wide fluctuations in salinity due to tidal incursions and the large volume of freshwater draining from bog lakes. It has features of a "shock lagoon" but the deeper regions may be relatively stable. Vegetation is diverse with swards of shallow water charophytes as well as *P. pectinatus, Ruppia* and *Lamprothmnium* communities. *Zostera angustifolia* was present in the Cara na gCaorach area. The fauna was moderately diverse but unexceptional.

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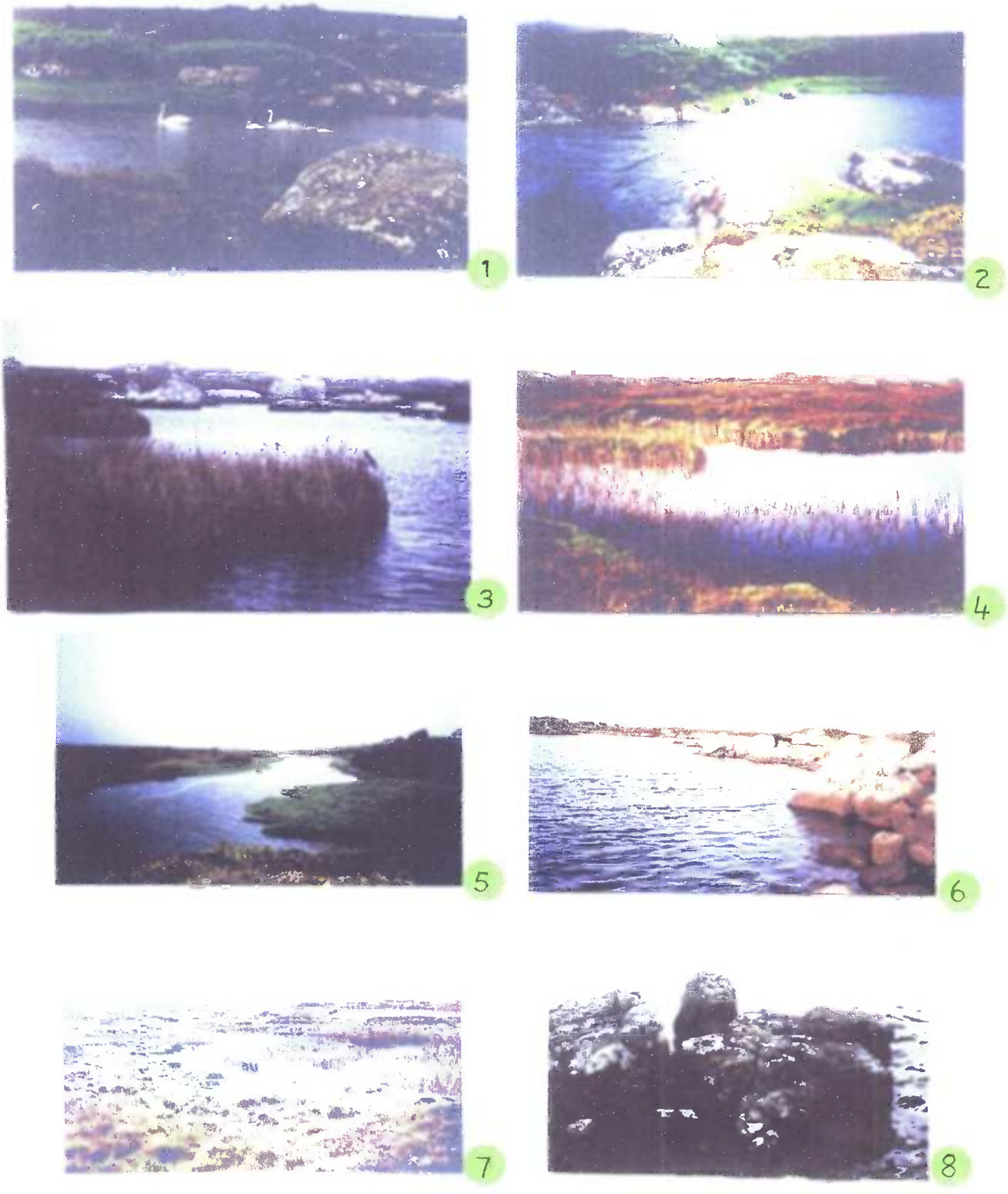


Plate 8. Loch Cara Fionnla, Connemara 1. Outlet channel just north of the lagoon, 2. Same part of outlet channel, tide flowing out (lagoon to the left), 3. *Scirpus* on east shore, 4. *Phragmites* at south end in October, 5. Tidal channel running into Cara na gCaorach, 6. Rocks showing change in water level, Area of inflowing streams at south end; 8. Rock with maritime lichens

9. LOCH an tSÁILE, CONNEMARA, Co. Galway

Lough Ahalia

This is actually two or three lakes, with different names on the OS map and that of Tim Robinson. Alternative names are: Loch an tSaile (or L. an tSaile Iochtarach) - Lough Ahalia South (or Lower Salt Lake; Loch an tSaile Thuiadh (or Loch Scribe) - Loughahalia North (or Screebe Lough)

Location: L 948386; 53°23.2'N, 9°35.0'W.
L 966393; 53°23.6'N, 9°34.0'W. OS Sheet 45
At Scriob (Screeb), at the extreme north end of Camus Bay.

Lagoon type	saline lake lagoon with silled inlet
Area	brackish section 90 ha
Salinity regime	oligohaline at the surface (0-15), stratified
Maximum depth	14 m
Seawater entry	silled inlet
Tidal range	(?)
Conservation status	NHA No. 2034

Origin and history nothing known.

Geology, geomorphology and landscape

The rock is Galway granite of lower-mid Devonian age, a pink to grey coloured granite with large, pink feldspar crystals. The lagoons lie in a landscape of rocky blanket bog, with hills reaching 100-200 m, and many lakes with interconnecting streams.

Description of the system

This complex of large lagoons represents the southernmost section of a string of lakes extending south from Maam Cross, connected by a river to the northernmost arm of Camus Bay. The lagoons lie in an area of low, undulating blanket bog with many rocky outcrops. Numerous streams from an ill-defined catchment of about 35 km^2 flow into the system. The upper lake (Loch an tSaile Thuiadh) is freshwater with white water lilies and was not sampled. The larger lower lagoon is connected to the upper one by a narrow channel, and to the sea by a broad, silled inlet with a screen, which passes under Screeb Bridge. The lower lake consists of four basins, one large and three smaller.

The lake shores are rocky with vertical peat banks and small gravelly bays and there are a number of small rocky islands in both lakes. There is little marginal vegetation. The lagoon bed in all four lower basins has steeply shelving rocky sides and a flat muddy floor. Large granite boulders scattered over the floor of the upper basin rise several metres and sometimes break the surface. The maximum depth measures was 14 m. The only easy access is to the inlet.

Hydrology

The main input of freshwater is from the river flowing into the upper lake and another entering the north-west of the lower lake. Salinities at the surface varied by only 0-3.5‰ but at 2 m the salinity was 4.6-13.9 in the two lower basins but only 2.8 in the mid region and 0-1 in the upper basin. Deeper water was stratified with an upper, clear, low salinity layer and a lower, cloudy, more saline layer. The upper layer extends to at least 4

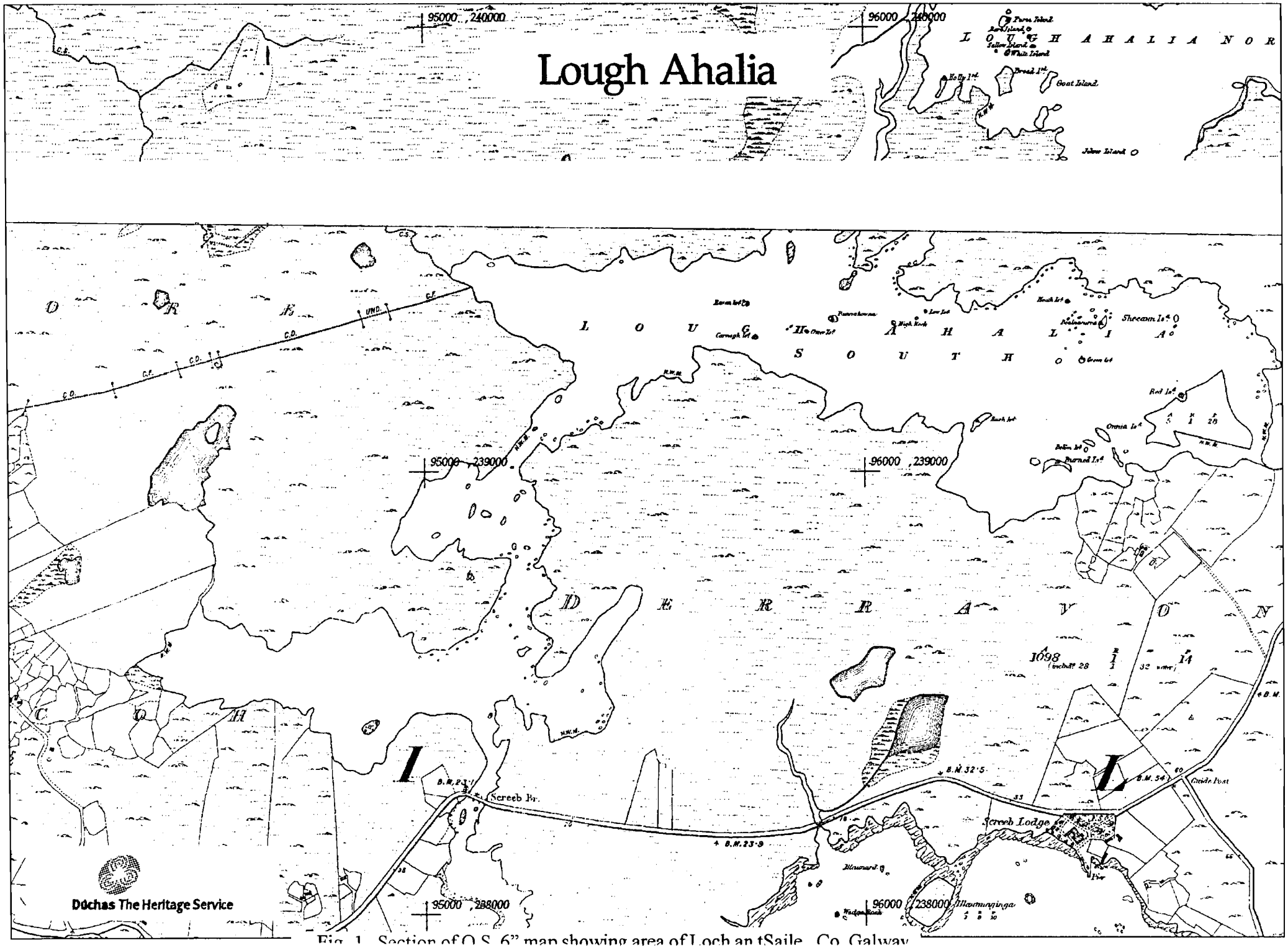


Fig. 1 Section of O.S. 6" map showing area of Loch an tSaile, Co. Galway

m in the deeper upper basin and salinity could not be measured below 5m with the 5 m probe cable. The halocline was shallower in the other basins. The main benthic macrophytes in the two smaller basins (*Chara aspera* and *Potamogeton pectinatus*) indicated a fairly low salinity whereas in the larger basin in the south-west, *Zostera* and *Ruppia* indicated more saline conditions. The area of the lagoon bed most influenced by tidal water thus appears to be the south-west. A tidal stream probably flows and ebbs mainly along the central bed and its influence on shallow waters appears to be small.

Exploitation and threats

The system is managed as a salmonid fishery and there is a salmon hatchery on the river north of the upper lake. There is some duck shooting. There are very few dwellings and no cultivated fields around the lakes.

VEGETATION

Site description

Loch an tSáile consists of a series of rock basins which lie at the northern extremity of Camus Bay. A small river which drains an ill-defined catchment of about 35 square kilometres enters the sea via the lagoon system. There are four loughs included under the name Loch an tSáile. Loch a tSáile North however is essentially a freshwater lake with emergent plants such as *Nymphaea alba*, which is never found in brackish systems. The four lakes are situated on granite bedrock which is heavily faulted. The largest basin lies along an east west oriented fault (Max *et al.* 1978). The surrounding countryside is covered by blanket bog with protruding granite bedrock and very large glacial erratic boulders. The shore lines of all the lakes are very steep and in general there is little or no marginal vegetation with the exception of communities of rocky shores. In this account four basins are considered (i) the large upper basin (09602391) (ii) the small middle basin or channel expansion (09502387) (iii) the large lower basin connected directly to the sea (09452382), (iv) the small basin to the east of (iii) and linked to it (09532385).

Underwater observations

This lagoon consists of several separate basins and inter-linking channels. Two types of water can be distinguished: an upper freshwater layer and a lower saline layer. The former extends to a depth of at least 4m in the upper basin but is much shallower in the lower basins. The less saline layer is very clear while the more saline layer is cloudy, possibly due to algal growth. As a result, visibility in the upper basin is good while it is poor elsewhere.

All the basins have a similar structure, with rocky steeply shelving sides descending to a flat muddy floor. In the upper basin very large granite boulders are scattered across the lake floor and rise several metres from the bottom sometimes actually breaking surface. Such large boulders are less evident in the other basins. The eastern part of the lower basin, is very shallow and is covered by a *Potamogeton pectinatus/Ruppia* sp. mixture. In the upper basin much of the lake floor is covered by the characteristic spherical balls of *Cladophora aegagropila*. However part of this basin is very deep (unreachable using a snorkel) and probably is covered only by mud. The remaining basins are only m in depth but the dark colour of the water seems to inhibit plant growth. In the lower basin a sparse population of *Zostera* occurs with some *Chaetomorpha linum*, while *P. pectinatus* is common in the middle basin.

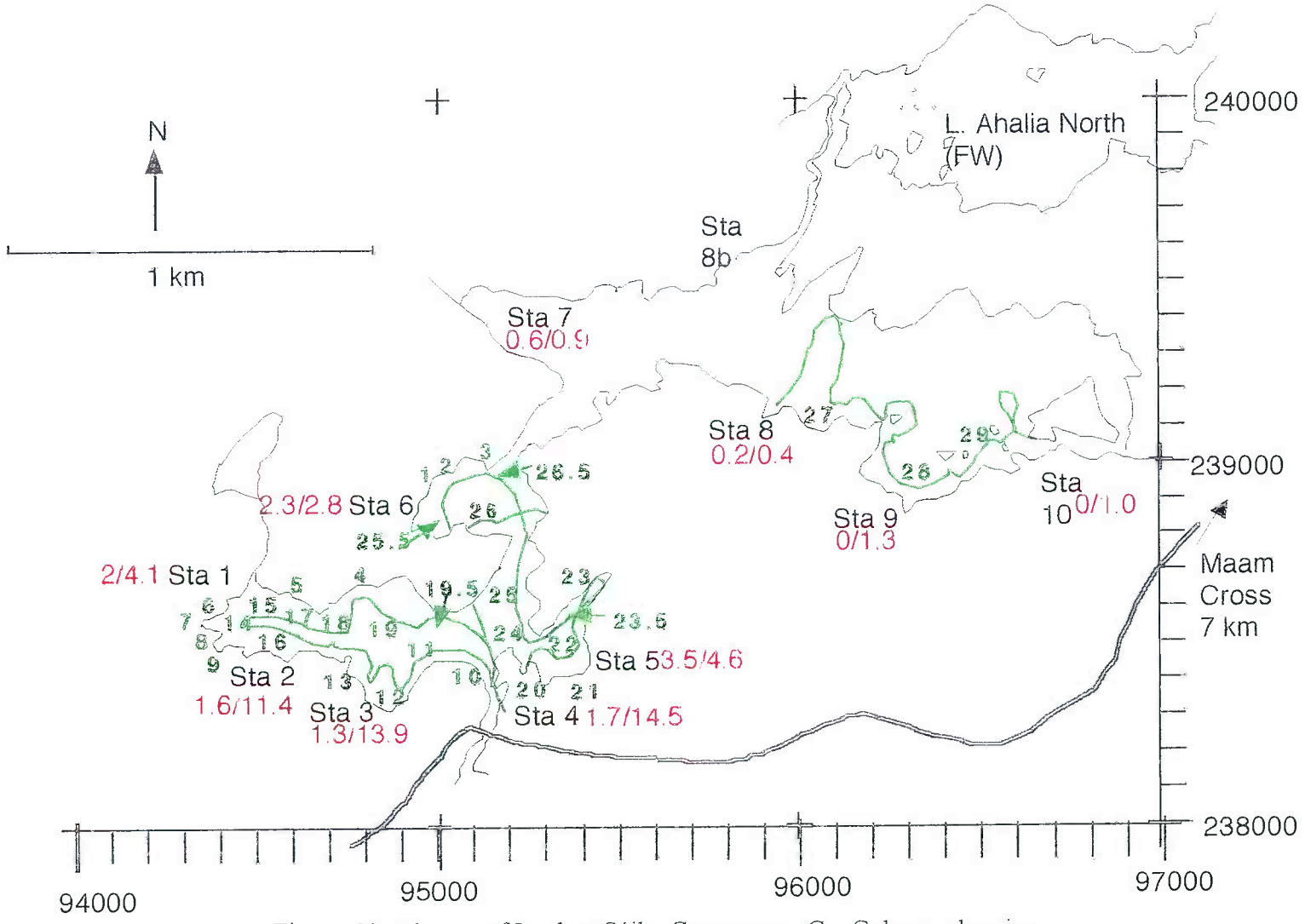
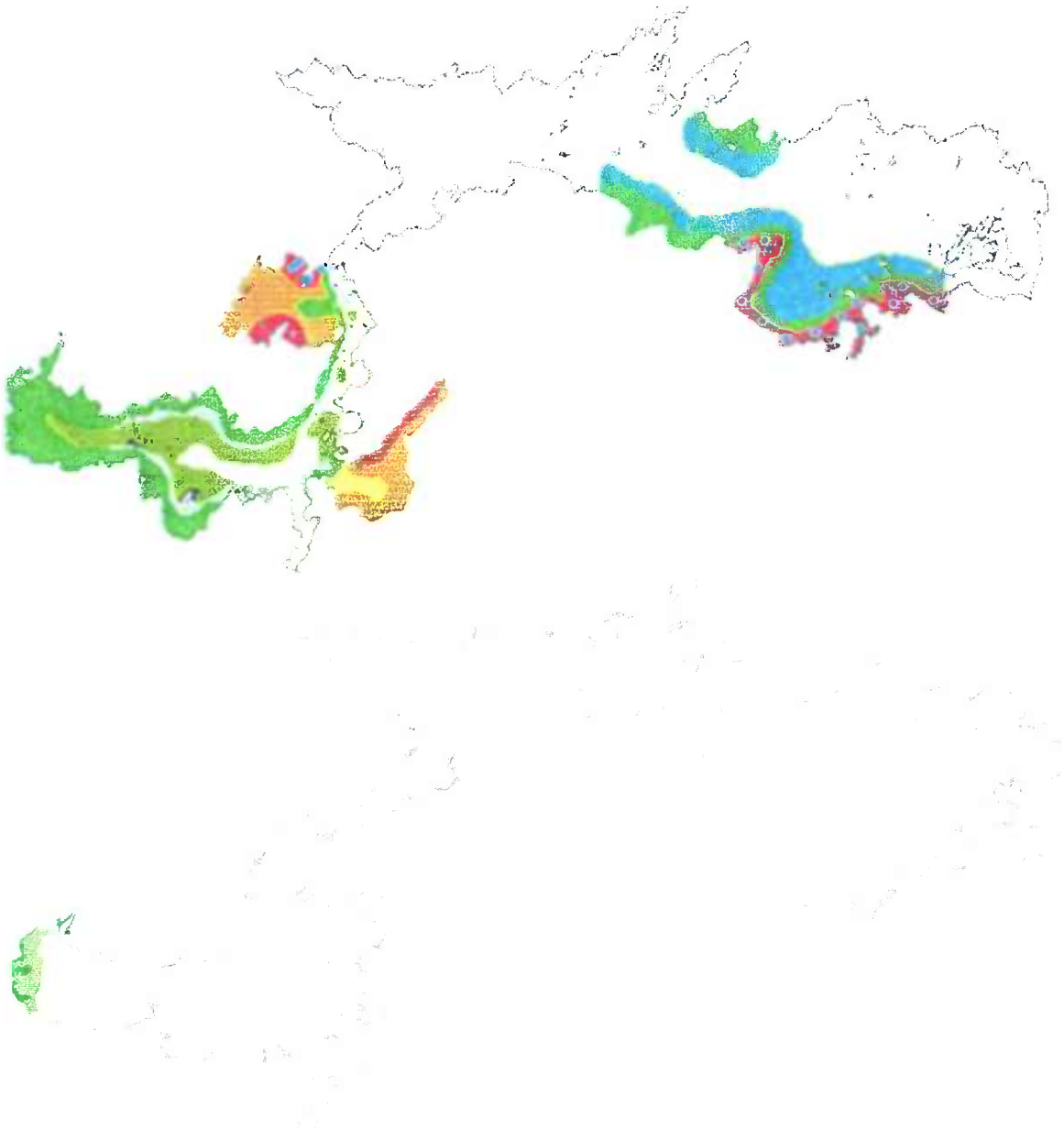


Fig. 2 Sketch map of Loch a tSáile, Connemara, Co. Galway, showing sampling stations 1998

Fig. 3 Benthic and marginal vegetation of Loch an tSáile



The sloping sides of the upper basin are very unusual. Close to the surface a sparse flora of freshwater plants including *Littorella uniflora, Myriophyllum alterniflolium* and *Potamogeton polygonifolius* grow amongst granite boulders and gravel. In places a green blanket of drift *Oedogonium* and other freshwater filamentous algae covers the bare granite rock. However as one descends this flora is replaces by a band of *Ruppia cirrhosa,* which in turn is replaced at location 27 by specimens of *Fucus ceranoides* and dead mussel shells. Elsewhere the *Ruppia* extends into the *C. aegagropila* zone.

In the other basins, a brackish flora extends from the surface downwards. *Enteromorpha* and *F.ceranoides* occur on bare rock while *Ruppia* sp. occur in mud and gravel. *C. linum* forms a distinct band at the base of the rocky sloping sides. Near the entrance of the lake *Fucus serratus* occurs growing permanently submerged at depths up to two metres.

Sampling

The lake complex was sampled on 10-11/8/98,31/8/1998 and 25/9/1998. Marginal vegetation was sampled, benthic vegetation was examined by snorkelling and two phytoplankton samples taken. The very large size of the site limited the area that could be examined by snorkelling. However all three basins were examined in part and the vertical gradation of the vegetation described.

1-5 (09502388) were made along the shore of basins ii and iii. The shore consists of small gravel beaches and outcrops of rock backed by heath and blanket bog.

6-9 (09402380) were made in a small stand of *Juncus maritimus.*

10-19.5 (09452393) were made in the sub littoral of basin iii

20-23.5 (09532385) were made in the sub littoral of basin iv

24-26.5 (09502387) were made in the main channel and basin ii

27-29 09602391) were made in the sub littoral of basin i.

Results

The great depth of the site (>14 m) and the strong salinity gradient result a wide range of vegetation:

(1) Charophyte communities in shallow water less than 1.0m.(23.5, 25.5, 26.5) Four different species occur depending on salinity. *Chara virgata, C. aspera, C. baltica* and *Lamprothamnium papulosum. C. virgata* occurs in the upper and middle basin often in association with *Littorella uniflora* . *C. aspera* occurs in the middle basin and the eastern arm of the lower basin. *C. baltica* and *L. papulosum* are confined to the latter site.

(2) The surface 3m of the upper basin contains a freshwater community of *Myriophyllum alterniflorum, Potamogeton polygonifolius* and *C. virgata* growing amidst large granite blocks (1-3m size). The vegetation is very sparse and largely confined to small patches of gravel amongst a scree of large and small granite boulders.

(3) A band of *Ruppia* sp. grows below this zone (27). The saline nature of this community is shown by dead *Mytilus* and *Cerastoderma* shells and rare plants of *Fucus ceranoides.*

(4) Mud and sand areas are covered by drifting balls of *Cladophora aegagropila* (28).

(5) The small middle basin contains *Ruppia/Potamogeton pectinatus* communities with some *Chaetomorpha linum* (26).

(6) The western arm of the lower basin is the most saline area. Rocky shores are covered by *Fucus ceranoides, Cladophora rupestris* and *Enteromorpha* sp.

(7) At 1-2m depth, *F. serratus* and *F. vesiculosus* also occur. At greater depths dense mounds of *C. linum* are found on rock (10).

(8) Soft sediments support *Ruppia* sp. and at greater depths *Zostera marina* and *Ruppia*

with some *C. linum* (14-19).
(9) The eastern arm (basin iv) is shallow with a dense growth of *P. pectinatus, Ruppia* sp. *L. papulosum* and *C. linum.* (20-23)
(10) The channel which links the four basins is 2-4m in depth. The floor is largely bare mud with occasional large boulders. A sparse growth of *Zostera marina, Ruppia* sp., *P. pectinatus* and *C. linum* occurs (23-25).

The lake basins are rocky so in general there is little marginal vegetation. The following communities were recognized; *Juncus maritimus* stands, Rocky shore communities with *Plantago* species and *Eleocharis uniglumis*, the *Samolus valerandii* variant of the *Juncus gerardii* association, and emergent communities with *S. tabernaemontani.*

The phytoplankton was essentially that of a freshwater lake.

Notable species

This lagoon has a rich charophyte flora with two red data book species, *Chara baltica* and *Lamprothamnium papulosum* . To date both species are known only from basin iv. An unusual form of *Potamogeton pectinatus* occurs in high salinity water where it grows in association with *Zostera marina.* Its precise identity is not yet established. *Cladophora aegagropila* (identity confirmed by Prof. Van den Hoek) was only found in this lagoon, it also occurs in freshwater lakes but is not widely distributed in Ireland as far as is known.

Assessment

The Loch an tSaile complex has an unusual salinity structure with a freshwater oligotrophic lake overlying a brackish community. The range of communities is the largest encountered in the survey. It contains several rare plants. Its large sizeincreases its conservation value. A floating fish cage is kept in the upper basin. In places dense blankets of filamentous green algae covered the lake bottom. However, similar growths were seen in Cara Fionnla, so algal growth may have no connection with fish culture.

AQUATIC FAUNA

Description

Loch an tSaile is a series of lakes with a natural outlet, somewhat modified by a road bridge and grille, apparently to prevent seals from entering the lakes which are an important salmonid fishery. The lakes lie at the north end of Camus Bay, to the north of the R340, 1.5 km west of Screeb. There are in fact three large connecting lakes with several smaller embayments which almost form separate lakes in themselves. There is some confusion about the naming of the three lakes but in general the upper lake is referred to as Ahalia north and the lower two lakes together as Ahalia south. To avoid further confusion the three are referred to as upper, middle and lower in the report.The northern lake appears to remain fresh at all times and only the lower and middle lakes were included in the survey.

The two lower lakes are regarded as saline lake lagoons and together these cover an area of approximately 90 ha. Seawater enters from the south on all tides but the lakes also receive large volumes of freshwater from a large catchment area. The lower lake is relatively shallow (0-4m) and brackish throughout while the middle lake is deep (13 m) and permanently stratified with water below 3m, measuring 14ppt. Surrounding land is a combination of acid bog, moorland, rough grazing and granite rocks which is reflected in the substrate of the lake being granite rock, coarse sand and gravel and peaty silt in

sheltered areas. The lower lake has dense growths of *Ruppia* in places, the middle is mostly deep and oligotrophic with steep banks and very few emergents but for the extreme east.

Sampling stations

The area was sampled briefly in 1996, on 13/6/98, from 10-12/8/98 and 27-29/9/98 Ten sampling stations were selected to reflect the influences of substrate, vegetation, freshwater and tidal inflows.

Station 1 (L 94370 38563) was located at the west end of the lower lake. Substrate consisted of peaty mud bordered by emergent *Phragmites* and *Scirpus*. Depth was relatively shallow (0-1m), salinity 1.8 ppt at the surface, 3.6 at 1m, with dense growths of *Ruppia*.

Station 2 (L 94632 38561) was located on the rocky south shore of the lower lake. The bank of the lake consisted of granite bedrock and large boulders which dropped steeply to 4m depth of peaty brown water. Substrate was soft peaty mud with dense growths of *Zostera, Ruppia* and *Chaetomorpha*. Salinity measured 1.5 ppt on the surface and 13.9 ppt at 4m. Beyond the granite banks, the area is bordered by moorland.

Station 3 (L 94929? 38214?) was located in a small bay on the south shore of the lower lake. Substrate consisted mostly of granite bedrock with large boulders and coarse granite sand. Depth varies from 0 - 2m and salinity measured 1.5 -7.5 ppt. The area was bordered by moorland, granite rocks and boulders.

Station 4 (L 95165 38320) was located at the inlet to the lakes. Depth was relatively shallow (0-2m) and salinity was surprisingly low at the time of sampling; (0ppt in July and September and 3.8 -4.8 ppt in August) presumably due to the large volume of freshwater flowing through the lakes and diluting the tidal water in Camus Bay. Substrate consisted of bedrock, stones and coarse sand. The area was bordered by moorland and granite.

Station 5 (L 95280 38438) was located in the bay at the east end of the lower lake. Depth was 0 -1m and salinity measured 3.5 ppt on the surface and 4.6 ppt at 1m depth. Substrate consisted mostly of granite boulders with coarse granite sand with patches of *Ruppia* and the area was bordered by moorland with peat cliffs and granite rocks.

Station 6 (L 94924 38875) was located at the far end of the bay to the west of the channel connecting the lower and middle lakes. Depth was shallow (0 -1m) and salinity measured 1.4 -2.8 ppt. Substrate consisted of coarse granite sand and fine silt with some stones covered with *Ruppia* in most areas. The shoreline at the far end consisted of moorland with peat cliffs, granite and patches of *Juncus* and *Scirpus*.

Station 7 (L 95047 39466) was located at the western end of the middle lake. Depth was 0 - 1m and salinity measured 0.6 -1.6 ppt. Substrate consisted mostly of granite sand and stones overlain with peaty silt. The area was bordered by moorland, granite, small peat islands with peat cliffs and patches of *Phragmites* and *Scirpus* along the shoreline. Patches of *Chara* were recorded in this area and despite the low salinity there were floating pieces of *Fucus* indicating the inflow of tidal water.

Station 8 (L 95883 39092) was located in a bay containing a grading pen for smolts on the south shore of the middle lake, bordered by peat, saltmarsh and granite rocks. Depth measured up to 4m, with salinity almost fresh (0.2ppt) at the surface and for the upper 3-4 m and 10.3 ppt at the lowest 4m. Substrate was stones and coarse sand and gravel.

Station 8b (L 96022 39681) was located on the north shore of the lake in the channel which connects the middle and upper lakes. Depth measured up to 2m and water flowing from the upper lake was completely fresh (21 mg/l). Substrate was stones and

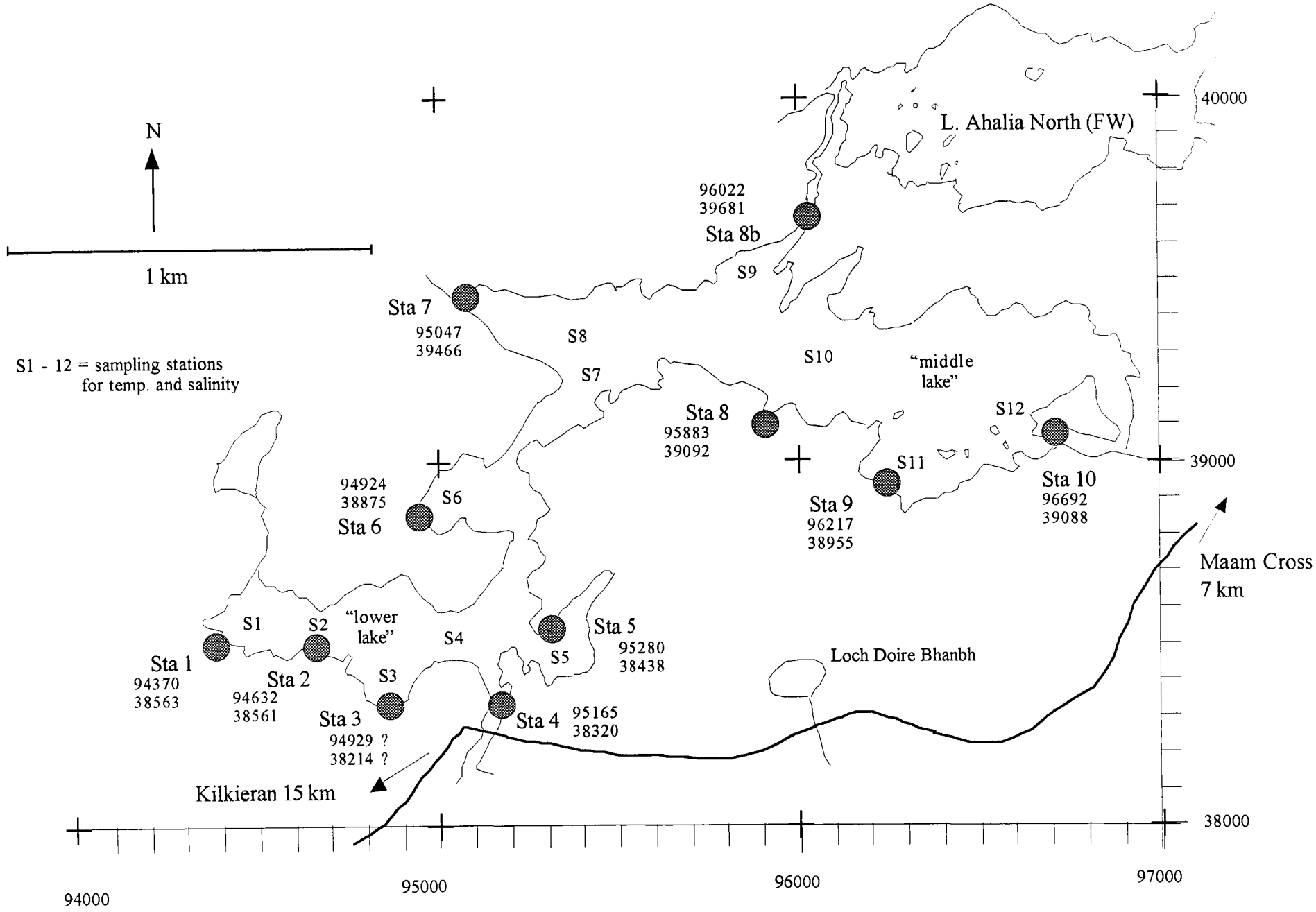


Fig. 4 Sketch map of Loch an tSaile, Connemara, Co. Galway, showing sampling stations used for a survey of aquatic fauna, 1998.

coarse sand and gravel and the area was bordered by moorland with isolated rocks and *Phragmites* along the banks of the channel.

Station 9 (L 96217 38955) was located midway along the south shore of the lake in a large bay. Depth measured up to 3-4m within 20m of the shore, salinity measured 0.2ppt at the surface, gradually rising to 1.3 at 4m depth. Substrate was granite stones and boulders with clean coarse sand and gravel. The area was bordered by moorland with isolated granite rocks and boulders.

Station 10 (L96692 39088) was located on the eastern end of the middle lake near an island of *Phragmites, Juncus* and *Molinia.* Depth measured up to 0-1m and salinity measured 0ppt (206-340 mg/l) in August but 1ppt (2.3mS/cm) in September. Substrate was boulders with clean coarse sand and gravel over most of the area, with fine silty peat where small streams enter the lake. The area was bordered by moorland with isolated rocks, some improved pasture and patches of *Phragmites.*

Results

Table 1 shows the total species list for each station. The following is a list of species arranged in broad ecological categories based on the Venice system of salinity regimes (L* = lagoonal specialist in Britain, L*IR = proposed as lagoonal specialist in Ireland; * = interesting or rare species. Species in brackets refer to previous records):

Marine
- *Astropecten irregularis*

Marine-polyhaline
- *Halichondria panicea*
- *Clava multicornis*
- *Corophium volutator*
- *Hydrobia ulvae*
- *Mytilus edulis*

Poly-mesohaline
- Mugilidae
- *Pomatoschistus microps*
- **Littorina "tenebrosa"* L*

Euryhaline
- *?Procerodes littoralis*
- *Neomysis integer* L*IR
- *Idotea chelipes* L*
- *Jaera nordmanni* L*IR ?
- *Lekanesphaera hookeri* L*
- *Gammarus duebeni*
- *G. zaddachi*
- *Palaemonetes varians* L*
- *Potamopyrgus antipodarum*
- **Conopeum seurati* L*
- *Anguilla anguilla*
- *Gasterosteus aculeatus*
- *Salmo trutta*

Meso-oligohaline
- *Ischnura elegans*
- *Gyrinus caspius*

Oligohaline-freshwater
- *Gyrinus substriatus*
- *Haliplus ruficollis*

Limnetic
- Aeschnid indet.
- *Chlorohydra viridis*
- *Stylaria lacustris*
- *Gerris lacustris*
- *Hesperocorixa castanea*
- *Sigara dorsalis*
- *S. scotti*
- *Velia sp.*

Uncertain
- *G. minutus*
- *Nebrioporus depressus*
- *Stictotarsus pustulatus*
- **(Megasternum obscurum)*
- *Ephemeroptera* indet

A total of 43 taxa were recorded of which 5 are regarded as lagoonal specialists in Britain, 2 additional species are proposed lagoonal specialists in Ireland and 3 species are interesting or rare:

Megasternum obscurum was also recorded at L. an Chara during this survey and at Furnace L. and this site during the 1996 survey but is otherwise described as rather rare in Ireland (Foster *et al.*, 1992).

Conopeum seurati has been recorded at 16 of the 36 sites surveyed, but is not listed in a recent review of Irish marine Bryozoa (Wyse Jackson, 1991). Either the species is

Table 1 Aquatic fauna recorded at stations in Loch an tSaile, Co. Galway. 1998.

		Stations																		
Taxa		1	L.T. 1	2	.T. 2	3	L.T.3	4	L.T. 4	5	L.T. 5	6	L.T. 6	7	L.T. 7	8a	8b	9	L.T.9	10
Porifera	*Halichondria panicea*					+														
Cnidaria	*Chlorohydra viridis*																+	+		
	Clava multicornis			+		+														
Turbellaria	*Procerodes littoralis*													+						
Annelida	Naididae indet.					+				+										
	Stylaria lacustris																+			
	Tubificidae indet.																			+
Crustacea																				
Mysidacea	*Neomysis integer*	c	8	+	5							+	5	+	4					4
Isopoda	*Idotea chelipes*			o	2					+	+									
	Jaera nordmanni							a				+		+				+	1	c
	Lekanesphaera hookeri	+	22	a	56	+	50					+		o		o		o	5	1
Amphipoda		+	100	+	20	c	c100		10		10	+	20	1	5			+	3	
	Corophium volutator	a	12	+	2			+	2	+	1	+	1		1					
	Gammarus duebeni				1				2											
	G. zaddachi	7	1	4	13	11	63	14	2		7	6	18	1	4				3	
	Melita sp.								1											
Decapoda	*Palaemonetes varians*	+	1					+	1											
Insecta																				
Ephemeroptera																	+			
Odonata	Anisoptera indet.													1						1
	Ischnura elegans											+	1	+						+
Trichoptera												+								
Heteroptera	Corixidae indet.											2		8		4	3			1
	Gerris lacustris													o		o				o
	Hesperocorixa castanea																			1
	Sigara dorsalis													1						
	S. scotti													3						
	Velia sp.																			1
		L.T. = light trap; + = present, o = occasional. c = common, a = abundant																		

Table 1 cont. Aquatic fauna recorded at stations in Loch an tSaile, Co. Galway. 1998.

		Stations																		
Taxa		1	L.T. 1	2	.T. 2	3	L.T.3	4	L.T. 4	5	L.T. 5	6	L.T. 6	7	L.T. 7	8a	8b	9	L.T.9	10
Coleoptera												+		12	1					10
	Gyrinus caspius											5		4						
	G. minutus													1						
	G. substriatus													1						
	Haliplus rufficollis											1		5						5
	(Megasternum obscurum)							1												
	Nebrioporus depressus													1						2
	Stictotarsus 12-pustulatus																			2
Diptera	Chironomidae indet.	c		o				c				o		o			+			+
Mollusca	Hydrobiidae indet.	+		+	45							+				+	+			
Prosobranchia	*Hydrobia ulvae*	1		c		+		+												
	Littorina "tenebrosa"			1		+		+												
	Potamopyrgus antipodarum	a		o				c				c		+		c	+	+		c
Bivalvia	*Mytilus edulis*			+				+												
Bryozoa	*Conopeum seurati*			+				+												+
Echinodermata	*Astropecten irregularis*			+		+		+												
Pisces	*Anguilla anguilla*	= 15				F = 1								+				F = 8		
	Gasterosteus aculeatus	+	5			+	2	+		+				+			+	+	2	+
	Mugilidae					F = 1														+
	Pomatoschistus microps		5					+		+		+		+				+	1	
	Salmo trutta																			+
		L.T. = light trap; F = Fyke net; + = present, o = occasional. c = common, a = abundant.																		

under recorded or a truly lagoonal specialist.

Littorina "tenebrosa" was also recorded during this survey at L. an Aibhnín and L. Fhada and during the 1996 survey in Lettermullen Pool, L.Tanaí, L. Murree and from the North Slob. These are the only known sites in Ireland. The status of this taxon is still under dispute but appears to be morphologically and ecologically distinct and is listed as a lagoonal specialist for Britain.

Astropecten irregularis was also found at Kincas L. but was found at surprisingly low salinity in L. an tSaile.

Salinity

Table 2 shows salinity and temperature data from various points (Sta 1-Sta 15, Fig. 9.2). Most of the lake is relatively shallow (0-2m) but up to 4m depth was measured at some points and a maximum depth of approximately 13m below the salmon cage (OS L96077 39227). Surface water varied from fresh at the eastern and northern parts of the middle lake up to 2.3 - 3.5ppt in sheltered bays (Sta 3, Sta 5,and Sta 6) but only 0.9ppt at the mouth of the inlet. It is clear that during the sampling period large volumes of fresh water were flowing through the lakes but salinity increased to up to 5.1ppt at 1m depth at the western end of the middle lake (Sta 7) and most parts of the lower lake. At 2m depth in the lower lake salinity was 7.5 - 11.4ppt and up to 14.7ppt in the deepest parts at 4m (Sta 2).

Table 2 Salinity (ppt) at various stations and depths in L. an tSáile, Co. Galway, 1998

	Stations											
depth (m)	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
0	1.8	1.5	2.5	1.7	3.5	1.4	0.5	1.2	0	0.2	0.2	0
1	3.6	3.4	2.3	1.7	4.6	2.8	0.5	1.3	0	0.2	0.2	1
2	4.1	11.4	4.8	11.3	-	-	0.7	1.5	-	0.2	0.2	-
3	-	-	7.5	14.1	-	-	-	7.9	-	10.2	0.2	-
4	-	13.9	-	14.7	-	-	-	8.7	-	10.3	0.7	-
5	-	-	-	-	-	-	-	-	-	12.2	1.3	-

ECOTONAL COLEOPTERA

This site consists of a series of three bayhead saline lakes with an outflow channel to Screeb Bridge and Aibhainn Scríbe, with rock, boulder, peat and till cliffed shores, in a grazed blanket bog and heath landscape.

Sampling

Four areas were selected for sampling from 7.vii-17-ix.98:

(1) (L 951383) A small area of c. 0.5 ha grass bank shore of the outflow channel above the bridge, with *Agrostis stolonifera, Juncus maritimus, Festuca rubra*, etc. and sheltered from the west by rock outcrops and heath.

(2) As above but less sheltered.

(3) (951384) An area of gently sloping granite rocky shore with thin peat and coarse sand in patches, covered by a *Fucus* and *Enteromorpha* mat. Offshore (0.5 m) salinity was 0 ‰.

(4) (962394) An area of cobbles and boulders on sand/silt shore below c. 1m high peat cliff with boulders, heath and bog vegetation.

Results

Eleven species of carabid, eighteen species of staphylinid and three species of pselaphid were recorded, one of which is regarded as an indicator species (Tables 3 and 4).

TABLE 3 Staphylinidae and Pselaphidae from saline lake/lagoon peat shores in Connemara (Co. Galway): Loch an tSaile, Lough Athola. The same sampling techniques and effort were used at each site. Indicator species are marked with an asterisk.

	L. an tSaile	L. Athola
Aleochara brevipennis Grav.	1	-
Atheta fungi (Grav.)	1	-
Brachygluta fossulata (Reich.)	31	-
Brachygluta helferi (Schm.)	138	129
Cordalia obscura (Grav.)	1	-
Encephalus complicans Kirby	6	-
Lesteva sicula Er.	2	-
Ocypus olens (Müll.)	1	1
Olophrum fuscum (Grav.)	1	-
Oxypoda elongatula Aubé	1	-
Reichenbachia juncorum (Leach)	44	4
Rugilus erichsoni (Fauvel)	1	-
Sepedophilus nigripennis (Steph.)	12	8
Stenus bimaculatus Gyll.	5	-
Stenus brunnipes Steph.	1	3
Stenus clavicornis (Scop.)	4	1
Stenus fulvicornis Steph.	3	2
Stenus impressus Germ.	10	2
Stenus juno (Payk.)	9	-
Stenus lustrator Er. *	19	19
Stenus nitidiusculus Steph.	1	-
Bledius limicola	-	9
Drusilla canaliculata	-	4
Stenus fuscipes	-	1

TABLE 4. Carabidae and Heteroceridae from saline lake/lagoon peat shores in Connemara (Co. Galway): Loch an tSaile; Lough Athola. The same sampling techniques and effort were used at each site. Indicator species are marked with an asterisk.

	L. an tSaile	L. Athola
Agonum albipes (Fab.)	1	-
Agonum fuliginosum (Panz.)	2	-
Bembidion assimile (Gyll.)	1	-
Bembidion mannerheimi Sahlb.	7	9
Carabus granulatus L.	1	-
Dromius linearis (Ol.)	3	1
Elaphrus cupreus Dufts.	1	-
Ocys harpaloides (Serv.)	1	-
Pterostichus strenuus (Panz.)	1	-
Pterostichus melanarius (Ill.)	6	-
Pterostichus niger (Schall.)	40	3
Carabus problematicus	-	1
Heterocerus fossor	-	7

Evaluation

The presence of one indicator species indicates low conservation value. However, the most suitable habitat, where this species was recorded was the inlet from Abhainn Scribe. This relatively sheltered area is perhaps better classified as part of the Foirnís and Scrib bayhead, east of An Snáimhín (see Robinson, 1990), where brackish salt-marsh conditions will occur, than as part of the Loch an tSáile lake system. The lake shores are generally abrupt and eroded with rock, boulder or high peat cliffs with freshwater peatland vegetation (*Schoenus nigricans, Molinia caerulea*, etc.) directly above the standing water (even at the eastern side of An tOileann Rua). Also, with a large watershed (c. 45 km2) and relatively high annual rainfall, disturbance of shore habitats due to water level fluctuation is likely to be great. The saline lake at Doire Bhánbh was not sampled, as it was considered a separate system.

SUMMARY

Loch an tSáile has an exceptionally diverse aquatic vegetation with important populations of *Chara baltica, Lamrothamnium papulosumn, Zostera marina,* and *Cladophora aegagropila* which is very rare in Europe. The fauna, although less interesting, was diverse and includes some rare species. The lagoon was not fully surveyed owing to its size. It is deep and stratified and has a wide range of salinities. The owner of the salmonid fishery is interested and co-operative.

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Plate 9. Loch an tSáile, Connemara. 1. Lower lake, east shore (faunal Stn. 5); 2. Middle lake, looking north to inlet from upper lake; 3. Middle lake with salmon cage; 4. Middle lake, east shore; 5. Middle lake; 6. Loch Doire Bhanbh.

10. LOUGH ATHOLA, MANNIN BAY, Co. Galway

Salt Lake, Loch an tSaile

Location: L 626484; 53°28.0'N, 10°04.2'W. OS Sheet 44.
On the south side of the Errislanaan Peninsula, on the north shore of Mannin Bay, 3.5 km from Ballinaboy.

Lagoon type	saline lake lagoon with silled inlet
Area	about 11 ha
Salinity regime	poly-euhaline (6) 27-34‰
Maximum depth	4-5 m
Seawater entry	silled inlet, some overwash?
Tidal range	20 cm at springs
Conservation status	not in an NHA. Part of Mannin Bay Sea Area

Origin and history - nothing known

Geology, geomorphology and landscape

The rock is Ordovician quartz-diorite-orthogneiss, highly metamorphosed and strongly banded.

The peninsula has gentle hills with heath and rough pasture.

Description of the system

L. Athola is one of two lakes situated parallel to the coast; a small stream connects it to Lough Usk which is freshwater. It is sheltered to the north by hills and separated from the sea by a broad barrier of rough grazing and abandoned fields. The lagoon is shallow throughout, with an average depth of (2 m) and shallower regions near the small rocky islands. The shores are mainly rocky or stony with some small areas of saltmarsh while the central bed is floored with muddy sand or peat A deep hole near the inlet, reaching 4-5 m has a bottom of gravel and stones. A complicated network of creeks in an area of peat with saltmarsh vegetation connects the lagoon with one main, and several minor, silled inlet/outlets. The sea may wash over low land onto the mid south shore.

Hydrology

The lagoon was fully marine (33.7-34.1‰ throughout) during the 1998 sampling at spring tides but in 1997 the salinity was 27-33 and a small area near the stream outlet was only 6‰. As there are no important freshwater inflows, salinity fluctuations are assumed to be relatively small. However, the small stream from L. Usk is sufficient to influence the aquatic vegetation in the eastern area. The inlet sill is above MTL and the lagoon is probably only tidal during springs when a range of about 20 cm was observed.

Exploitation and threats

There were no boats on the lagoon, nor any evidence of fishing. No threats were apparent.

Conservation status

None?

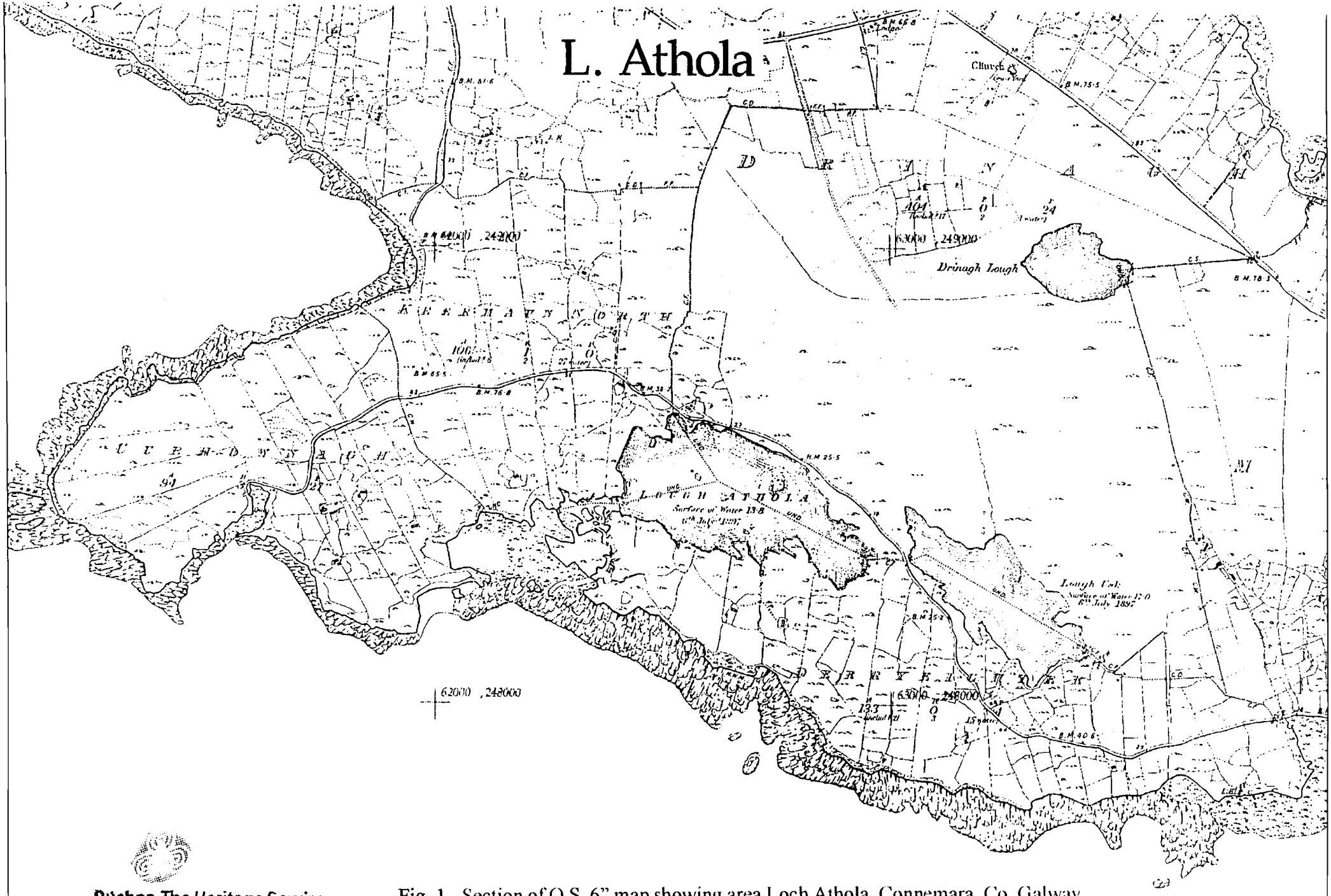

Fig. 1 Section of O.S. 6" map showing area Loch Athola, Connemara, Co. Galway.

VEGETATION

Description

Lough Athola is a coastal lough on gneiss bedrock on the south side of the Errislannan peninsula. It is surrounded by low hills which are covered with heath, farmland and a little blanket bog. A small stream enters the lake at the eastern end. The lake shores are steep and rocky but salt marsh communities are well developed on the south shore between the lake and the open sea at Mannin Bay.

Underwater observations

Lough Athola comprises a single shallow basin which is connected to the sea by channels which cut into a peat and rock barrier to a depth of 3m. These channels terminate at a rock shelf which forms a very shallow sill separating the lake from the sea. The deepest point of the lake (like Loch an Aibhnín), - 4m - is immediately inside the peat barrier. The main basin is floored by muddy sand while the deeper hole has a bottom of gravel and stones.

The lake floor is covered by *Cladophora battersii* with occasional plants of *Cystoseira foeniculaceus* attached to stones. Outcropping rocks are covered by an unusual marine algal community.

Sampling

The lake was sampled on 2-3/9/1998. Marginal vegetation was sampled, benthic vegetation was examined by snorkelling and a phytoplankton sample taken.
3/9/1998
1-5 (06292483) were made on in a small area of grazed saltmarsh.
6-9 (06282482) and 10-13 were made in *Juncus maritimus* stands
14-18 (06262483) were made along a strip of salt marsh which runs from Lough Athola to the sea shore.
2/09/1998
19-20 (06272483) were made on the muddy bottom of the lake
21 (06272483) and 22 (06232483) were on rocks in the upper sublittoral
23 was made at the deepest point in the lake.

Results

A small area of *Ruppia* sp. occurs near a freshwater stream but no fruits were seen. (19)

The lake is about 2m deep in the eastern section with a deeper area (5m) inside the barrier. The greater part of the lake floor is soft sediment (submerged peat, at least in part) with occasional stones. The soft sediment is covered by *Cladophora battersii* (20) with *Cystoseira foeniculaceus* clumps on stones. *C. ericoides* occurs towards the mouth (22). *Chorda filum, Fucus vesiculosus* and *Halidrys siliquosa* are occasional.
Salinity is close to that of coastal seawater and macroalgae are abundant. Maritime lichens occur in the splash zone, *Pelvetia canicula*ta occurs at the water surface. Rock faces in the upper 2m are covered in a algal mat consisting of red algae (21) *Gelidium pulchellum, Chondracanthus acicularis , Pterocladia capillacea, Jania rubens, Chondria dasyphylla, Codium fragile tomentosum, Chyllocladia verticilliata, Corallina officinalis, Laurencia pinnatifida* with some *Cladophora battersii* entangled in the other species.

At greater depths near the channel leading to the sea a different flora occurs (23) with *Phyllophora crispa, P. ceranoides, Gracilaria gracilis, Chondrus crispus, Plocamium cartilagneum, Rhodophyllis divaricata, Calliblepharis jubata, Furcellaria lumbricalis,*

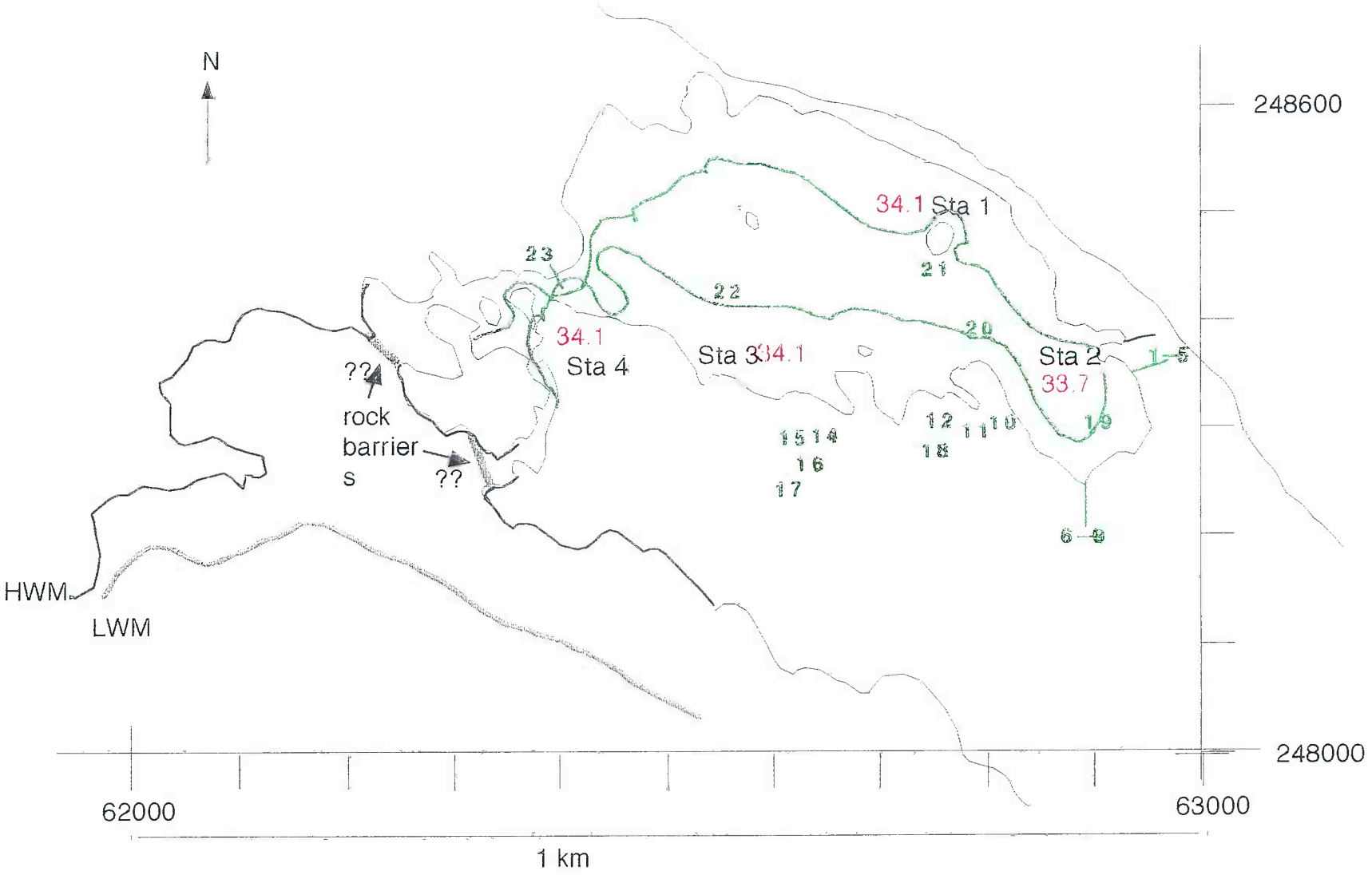

Fig. 2 Sketch map of Loch Athola, Connemara, Co. Galway, showing sampling stations , 1998.

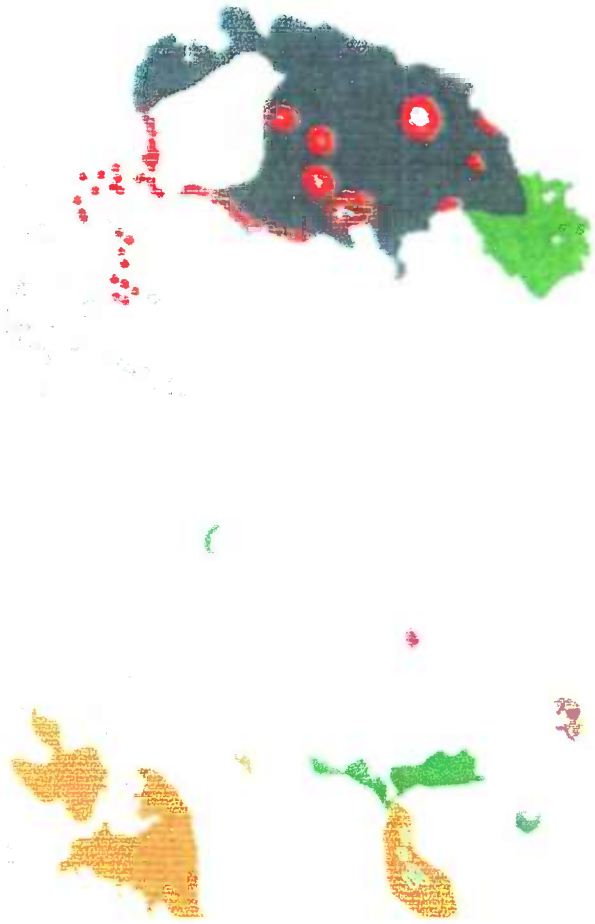

Fig. 3. Benthic and marginal vegetation of Lough Athola.

Hypoglossum woodwardii, Polysiphonia elongata, Rhodomela confervoides.

Some of these communities can be equated with the following communities of Covey and Thorpe (1994):

OB5 Littoral fringe sheltered rock with *Pelvetia canaliculata*

OB24 Hard substratum with *Phyllophora pseudoceranoides*

However the *Chondracanthus acicularis* turf cannot be matched with any community in Covey and Thorpe.

Marginal vegetation includes Puccinellietum and *Juncus gerardii* associations of salt marsh, *Juncus maritimus* stands, *Festuca rubra* grassland, *Blysmus rufus* association, *Eleocharis uniglumis* community and maritime lichens on rock. Both the *Juncus maritimus, Blysmus rufus* and *Juncus gerardii* communities are extensive on the south shore of the lough.

The phytoplankton was dominated by brackish water dinoflagellates.

Notable plants

Blysmus rufus is common on the south side. It is uncommon in western Ireland. *Cladophora battersii* was confirmed by Prof. C. Van den Hoek. This is one of two populations discovered during the survey; it is a very rare plant previously known only from pre 1914 records. *Chondracanthus acicularis* is a very local species found from Galway to Cork, here it is close to its northern limit in Europe.

Assessment

Lough Athola is a high salinity lagoon, but its vegetation and flora is very different from that of the open coast, presumably due to reduced tides. The fucoid zone is almost completely absent except for a small area on the north shore, and is replaced by a very distinctive red algal community. The *Cladophora battersii* community is shared only with Sally's Lough. It appears to be the best example of a high salinity lagoon seen during the survey.

AQUATIC FAUNA

Description

Lough Athola is a saline lake lagoon with a natural tidal inlet through creeks in salt marsh and peat superimposed on a rock barrier. The loch covers approximately 10 ha and is situated on the north shore of Mannin Bay, 4 km northwest of Ballinaboy (Fig 4.10.1). It is flooded by most tides but restricted by the narrow inlet. It is shallow (max 2-3m) and salinity is close to full seawater throughout; the lowest measured in August '98 was 33.7 ppt but 27 ppt was recorded at the western end in 1996 and 6 and 7 ppt close to a freshwater inflow in June and September (1998), respectively. Substrate is mostly rock and stones overlain in many areas by a thick layer of peaty silt and covered with a mats of *Chaetomorpha* or "tufty" *Cladophora battersii.*

Sampling stations

The area was sampled in briefly in June 1996, on 29/6/98 and from 25-26//9/98.

Four sampling stations were selected to reflect the influences of substrate, vegetation, freshwater and tidal inflows.

Station 1 (L 62834 48487) was located on the north shore of the lough close to the main road. Water depth was up to 1m and salinity measured 34.1ppt. Substrate consisted of rock and stones with a thick layer of decomposing algae. The area was surrounded by moorland and rock.

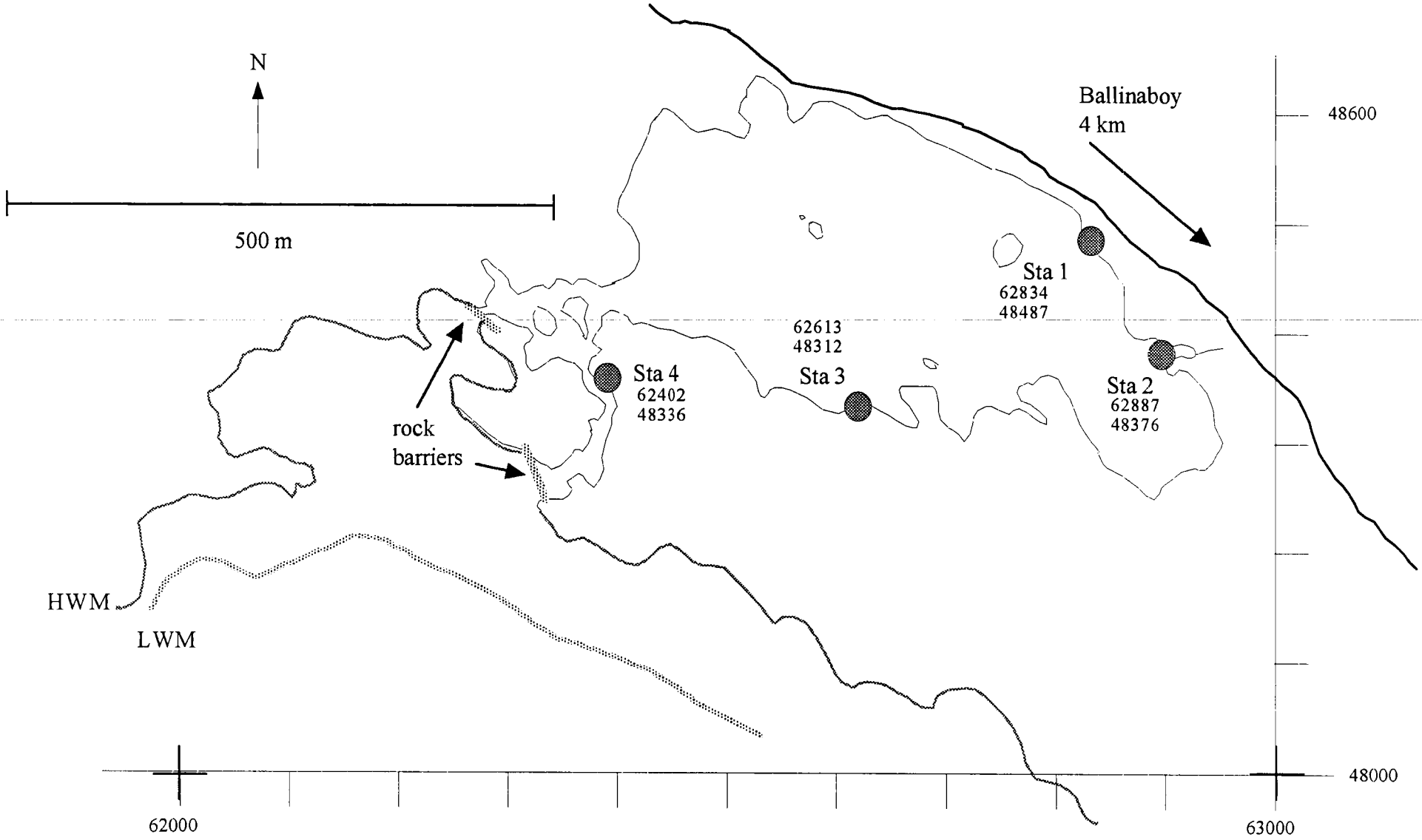

Fig. 4 Sketch map of Loch Athola, Connemara, Co. Galway, showing sampling stations used for a survey of aquatic fauna, 1998.

Station 2 (L 62887 48376) was located at the eastern end of the lough close to where a freshwater stream enters. Depth was up to 1m and salinity measured 33.9 ppt although 27 ppt was recorded in this area in 1996 and 6 and 7 ppt close to a freshwater in flow in June and September. Substrate consisted of rock, stones and coarse sand with peat islands and silty peat in sheltered areas. Further from the shore the substrate was mostly silty peat with a dense growth of algae. The area was bordered by low peat cliffs and grassland.

Station 3 (L 62613 48312) was located on the south shore of the lough in an area where seawater appears to enter the lough during storms by overtopping the storm beach to the south. Depth was up to 1m and salinity measured 34.1 ppt. Substrate consisted of rock with small stones and gravel with a covering of "tufty" *Cladophora sp.* at 1m depth.

Station 4 (L 62402 48336) was located at the western end of the lough at the tidal inflow. Substrate was rock, stones, gravel and coarse sand. Depth was up to 1m and salinity measured 34.1 ppt. From this point the tidal channel meandered through peat islands and flowed over a rock sill.

Results

Table 1 is a list of species arranged in broad ecological categories based on the Venice system of salinity regimes, with additional species recorded during the Biomar Survey on 17/6/95. Table 2 shows the total species list for each station.

A total of 93 taxa were recorded of which 5 are regarded as lagoonal specialists in Britain and two additional species, one rare, are proposed as a lagoonal specialists in Ireland. Only 3 species are of particular importance:

Jaera ischiosetosa was also recorded at L.an Chara, and Maghery L. in 1998 and at Moorlagh, L. Murree and Furnace L. in 1996. The only previous record appears to be for L. Hyne. Co. Cork (Goss Custard *et al.*, 1979). This apparently rare crustacean is a proposed lagoonal specialist for Ireland.

Conopeum seurati has been recorded at 16 of the 36 sites surveyed, but is not listed in a recent review of Irish marine Bryozoa (Wyse Jackson, 1991). Either the species is under recorded or a truly lagoonal specialist.

Leptocheirus pilosus was recorded during the 1996 survey at Furnace Lough. The only other known Irish localities are the south side of Wexford Harbour (Costello *et al.*, 1989) and a brackish channel on the North Slob, Co. Wexford (Galvin, 1992). The only known sites are all brackish and this species is proposed as a lagoonal specialist in Ireland.

Evaluation

The fauna of Lough Athola is very rich but dominantly marine and marine-polyhaline, although 7 species are lagoonal specialists and 3 species appear to be rare in Ireland.

The lagoon is set in a natural area of great scenic interest and is a good exanmple of its type, with a natural rock barrier and peat islands

Table 1 List of fauna arranged in broad ecological categories based on the Venice system of salinity regimes (L* = lagoonal specialist in Britain; L*IR = proposed lagoonal specialist for Ireland; * = rare or interesting species

Marine		
	Clathrina coriacea	
	Leucoselenia botryoides	
	Suberites sp.	
	Sycon ciliatum	
	Tergiops fugax	
	Anthopleura ballii	
	Sagartia elegans	
	Circeus spirillum	
	Eteone picta	
	Flabelligera affinis	
	Harmothöe imbricata	
	Odontosyllis gibba	
	Perinereis cultrifera	
	Platynereis dumerili	
	Polyophthalmus pictus	
	Pomatoceros triqueter	
	Serpula vermicularis	
	Spirorbids	
	Sthenolais boa	
	Typosyllis hyalina	
	Chthamalus montagui	
	Tanais dulongi	
	Mysidopsis gibbosa	
	Ampithoe ramondi	
	Dexamine spinosa	
	Erichthonius ?brasiliensis	
	Lysianissidae indet.	
	Microdeutopus anomalus	
	Phtisica marina	
	Cancer pagurus	
	Hippolyte ?varians	
	Lepidochitona cinereus	
	Gibbula cineraria	
	G. umbilicalis	
	Patella vulgata	
	Rissostomia membranacea	
	Skeneopsis planorbis	
	Anomia ephippium	
	Lasaea rubra	
	Monia patelliformis	
	Modialarca tumida	
	Musculus discors	
	Mysella bidentata	
	Tapes decussata	
	Asterina gibbosa	
	Ophiothrix fragilis	
	Aetea truncata	
	Amathia truncata	
	Ascidia mentula	
	Botryllus schlosseri	
	Clavelina lepadiformis	
	Scrupocellaria reptans	
Marine-polyhaline		
	Halichondria panicea	
	Anemonia viridis	
	Arenicola marina	
	Capitella capitata	
	Tubificoides benedii	
	Noteropterus auritus	
	Semibalanus balanoides	
	Praunus flexuosus	
	P. ?inermis	
	Jassa falcata	
	Melita palmata	
	Palaemon elegans	
	P. serratus	
	Bittium reticulatum	
	Hydrobia ulvae	
	Littorina saxatilis	
	L. littorea	
	Ostrea edulis	
	Amphipholis squamata	
	Bowerbankia gracilis	
	Cryptosula pallasiana	
	Gobius niger	
Poly-mesohaline		
	**Jaera ischiosetosa*	L*IR ?
	**Leptocheirus pilosus*	L*IR ?
	Onoba aculeus	L*
	Cerastoderma glaucum	L*
	Mytilus edulis	
	Ascidiella aspersa	
	A. scabra	
	Mugilidae	
Euryhaline		
	Idotea chelipes	L*
	Gammarus zaddachi	
	Carcinus maenas	
	Palaemonetes varians	L*
	**Conopeum seurati*	L*
	Anguilla anguilla	
	Gasterosteus aculeus	
	Pomatoschistus microps	
Additional species recorded in the Biomar Survey:		
	Polymastia mamillaris	
	Hymeniacidon perleve	
	Dysidia gracilis	
	Sagartiogeton laceratus	
	Scoloelepis foliosa	
	Necora puber	
	Eysia viridis	
	Phoronis hippocrepa	
	Marthasterias gracilis	
	Corella parallelogramma	
	Ascidia conchilega	
	Botrylloides leachi	
	Agonus cataphractus	
	Pleuronectes platessa	

Table 1 Aquatic fauna recorded at sampling stations in Loch Athola, 1998.

Taxa		1	L.T. 1	1b	2	L.T. 2	3	4	L.T.4
Porifera									
	Clathrina coriacea							+	
	Halichondria panicea				+		+	+	
	Leucoselenia botryoides				+				
	Suberites sp.						+		
	Sycon ciliatum	+							
	Tergiops fugax						+		
Cnidaria	*Anemonia viridis*							+	
	Anthopleura balli	c			c		c	+	
	Sagartia elegans							+	
Turbellaria	planarian indet.							+	
Annelida	*Arenicola marina*							+	
	Capitella capitata			a					
	Circeus spirillum	+			+		a		
	Eteone picta							+	
	Flabelligera affinis						c		
	Harmothöe imbricata						+	+	
	Odontosyllis gibba				o				
	Perinereis cultrifera				+				
	Platynereis dumerili				+			a	
	Polyophthalmus pictus	+	1		a			+	5
	Pomatoceros triqueter						+	+	
	Serpula vermicularis							+	
	Spirorbidae indet.	+			+		+	+	
	Stenolais boa							+	
	Typosyllis hyalina							+	
	Tubificoides benedii	+		+					
Sipuncula	indet.						+		
Crustacea									
	Copepoda indet.	+							
Copepoda	*Notopterophorus auritus*							+	
Cirripedia	*Chthamalus montagui*						+	+	
	Semibalanus balanoides	+					+		
Tanaidacea	*Tanais dulongi*				c		+	+	
Mysidacea	*Mysidopsis gibbosa*		3						1
	Praunus flexuosus	+	23		+	45	+	+	20
	P. ?inermis		2			5			10
Isopoda	*Idotea chelipes*	+							
	Jaera ischiosetosa						+		

L.T. = light trap; + = present, o = occasional, c = common, a = abundant.

Table 1 cont.

Taxa		1	L.T. 1	1b	2	L.T. 2	3	4	L.T.4
Amphipoda		+	+		+	1	+	+	8
	Ampithoe ramondi						1	11	1
	Dexamine spinosa							3	
	Erichthonius ?brasiliensis		1						
	Gammarus zaddachi	17			1	1		1	
	Jassa falcata		1						
	Leptocheirus pilosus							16	
	Lysianissidae indet		1						
	Melita palmata				12		2		5
	Microdeutopus anomalus	1			10		4	1	
	Phytisica marina		7	2				+	
Decapoda	*Cancer pagurus*							F=1	
	Carcinus maenas	+			F=53		+	F=15	
	Hippolyte ?varians		1						
	P. elegans	+			+	1	+	+	
	P. serratus				+		+	F=53	
	Palaemonetes varians				o	1			
Insecta	Chironomidae indet.	+			+		+	+	
Mollusca									
Polyplacophora	*Lepidochitona cinereus*						+	o	
Prosobranchia	*Bittium reticulatum*							+	
	Gibbula cineraria	+						+	
	G. umbilicalis							+	
	Hydrobia ulvae						+	+	
	Littorina saxatilis	+			+		o	c	
	L. littorea							+	
	Onoba aculeus			+				+	
	Patella vulgata	+						+	
	Rissostomia membranacea	+						+	
	Skeneopsis planorbis	+		c	+		+		
Bivalvia	*Anomia ephippium*							+	
	Cerastoderma glaucum	ad			+		+	ad	
	Lasaea rubra							+	
	Monia patelliformis							+	
	Modiolarca tumida							+	
	Musculus discors	+							
	? Mysella bidentata						+	+	1
	Mytilus edulis	+			+		+	+	
	Ostrea edulis							+	
	Tapes decussata							+	

F = Fyke net; L.T. = light trap; + = present, o = occasional, c = common, a = abundant.

Table 1 cont.

Taxa		1	L.T. 1	1b	2	L.T. 2	3	4	L.T.4
Bryozoa	*Aetea truncata*						+	+	
	Amathia lendigera						+	+	
	Bowerbankia gracilis						+	+	
	Conopeum seurati				+				
	Cryptosula pallasiana						+	+	
	Scrupocellaria reptans						+	+	
Echinodermata	*Asterina gibbosa*							+	
	Amphipholis squamata	+			+		+	+	
	Ophiothrix fragilis							+	1
	A. scabra				+		+		
	Ascidia mentula							+	
	Botryllus schlosseri						+		
	Clavelina lepadiformis			+					
Pisces	*Anguilla anguilla*				F=2		+	F=3	
	Gasterosteus aculeatus	+			+	2			
	Gobius niger				F=3			F=6	
	Mugilidae indet.								
	Pomatoschistus microps	+					+	+	

F = Fyke net; L.T. = light trap; + = present, o = occasional, c = common, a = abundant

ECOTONAL COLEOPTERA

This is a partially tidal lagoon with a rock barrier, rocky and peaty shores, with areas of *Juncus maritimus* and salt-meadows.

Sampling

Five areas were selected for sampling from 3-25/9/98:

(1) (L628 483) An area (c. 0.4 ha) dominated by *Juncus maritimus, Agrostis stolonifera, Festuca rubra, Leontodon autumnalis, Plantago maritima, Glaux maritima*, and with occasional plants of *Phragmites australis, Armeria maritima* and *Triglochin maritima*, grading down to salt-marsh with *Armeria maritima* and *Salicornia* sp. The area was not recently grazed, but probably spring or winter grazed by cattle.

(2) (626 482) An area of saline meadow on peat which was drained to the lake by creeks and dominated by *Blysmus rufus* with *Triglochin maritima, Plantago maritima, Juncus gerardii*, and sparse *Agrostis stolonifera*.

(3) (L626 483) An area of saline meadow with c. 0.5 m high peat cliffs at the margin of a creek.

(4) (L623 483) As above, but near the rock barrier to the sea on salt-marsh, these cliffs had deeper sides (c. 1m).

(5) An area of shore with granite cobbles and large pebbles on coarse sand/peat, which is covered during flooding. This area also had *Juncus* litter and fibrous algal mats in places.

Results

In total, five species of carabid, ten species of staphylinid, two species of pselaphid and one species of heterocerid were recorded, one of which is regarded as an indicator species (Tables 3 and 4).

TABLE 3 Staphylinidae and Pselaphidae from saline lake/lagoon peat shores in Connemara (Co. Galway): Loch an tSaile; Lough Athola. The same sampling techniques and effort were used at each site. Indicator species are marked with an asterisk.

	L. an tSaile	L. Athola
Aleochara brevipennis Grav.	1	-
Atheta fungi (Grav.)	1	-
Brachygluta fossulata (Reich.)	31	-
Brachygluta helferi (Schm.)	138	129
Cordalia obscura (Grav.)	1	-
Encephalus complicans Kirby	6	-
Lesteva sicula Er.	2	-
Ocypus olens (Müll.)	1	1
Olophrum fuscum (Grav.)	1	-
Oxypoda elongatula Aubé	1	-
Reichenbachia juncorum (Leach)	44	4
Rugilus erichsoni (Fauvel)	1	-
Sepedophilus nigripennis (Steph.)	12	8
Stenus bimaculatus Gyll.	5	-
Stenus brunnipes Steph.	1	3
Stenus clavicornis (Scop.)	4	1
Stenus fulvicornis Steph.	3	2
Stenus impressus Germ.	10	2
Stenus juno (Payk.)	9	-
Stenus lustrator Er. *	19	19
Stenus nitidiusculus Steph.	1	-
Bledius limicola	-	9
Drusilla canaliculata	-	4
Stenus fuscipes	-	1

TABLE 4. Carabidae and Heteroceridae from saline lake/lagoon peat shores in Connemara (Co. Galway): Loch an tSaile; Lough Athola; Lough Bofin. The same sampling techniques and effort were used at each site. Indicator species are marked with an asterisk.

	L. an tSaile	L. Athola
Agonum albipes (Fab.)	1	-
Agonum fuliginosum (Panz.)	2	-
Bembidion assimile (Gyll.)	1	-
Bembidion mannerheimi Sahlb.	7	9
Carabus granulatus L.	1	-
Dromius linearis (Ol.)	3	1
Elaphrus cupreus Dufts.	1	-
Ocys harpaloides (Serv.)	1	-
Pterostichus strenuus (Panz.)	1	-
Pterostichus melanarius (Ill.)	6	-
Pterostichus niger (Schall.)	40	3
Carabus problematicus	-	1
Heterocerus fossor	-	7

Evaluation

The presence of only one indicator species indicates low conservation value for this site.

SUMMARY

Lough Athola is a very interesting high salinity lagoon with a unique aquatic flora including *Ruppia* as well as rare species and communities of algae. Plankton was dominated by brackishwater dinoflagellates. There was a high diversity of marginal vegetation. The fauna was rich, with a good representation of brackish species for such a high salinity, including seven lagoonal specialists and three species which appear to be rare in Ireland. . The barrier and inlet are natural, conditions appear to be stable, and no threats are apparent.

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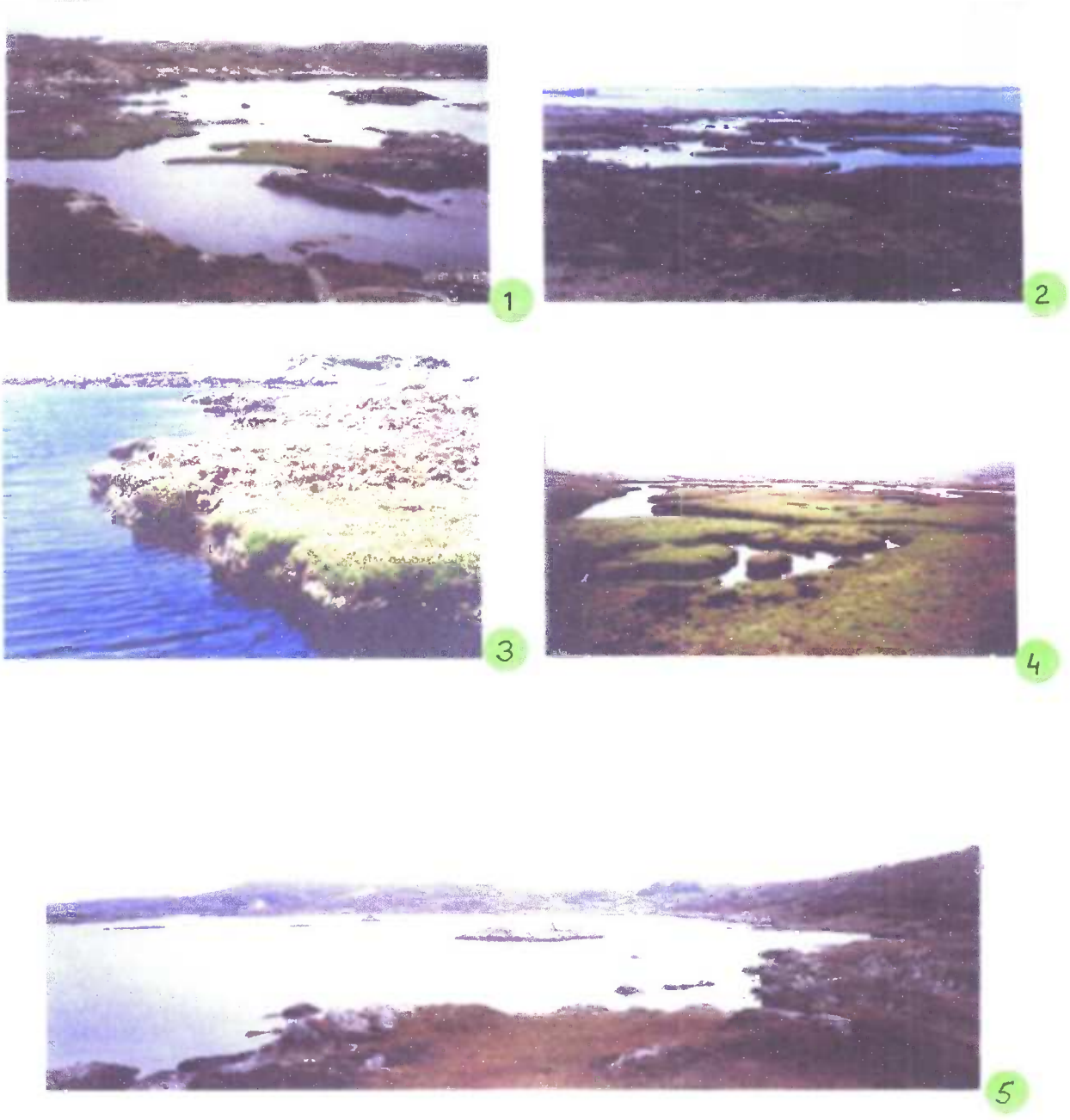


Plate. 10. Lough Athola, Connemara. 1. East end of the lagoon seen from the road; 2. Mosaic of saltmarsh vegetation on peat near the outflow; 3. Vertical peat bank of outlet creek; 4. Grazed saltmarsh and outlet creeks; 5. view from the northeast, outlet towards the left.

11. LOUGH BOFIN, INISHBOFIN, Co. Galway

Loch an Bo Finne, Loch Bo Finne

Location: L 525656; $53^0$37.1'N, $10^0$14.1'W. OS Sheet 37.
North side of the island, 2 km from the harbour.

Lagoon type	sedimentary lagoon without inlet
Area	8 ha
Salinity regime	oligo-euhaline
Maximum depth	2 m
Seawater entry	percolation and overwash
Tidal range	none
Conservation status	NHA No. 278

Geology, geomorphology and landscape

The rock on the island belongs to the Ben Levy Grit formation of doubtful age ("Cambrian-Ordovician, dubiously Dalradian"), metamorphosed and deformed. The island is hilly with hills reaching over 60 m. Lough Bofin lies on the north shore, at the head of a sandy bay which is protected at its mouth by rocks. A complete barrier of cobbles is without inlet but is unvegetated and is obviously mobile and thus subject to changes in profile.

Description of the system

The lagoon lies at the base of steep slopes on its east side, with lower land to the west. It is shallow, with an average depth of 1-2 m. The east and north shores are stony and gently sloping, while in the west they are peaty with grassy banks. The bed is mainly muddy sand and has an almost uniformly dense covering of *Ruppia.* A band of saltmarsh separates the lagoon from the barrier.

Hydrology

The lagoon was mesohaline when sampled in July 1998 but was almost full seawater in 1996, while 3‰ was recorded in March 1999. Seawater probably seeps in by percolation through the barrier, but as the barrier is low, frequent influxes by overwash are likely, and this may explain the extent of variation. The main source of freshwater is probably runoff from the steep hill on the east side; a number of temporary streams were seen flowing down these slopes during persistent rain and one permanent stream is shown on the map. A small stream also drains from a marshy hollow in the south-west.

Exploitation and threats

There are few fish in the lake and therefore little or no fishing. The main threat is from a proposed housing development which would be sited north west of the lagoon. Planning permission for this has already been refused.

Conservation status

The island is an NHA

Research

Investigations of plankton are in progress by Dr Pauline King of Galway-Mayo Institute of Technology.

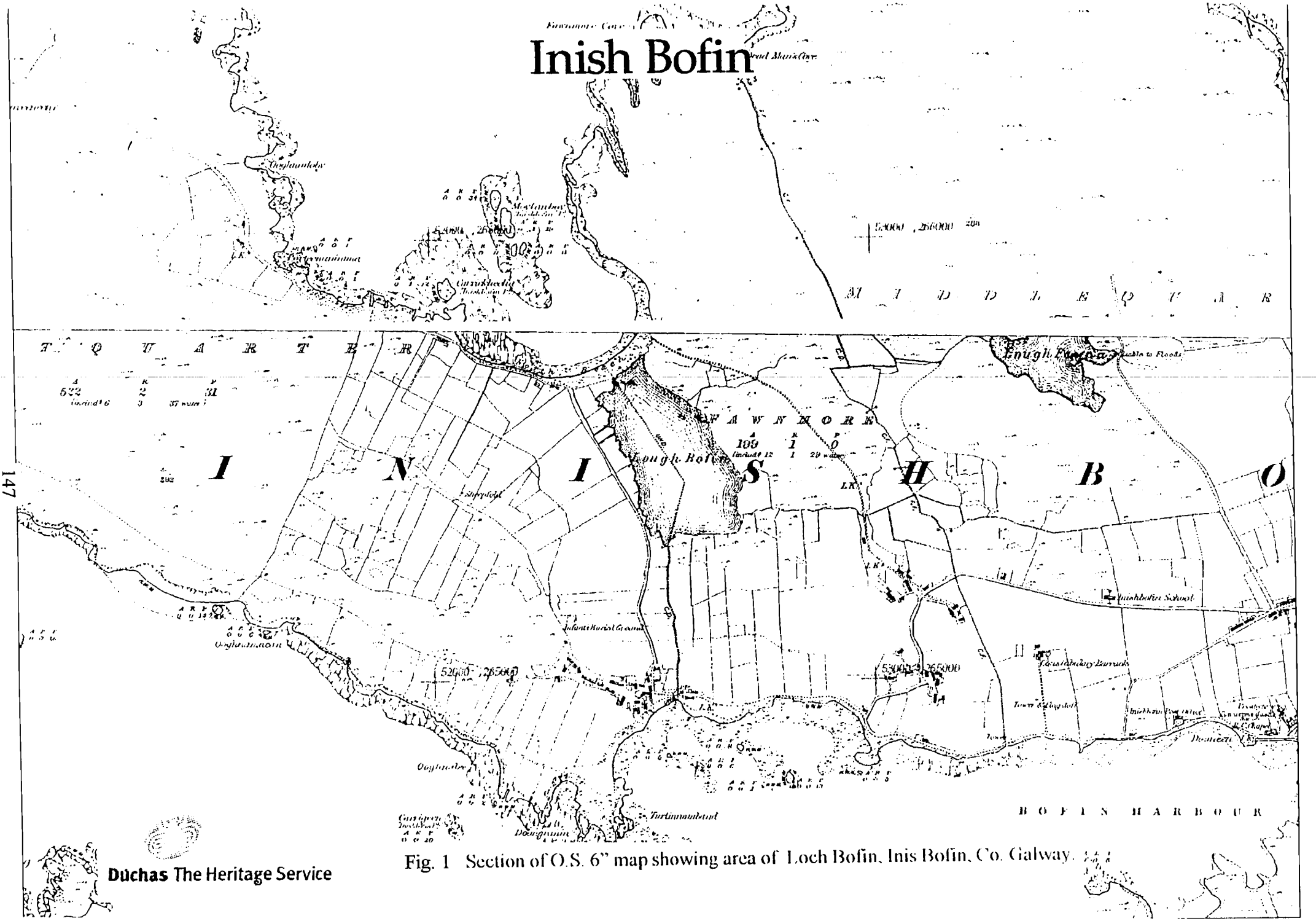


Fig. 1 Section of O.S. 6" map showing area of Loch Bofin, Inis Bofin, Co. Galway.

VEGETATION

Lough Bofin is situated on the northwest coast of Inish Bofin. It is surrounded by low hills of metamorphic rock on three sides while a cobble barrier forms the shore on the northwest side. A small stream enters the lake on the eastern side. The shoreline includes areas of gravel and cobbles, small cliffs and a small area of saltmarsh.

Underwater observations

Lough Bofin is a shallow oval basin separated from the sea by a massive cobble barrier. While on the seaward side, the barrier descends to a rocky sea floor at a depth of 4-5m, the inner or lake side descends to a soft muddy bottom at a depth of 1-2m. This depth difference suggests that a considerable amount of sediment has accumulated in Lough Bofin. The lake bottom has an almost uniform dense covering of *Ruppia* sp. This is mixed through with a sparser population of *Lamprothamnium papulosum*.

Sampling

The site was visited on 4-5/8/1998. Marginal vegetation was sampled, benthic vegetation was examined by snorkelling, and a phytoplankton sample taken.
5/8/1998
1-7 (05342656) were taken in fringing vegetation on the west side of the lake.
8-10 (05362656) were taken on gravel shores
11-12 05352651) were taken in a *Phragmites* swamp.
4/8/1998
13-17 (05352655) were taken in the sublittoral at a depth of 1-2m.

Results

The benthic vegetation is uniform consisting of stands of *Ruppia cirrhosa* and *R. maritima*, as well as a mixed *Ruppia* and *Lamprothamnium* community with some *Chaetomorpha linum*. There are very few bare mud or sand patches and the vegetation is dense, (13-16). Some *Enteromorpha intestinalis* and *Cladophora* sp. grow on the cobble barrier (17).

The shore is mainly stony or grass covered. There are small patches of *Scirpus maritimus* and *Phragmites australis*, (7,11,12).

Marginal vegetation includes areas of the *Juncus gerardii* association including the *Potentilla anserina* variant (1-6) and communities of gravel shores (8-10).

The phytoplankton is interesting with several brackish species of the genus *Prorocentrum* .

Notable plants

Lamprothamnium papulosum and *R. cirrhosa* both occur in considerable quantity. *Ruppia maritima* also occurs.

Assessment

The benthic vegetation of Lough Bofin is an excellent example of *Ruppia/Lamprothamnium* community. The plankton appears to contain unusual species.

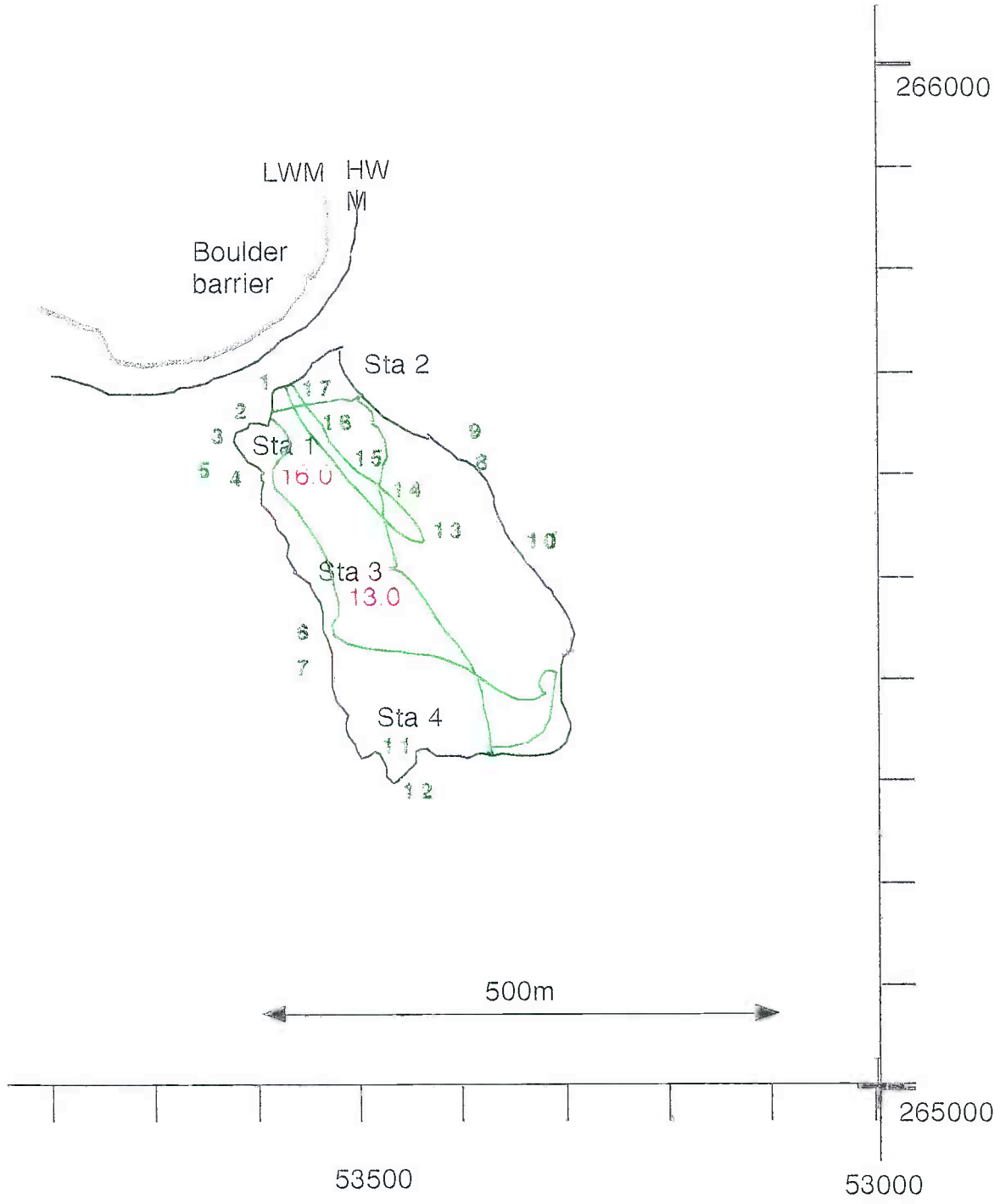


Fig. 2 Sketch map of Loch Bofin, Inis Bofin, Co. Galway, 1998.

Fig. 3. Benthic and marginal vegetation of Lough Bofin.

Description

Lough Bofin is a natural sedimentary lagoon with a cobble barrier. The lagoon is situated on the north shore of the island of Inishbofin, approximately 2km to the west of the harbour (Fig 1). The barrier is high and seawater enters the lagoon by percolation and by overwash during storms. The lagoon is shallow (no deeper than 1.5m) and covers an area of approximately 8 ha. Although there is no direct connection with the sea, the volume of the lagoon is small and the amount of seawater that enters, either by percolation or overwashing can be relatively high. Several small streams enter the lagoon and large amounts of freshwater can also enter at times of high rainfall and it appears that the lagoon undergoes extreme variations in salinity. During the sampling period in August 1998, salinity measured 13-17 ppt from the landward end to the barrier. However, 32.3-33.1 ppt was recorded in August 1995, 23.5-27.6 ppt in April 1996 and 34-36 ppt in August 1996. The latter record indicates that the lagoon may become hypersaline away from the barrier. Substrate of the lagoon is rock, cobbles and shingle along most of the shoreline with a thick organic silt deposit covering most of the central area.

Sampling stations

The area was sampled from 5-7/8/98.

Four sampling stations were selected to reflect the influences of substrate, vegetation, freshwater and tidal inflows. Weather conditions were particularly bad during this period with heavy rainfall which undoubtedly affected salinity measurements and sampling efficiency.

Station 1 (L52361 65630) was located at the northwest corner of the lagoon close to a seepage area through the cobble barrier. Water depth was up to 1m and salinity measured 16.0 -17.5 ppt. Substrate consisted of cobbles and muddy gravel with occasional large stones giving way to finer sediments further from the shore. A dense growth of *Chaetomorpha* covered most of the substrate.The area was surrounded by the cobble barrier to the north, an eroding vertical edge of peat, and pasture with patches of *Phragmites* along the eastern shore.

Station 2 (L 52490 65730) was located at the foot of the hills on the northeastern shore of the lagoon. Depth ranged from 0 -1m, and salinity measured 15-16 ppt. Surface water was running off in streams all along the eastern shore after 24 hours of heavy rain. Substrate consisted of bed rock (?schist) with large stones, flat stones and gravel and the area was bordered by a gently shelving edge with *Juncus* and rough grazing on the hillsides.

Station 3 (L 52459 65503) was located midway along the western shore where a drainage ditch enters the lagoon. Depth varied from 0.7 -1m along the edge and salinity measured 13.1 ppt. Substrate consisted of silty peat without rock or stones bordered by vertical banks of peat below damp pasture.

Station 4 (L 52569 65335) was located at the southwestern end of the lagoon where streams enter from a freshwater marsh. Depth was up to 1m and salinity measured 4-7 ppt at the edge of the marsh and 17 ppt a short distance from the shore. Substrate was gravelly mud with flat stones and small isolated peat clumps giving way to deep silty mud.

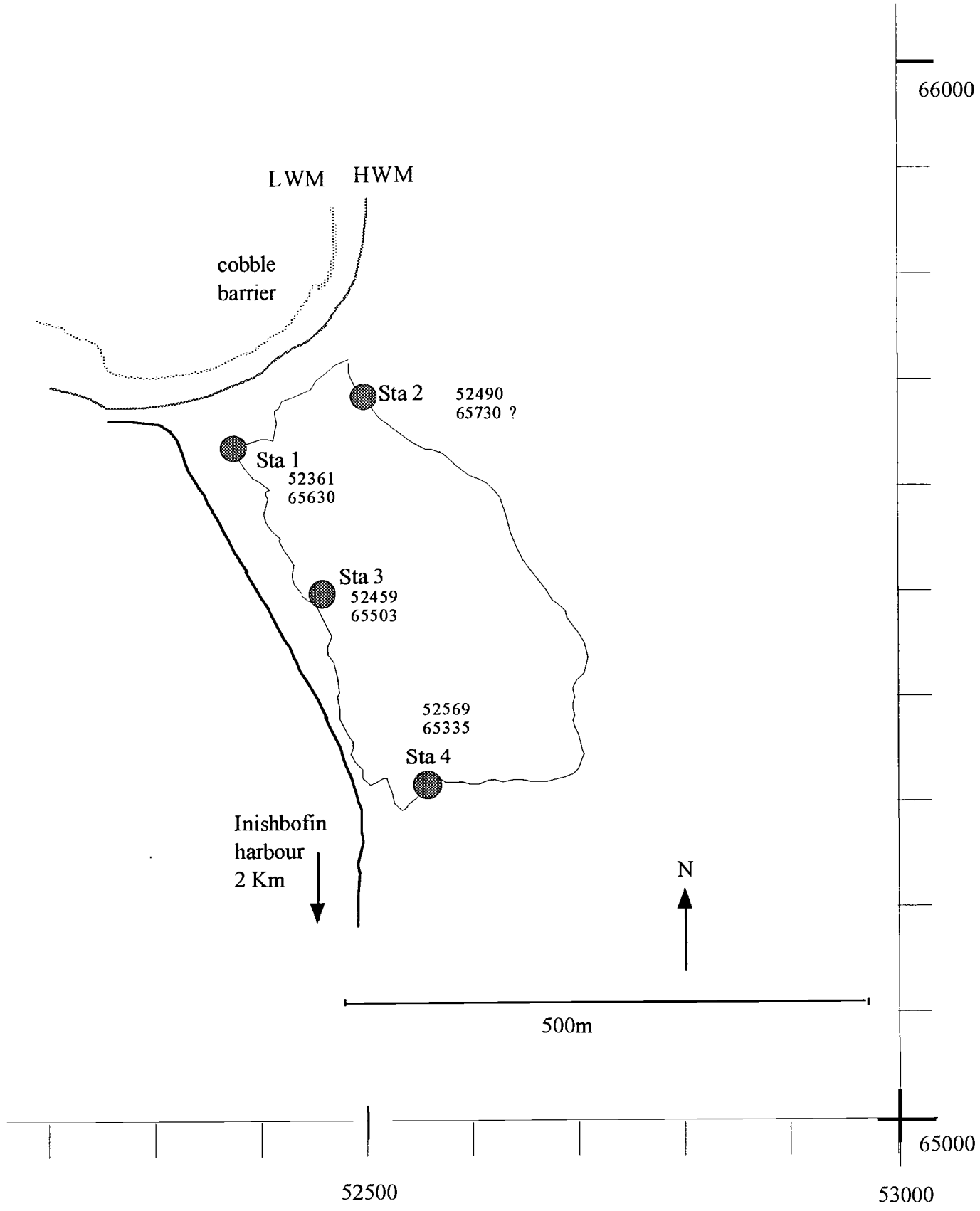


Fig. 4 Sketch map of Loch Bofin, Inis Bofin, Co. Galway, showing sampling stations used for a survey of aquatic fauna, 1998.

Results

Table 1 shows the total species list for each station. The following is a list of species arranged in broad ecological categories based on the Venice system of salinity regimes (L*IR = proposed as lagoonal specialist in Ireland.).

Marine-polyhaline
- *Bowerbankia gracilis*
- *Melita palmata*

Euryhaline
- *Procerodes littoralis*
- *Hediste diversicolor*
- *Jaera nordmanni* L*IR?
- *Gammarus duebeni*
- *Anguilla anguilla*
- *Gasterosteus aculeatus*

Table 1 Species recorded at sampling stations in Lough Bofin, 1998.

Taxa		1	L.T. 1	2	L.T. 2	3	L.T. 3	4	L.T. 4
Turbellaria	*Procerodes littoralis*	c		c					
Annelida	*Hediste diversicolor*	o				o		c	
Crustacea									
Copepoda	indet.	(a)		(a)		(a)		(a)	
Isopoda	*Jaera nordmanni*	c	7	c		8		6	2
Amphipoda		a	c250		c250	a	c1000	+	c500
	Gammarus duebeni	28	27	8	60	a	131	11	225
	Melita palmata	1							1
Insecta	Chironomidae indet.	+							
Bryozoa	*Bowerbankia gracilis*	+							
Pisces	*Anguilla anguilla*					F=5			
	Gasterosteus aculeatus	c	1	c	3	c		a	20

F = Fyke net; L.T. = light trap; + = present, o = occasional, c = common, a = abundant. ( ) = previous record

The fauna of this lagoon was extremely poor with only 10 taxa recorded, of which 8 were identified to species. One is a proposed lagoonal specialist in Ireland. None can be described as rare. The copepods were described as abundant in 1996 but were not identified. Surprisingly there were no hydrobiids of any species found.

Evaluation

Geomorphologically Lough Bofin is a fine example of a sedimentary lagoon with a high cobble barrier.

The fauna however is extremely impoverished, possibly due to extreme variations in salinity and periodic anoxia, presumably due to rotting algae. The lagoon could be referred to as what Hartog (1974) describes as a "shock system".

ECOTONAL COLEOPTERA

This shingle barrier lagoon, facing north-north-west into the Atlantic ocean, has heavily grazed sheep pasture and eroded till and rock shores with shores of peat with *Juncus gerardii*, etc. on its south-west margin. There is also a reed-bed at the freshwater inlet. Restricted drainage to sea is likely to result in frequent fluctuations in water level.

Sampling

Two areas were selected for sampling from 29/8 – 19/9/98:
(1) (L523 656) A narrow (c.2m) band of *Juncus gerardii* dominated vegetation with *Glaux maritima, Potentilla anserina, Plantago maritima*, sparse *Agrostis stolonifera, and Leontodon autumnalis*, on peaty soil near the shingle barrier. Standing water salinity offshore was 9-10 ‰.
(2) As above, but with denser cover with higher density of *Agrostis stolonifera*. (These two sampling subsites were close to each other because they were considered to represent the best examples of shore habitat, in comparison to other more eroded or disturbed (by flooding) areas.

Results

In total, two species of carabid, nine species of staphylinid and one species of pselaphid were recorded, none of which are regarded as indicator species (Tables 2 and 3). The extent of ecotonal shore habitat was limited at this site, and flooding of the shore appears to occur regularly.

TABLE 2. Staphylinidae and Pselaphidae from cobble barrier lagoon shores at Lough Bofin in Connemara (Co. Galway). Indicator species are marked with an asterisk.

Atheta amplicollis (Muls. Rey)	3
Cordalia obscura (Grav.)	1
Euaesthetus bipunctatus (Ljungh)	3
Reichenbachia juncorum (Leach)	5
Stenus boops Ljungh	1
Stenus brunnipes Steph.	2
Stenus canaliculatus Gyll.	8
Stenus cicindeloides (Schall.)	4
Stenus juno (Payk.)	23
Stenus tarsalis Ljungh	8

TABLE 3 Carabidae from from cobble barrier lagoon shores at Lough Bofin in Connemara (Co. Galway). Indicator species are marked with an asterisk.

Pterostichus niger (Schall.)	1
Pterostichus diligens (Sturm)	1

Evaluation

Conservation value was not indicated at this site because no indicator species were found. The extent of ecotonal shore habitat was limited at this site, and flooding of the shore appears to occur regularly.

SUMMARY

Geomorphologically, Lough Bofin is a good example of a western sedimentary lagoon with a cobble barrier. The vegetation is not diverse but is well developed with *Ruppia* and *Ruppia-Lamprothamnium* swards. The phytoplankton was interesting. The fauna, however was the poorest of any lagoon investigated and was remarkable for the absence of hydrobiids. Only sticklebacks and gammarids were common. The salinity varies considerably and the lagoon may be subject to "shock" from barrier overwash.

References

Hartog, C. den, 1974 Brackish-water classification, its development and problems. Hydrobiological Bulletin 8: 15-28.

Plate 11. Lough Bofin, Inish Bofin. 1. West half of barrier; 2. West end of barrier (faunal Stn. 1); 3. View of barrier from the southeast; 4. *Phragmites* at outlet of small stream in the southwest (faunal Stn. 4); 5. Currach on barrier (1996)

12. MAGHERY LOUGH, Co. Donegal

Location: B 723094; 54°55.7'N, 8°55.7'W. OS Sheet 1
5.5 km west of Dunglow.

Lagoon type	saline lake lagoon, modified inlet
Area	about 19 ha
Salinity regime	15-34 ppt polyhaline
Maximum depth	2 m
Seawater entry	silled inlet
Tidal range	exceptionally 50 cm
Conservation status	none?

Origin and history

The lagoon and its outlet appear natural but the latter has been modified to allow a road to pass over it and a sluice was installed. Maintenance of the sluice has lapsed and it was broken at the time of sampling.

Geology, geomorphology and landscape

The rock in the area is coarse-grained Rosses granite which outcrops in land surrounding the lagoon and forms hills inland. Low sandy ground and dunes lie to the west.

Description of the system

The lagoon is separated from the sea east of Termon Strand by a barrier of rocky grassland. It is shallow, average depth 2 m, with numerous rocks near the outlet and on the eastern shore. The west shore is peaty and there are *Phragmites* beds on the south-west and south shores. The substrate is coarse sand with stones in rocky areas, and soft sandy silt elsewhere. The outlet under the road empties onto a fucoid rocky shore. Rough, rocky pasture with areas of marsh surround the lagoon.

Hydrology

The sill is situated a little above MTL and the lagoon probably receives some tidal water on most tides, pouring in as a strong tidal stream at springs. During high springs on 4th September 1998, the tide flowed for 3.5 hours, and turned 1.5 h after high tide. The tidal range on this occasion was about 50 cm, but this is probably unusual. The sea washes over the road at extreme high tides and during rough weather and seawater also penetrates through cracks in the wall supporting the road and trickles into the lagoon. Freshwater draining from higher ground, especially from the hill to the south, creates saturated peaty ground around the lagoon and forms small streams during wet weather. There are said to be freshwater springs in one area of the lagoon bed.

Exploitation and threats

There is some leisure angling and fishing for domestic consumption. Plans to stock the lagoon with trout following installation of a new sluice have been suggested. High water levels which are threatening a cemetery near the shore of the lagoon are also creating pressure to repair the sluice. Overwash and seepage would be sufficient to maintain brackish conditions but stabilisation of salinity at a low mesohaline level could be harmful to the *Lamprothamnium* which requires high salinity. However, the population is known to have existed for some time, in spite of attempts to repair the sluice. The

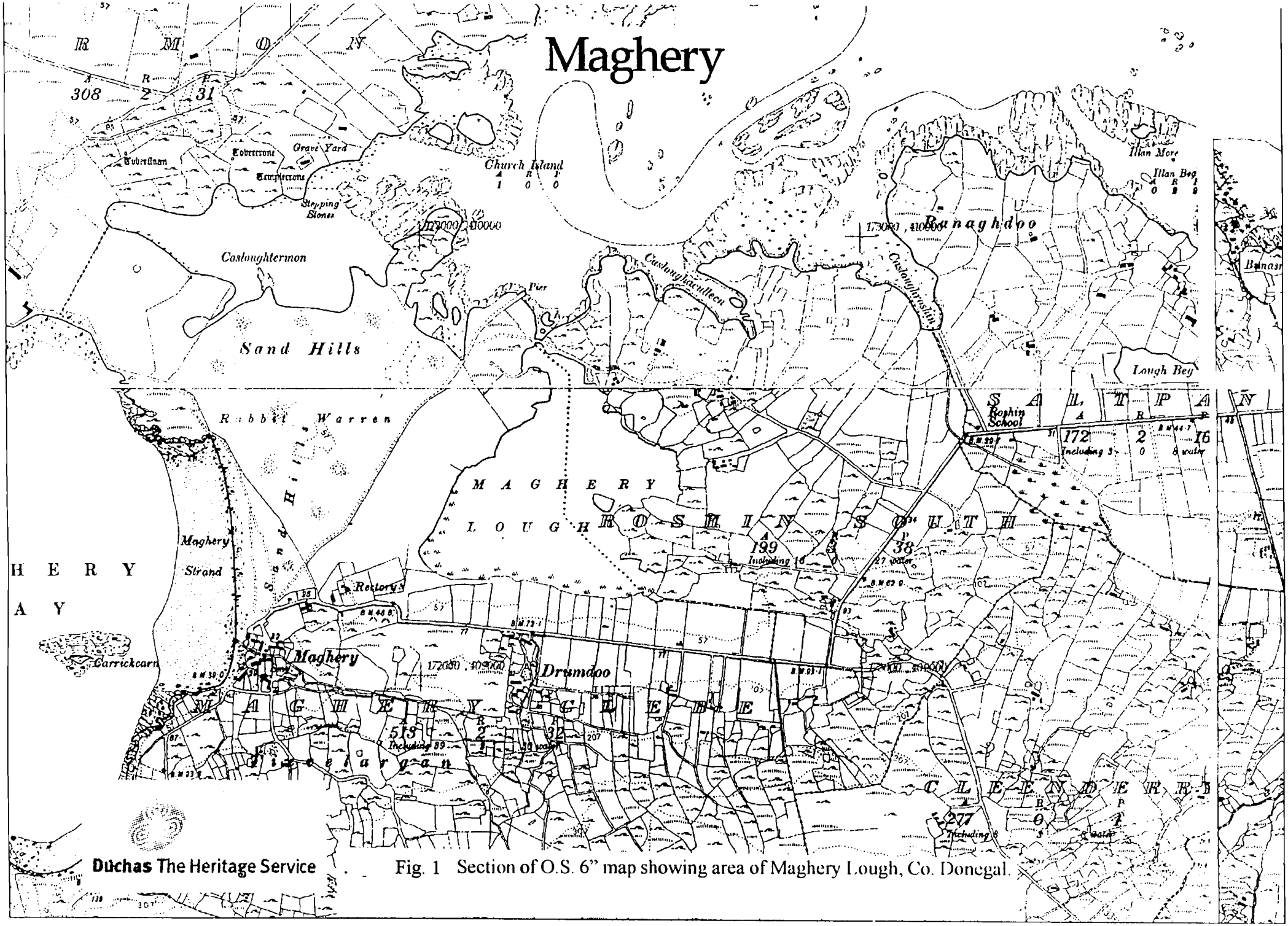


Fig. 1 Section of O.S. 6" map showing area of Maghery Lough, Co. Donegal.

impact of house-building in regions from which water drains into the lagoon would need to be monitored.

Conservation status

None?

VEGETATION

Maghery Lough is situated on the south shore of Dungloe Bay. Rocky ground and low hills occur to the south and east. To the west, the lake is separated from the sea by low sandy ground and a sand dune system. At the northern extremity the lake is linked to the sea by an outflow that runs under a road. At extreme spring tides seawater overtops the road and cascades into the lake. It is possible that the lake was originally formed when growth of the sand dune system on the western side impounded a small coastal bay.

Underwater observations

The lake is a wide shallow basin with a maximum depth of about 2m. The northern part of the lough is floored with scattered rocks and sand. A poor marine algal flora occurs here. In the centre and southern part, the sand is replaced by soft mud. *Ruppia* sp. and *Lamprothamnium papulosum* grow in some quantity in this part of the lake. Large reed beds occur along the shore. In several places the siphons of *Mya arenaria* protruding from the lake floor were very conspicuous.

Sampling

The lake was sampled on 29/6/98 and 7-8/9/98. Marginal vegetation was sampled, benthic vegetation was examined by snorkelling, and a phytoplankton sample taken.
8/9/98
1-4 (17194092) were made in marshy ground separated from the lake by an extensive bed of *Phragmites australis.*
5-11 (17254095) were made along the rocky eastern shore of the lake.
7/9/1998
12-16 17234094) were made in the sub littoral.

Results

Maghery is shallow (1-2m) coastal lake with a mud and sand bottom with some outcropping rock. Benthic vegetation includes stands of *Ruppia maritima, R. cirrhosa* and *Lamprothamnium papulosum* (14-16), as well as extensive beds of *Phragmites australis* with an understory of *Ruppia* sp. and the *flabellatus* form of *Potamogeton pectinatus.* A single plant of *Zostera marina* was seen on the eastern side of the lake.

Poorly developed macroalgal communities are found near the lake exit, where they grow on scattered rocks protruding from the sandy lake floor. Species include *Phyllophora pseudoceranoides, Chondrus crispus, Coccotylus truncata, Furcellaria lumbricalis, Cladophora rupestris* and *Enteromorpha* sp. This community corresponds to the OB24 of Covey and Thorpe (1994).

The phytoplankton contained several brackish water dinoflagellates.

Marginal vegetation was well developed and included the *Juncus gerardii* community (5-8), *Juncus maritimus* stands (9,10) and *Schoenoplectus tabernaemontani/ Phragmites* stands grading into freshwater marsh (1-4).

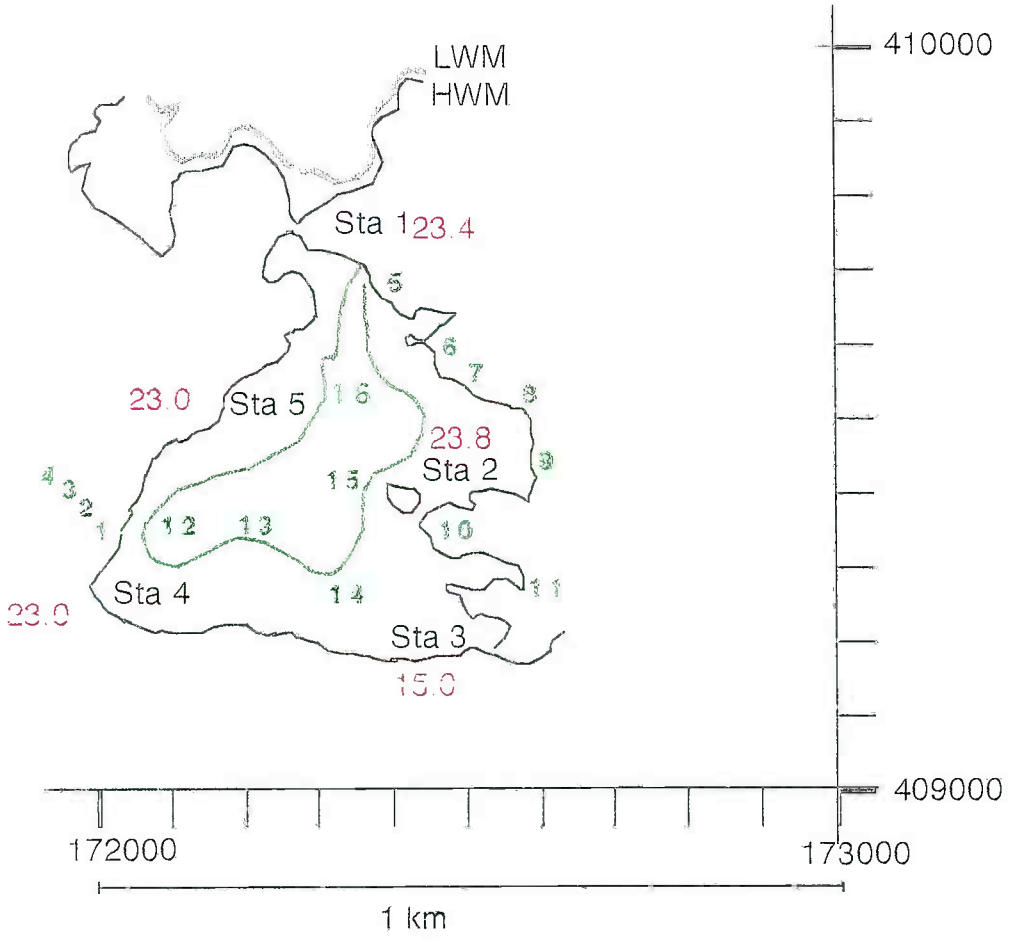
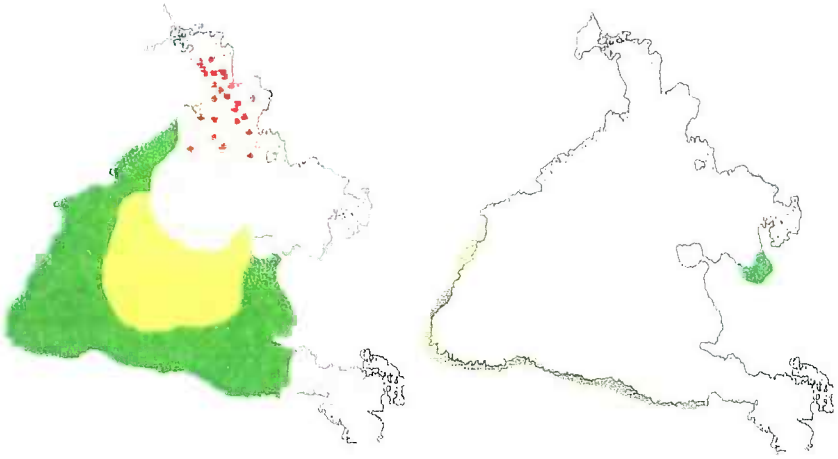


Fig. 2 Maghery Lough, Co. Donegal, showing sampling stations, 1998.

Fig. 3 Benthic and marginal vegetation of Maghery



Notable plants

The charophyte *Lamprothamnium*, which is a Red Data book species has its only known station in Ulster at this lake. The unusual form of *Potamogeton pectinatus* also occurs in Loch an tSáile in Co. Galway, it may be characteristic of brackish water of higher salinity. Both species of *Ruppia* occurred in the lake.

Assessment

Maghery Lough contains good examples of the *Ruppia / Lamprothamnium* vegetation. There is a diversity of other communities but these are not extensive nor species rich.

AQUATIC FAUNA

Description

Maghery Lough is a saline lake lagoon with a modified, sluiced outlet. The lake covers approximately 19 ha and adjoins Maghery Bay, 5km to the west of Dungloe (Fig 1). Seawater enters the lake on most tides but the lake is surrounded by hills and wet grassland and marshes and several small streams flow into the lake in the southeast. The inlet is probably natural but has been modified by the building of a road bridge and addition of a wooden sluice flap, which was broken at the time of sampling. Depth is very shallow (up to 1.5 m) and salinity at the time of sampling was 34 ppt at the inlet and 29.5 ppt in the deepest parts of the lake but 23ppt over most of the surface and down to 15 ppt in the southeast. 22-4 ppt was measured in July. Substrate was rock, stones and coarse sand near the inlet, soft, sandy organic silt in sheltered areas and in parts of the centre, clean fine sand along parts of the western shore. A fringe of *Phragmites* was present along the southwest, south and southeast shores.

Sampling stations

The area was sampled in June 1996, briefly on 29/6/98 and from 4 -5/9/98.

Five sampling stations were selected to reflect the influences of substrate, vegetation, freshwater and tidal inflows.

Station 1 (B72232 09783) was located at the north end of the lake near the inlet. Depth varied from 0-1m and salinity measured 23.4 ppt. Substrate consisted of isolated rocks with coarse sand, gravel and stones and softer sediments in sheltered places. The area was bordered by moorland, granite rocks, boulders and stones.

Station 2 (B 72450 09364) was located midway along the eastern shore where an island is connected to the shore by a line of stones. Substrate consisted of soft organic silt with coarse gravel and some stones. Large granite rocks and moorland lined the shore. Depth varied from 0-1m and salinity measured 23.8 ppt.

Station 3 (B 72541 09208) was located in the southeast corner of the lake where small streams enter the lake through wet grassland and *Phragmites* swamp. Depth was slightly greater here (up to 1.5m) and salinity increased from 15 to 23 ppt away from the shore. Substrate was coarse sand with fine peaty silt.

Station 4 (B 72036 09330) was located at the southwestern end of the lake in a shallow area bordered by *Phragmites*. Depth was less than 0.5 m and salinity measured 19 -23 ppt. Substrate consisted of soft peaty silt overlain with mats of decaying reed stems.

Station 5 (B 72113 09317) was located in a small bay midway along the western shore. Depth was shallow (less than 0.5m) and salinity measured 23ppt. Substrate consisted of clean coarse shell sand and the area was bordered by *Phragmites*, improved grassland and metamorphosed bedrock.

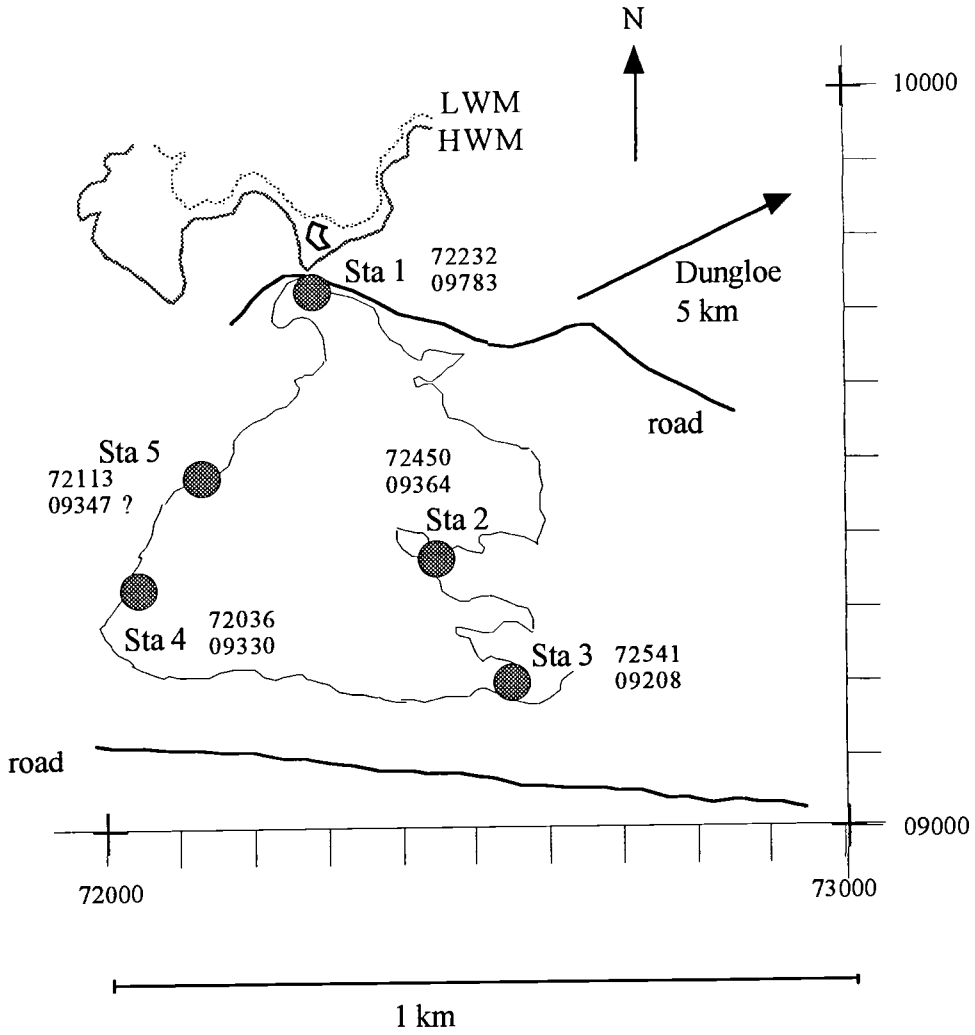


Fig. 4 Sketch map of Maghery Lough, Co. Donegal, showing sampling stations used for a survey of aquatic fauna, 1998.

Results

Table 1 shows the total species list for each station. The following is a list of species arranged in broad ecological categories based on the Venice system of salinity regimes (L* = lagoonal specialist in Britain, L*IR = proposed as lagoonal specialist in Ireland; * = interesting or rare species. Species in brackets refer to previous records).

Marine	
Operculariella lacerata	
Marine-polyhaline	
Arenicola marina	
Semibalanus balanoides	
Praunus flexuosus	
Melita palmata	
Crangon crangon	
Palaemon elegans	
P. serratus	
Hydrobia ulvae	
Littorina littorea	
(L. saxatilis) (1996)	
Mya arenaria	
Taurulus bubalis	
Poly-mesohaline	
**Jaera ischiosetosa*	L*IR ?
Corophium volutator	
Cerastoderma glaucum	L*
Mytilus edulis	
(Pomatoschistus microps) (1996)	
Euryhaline	
Hediste diversicolor	
Neomysis integer	L*IR?
Idotea chelipes	L*
Jaera nordmanni	L*IR?
Gammarus zaddachi	
Carcinus maenas	
Palaemonetes varians	L*
Potamopyrgus antipodarum	
**Conopeum seurati*	L*
Anguilla anguilla	
Pleuronectes flesus	
Gasterosteus aculeus	
Oligohaline-limnetic	
Hydrometra stagnorum	
Hydroporus memnonius	
Limnetic	
Agabus bipustulatus	
Helophorus brevipalpis	

A total of 32 taxa were recorded in 1998, of which 4 species are listed as lagoonal specialists in Britain and 3 additional species are proposed as lagoonal specialists in Ireland. 3 additional species were recorded in 1996 but not found alive during the 1998 survey. The thriving population of *Mya arenaria* was the most striking feature of this lagoon. Two species are thought to be of interest:

Jaera ischiosetosa was also recorded at L.an Chara and L. Athola in 1998 and at Moorlagh, L. Murree and Furnace L. in 1996. The only previous record appears to be for L. Hyne. Co. Cork (Goss Custard *et al.*, 1979).

Conopeum seurati has been recorded at 16 of the 36 sites surveyed, but is not listed in a recent review of Irish marine Bryozoa (Wyse Jackson, 1991). Either the species is under recorded or a truly lagoonal specialist.

Evaluation

The fauna of the lagoon is mostly euryhaline and marine/polyhaline and not particularly rich. Only one species is possibly rare but several species are lagoonal specialists.

The lagoon is a good example of its type, relatively unspoilt despite the modified inlet, in an area of natural beauty.

Table 1 Aquatic fauna recorded at sampling stations in Maghery Lough, 1998.

Taxa		1	L.T. 1	2	L.T. 2	3	L.T. 3	4	L.T. 4	5
Cnidaria	*Operculariella lacerata*	+								
Polychaeta	*Arenicola marina*	+								+
	Hediste diversicolor					c				
Crustacea										
Cirripedia	*Semibalanus balanoides*	(+)								
Mysidacea	*Neomysis integer*	c	7	c	2	o	1	c	16	
	Praunus flexuosus	o	1	o	1					
Isopoda	*Idotea chelipes*						1			
	Jaera ischiosetosa	1		c						
	J. nordmanni	+				+	5			
Amphipoda		+	+	a	+	+	+	+	+	+
	Corophium volutator	+				1				
	Gammarus zaddachi	123	34	136	6	34	34	59		52
	Melita palmata	1						1		
Decapoda	*Carcinus maenas*	F=126								
	Crangon crangon	a								
	Palaemon elegans	c	1				+			
	P. serratus	c	1							
	Palaemonetes varians	c								
Arachnida	Acarina indet.								1	
Insecta										
Heteroptera	*Hydrometra stagnorum*					+				
	(Corixidae indet.)							3		
Coleoptera	*Agabus bipustulatus*							1		
	Helophorus brevipalpis							1		
	Hydroporus memnonius							6		
Diptera	Chironomidae indet.	o		c		a		c		a
Mollusca										
Prosobranchia	*Hydrobia ulvae*	+								
	Littorina littorea	(+)		o						
	L. saxatilis	(+)								
	Potamopyrgus antipodarum	12				25		+		+
Bivalvia										
	Cerastoderma glaucum	o				shells				
	Mya arenaria	o		c		a		o		a
	Mytilus edulis	o								
Bryozoa	*Conopeum seurati*	+		+						
Pisces	*Anguilla anguilla*	F=2				F=7				
	Pleuronectes flesus	o		o						
	Pomatoschistus microps	(+)								
	Gasterosteus aculeatus	o		c	1	c		c	7	+
	Taurulus bubalis	F=2								

L.T. = light trap; F = Fyke net. + = present, o = ocasional, c = common, a = abundant. ( ) = previous record

This is a saline lake lagoon with a sluiced causeway barrier. The shores on the exposed side (especially the east shore) are of eroded rock. Those on the sheltered side have pasture and extensive reedbed on peaty soil.

Sampling

Three areas were selected for sampling from 2/7 –4/8/98:
(1) (B 722 095) A narrow (c 0.4 m) strip of shore vegetation with *Juncus gerardii*, grasses, *Glaux maritima, Juncus maritimus, Plantago maritima* and *Triglochin maritima*, on a peaty soil with boulders, and with a small (c. 0.25 m) cliff to the standing lake water. Salinity offshore was 4‰ (2 vii 1998).
(2) (B 721 092) A dense tall reedbed (*Phragmites australis*) on peaty soil with probable otter (*Lutra lutra*) tunnel tracks with deep compacted shaded reed litter. Standing water was present only in the outer part of the reedbed; the salinity of this water was 22 ‰ (2 vii 1998).
(3)(B 723 096) An area of wet reed and rush litter debris on coarse sand, on the northern shore.

Results

Nine species of carabid, twenty-seven species of staphylinid and one species of pselaphid were recorded, one of which is regarded as an indicator species (Tables 2 and 3).

Atheta aquatilis was only recently recorded as Irish, from Lynn Lagoon, Larne Lough in Co. Antrim (Anderson et al., 1997). It is local in Britain (Hyman and Parsons, 1994), and uncommon in Central Europe and Scandanavia (Palm, 1970; Benick and Lohse, 1974). It is a stenotopic species restricted to moss and litter in flooded shaded habitats, springs, flushes and wet woodland (Palm, 1970; Koch, 1989; Hyman and Parsons, 1994).

TABLE 2. Staphylinidae and Pselaphidae from saline lake peaty shores at Maghery Lough, Sally's Lough, Kincas Lough and Moorlagh (Co. Donegal). The same sampling techniques and effort were used at each site, with the exception of Maghery where shore debris and Phragmites litter was sieved. Indicator species are marked with an asterisk.

	Maghery	Sally's	Kincas	Moorlagh
Aleochara lanuginosa Grav.	1	-	-	-
Anotylus rugosus (Fab.)	1	-	-	-
Atheta aquatilis (Thoms.) *	3	-	-	-
Atheta fungi (Grav.)	1	-	-	7
Atheta graminicola (Grav.)	1	-	-	-
Bryaxis bulbifer (Reich.)	1	-	-	-
Cordalia obscura (Grav.)	1	1	-	-
Gyrohypnus angustatus Steph.	1	-	-	-
Lathrobium boreale Hochhuth	1	-	1	-
Lathrobium terminatum Grav.	5	-	2	-
Lesteva sicula Er.	17	-	-	-
Myllaena brevicornis (Matth.)	3	-	-	-
Myllaena infuscata (Kr.)	1	-	-	-

Olophrum fuscum (Grav.)	1	-	-	3
Olophrum piceum (Gyll.)	1	-	-	-
Oxypoda elongatula Aubé	1	-	-	1
Philonthus varians (Payk.)	1	-	-	-
Quedius maurorufus (Grav.)	10	-	-	-
Quedius nitipennis (Steph.)	3	-	-	-
Rugilus erichsoni (Fauv.)	1	-	-	-
Staphylinus dimidiaticornis Gemm.	16	18	8	-
Stenus bimaculatus Gyll.	6	-	-	-
Stenus brunnipes Steph.	3	-	6	1
Stenus clavicornis (Scop.)	3	6	-	-
Stenus juno (Payk.)	1	-	2	3
Tachinus marginellus (Fab.)	1	-	-	-
Tachinus signatus Grav.	5	27	-	4
Xantholinus linearis (Ol.)	1	-	-	-
Aloconota gregaria (Er.)	-	1	-	-
Amischa analis (Grav.)	-	1	-	-
Atheta amplicollis (Muls. Rey)	-	3	-	13
Atheta celata (Er.)	-	1	-	-
Ocypus aeneocephalus (DeGeer)	-	2	-	-
Philonthus cognatus Steph.	-	2	-	-
Philonthus laminatus (Creutz.)	-	5	-	-
Pselaphus heisei Herbst	-	1	-	1
Quedius fuliginosus (Grav.)	-	2	1	-
Reichenbachia juncorum (Leach)	-	1	-	3
Xantholinus longiventris Heer	-	2	-	-
Bryaxis bulbifer (Reich.)	-	-	2	23
Carpelimus corticinus (Grav.)	-	-	1	-
Dinaraea angustula (Gyll.)	-	-	1	-
Euaesthetus bipunctatus (Ljungh)	-	-	1	-
Gabrius coxalus (Hochh.)	-	-	1	-
Mycetoporus splendidus (Grav.) agg.	-	-	1	-
Lathrobium brunnipes (Fab.)	-	-	1	-
Ocypus olens (Müll.)	-	-	1	-
Othius punctulatus (Goeze)	-	-	1	-
Stenus canaliculatus Gyll.	-	-	7	-
Stenus fulvicornis Steph.	-	-	3	8
Stenus impressus Germ.	-	-	1	21
Stenus nitens Steph.	-	-	1	-
Stenus nitidiusculus Steph.	-	-	1	7
Tachyporus dispar (Payk.)	-	-	1	9
Gabrius trossulus (Nordm.)	-	-	-	1
Geostiba circellaris (Grav.)	-	-	-	2
Othius angustus Steph.	-	-	-	1
Quedius nemoralis Baudi	-	-	-	1
Stenus cicindeloides (Schall.)	-	-	-	1
Stenus pusillus Steph.	-	-	-	1
Tachyporus nitidulus (Fab.)	-	-	-	1

TABLE 3. Carabidae from saline lake peat shores with Juncus and grasses at Maghery Lough, Sally's Lough, Kincas Lough and Moorlagh (Co. Donegal). The same sampling techniques and effort were used at each site, with the exception of Maghery where shore debris occurred. Indicator species are marked with an asterisk.

	Maghery	Sally's	Kincas	Moorlagh
Agonum thoreyi Dej.	76	2	1	-
Bembidion mannerheimi Sahlb.	3	2	6	2
Elaphrus cupreus Dufts.	1	-	5	1
Leistus fulvibarbis Dejean	1	-	-	-
Leistus terminatus (Hellw.)	1	-	-	-
Loricera pilicornis (Fab.)	1	-	-	-
Pterostichus diligens (Sturm)	6	-	1	3
Pterostichus niger (Schal.)	1	-	-	-
Pterostichus nigrita (Payk.)	2	-	1	-
Agonum fuliginosum (Panz.)	-	5	2	-
Harpalus rufipes (DeGeer)	-	1	-	-
Notiophilus palustris (Dufts.)	-	1	1	-
Pterostichus crenatus (Dufts.)	-	5	3	-
Pterostichus strenuus (Panz.)	-	1	-	4
Pterostichus versicolor (Sturm)	-	1	-	-
Abax parallelepipedus (Pil. & Mit.)	-	-	1	-
Carabus granulatus L.	-	-	4	-
Dromius linearis (Ol.)	-	-	6	-
Pterostichus melanarius (Ill.)	-	-	1	-
Pterostichus minor (Gyll.)	-	-	1	-
Agonum albipes (Fab.)	-	-	-	6
Dromius melanocephalus Dej.	-	-	-	1
Nebria brevicollis (Fab.)	-	-	-	1
Ocys harpaloides (Serv.)	-	-	-	3

Evaluation

The presence of only one indicator species indicates low conservation value. The site is relatively isolated geographically, and the indicator species has not been reported in the available literature as being halotolerant.

SUMMARY

Maghery Lough is the best example in Donegal of a shallow silled lake with more or less stable polyhaline conditions and the only lagoon with ***Lamprothamnium.*** Also notable was the presence of the high salinity ***flabellatus*** form of *Potamogeton pectinatus.* A poorly developed red algal community was present on rocks. The fauna was moderately diverse with both marine and limnetic fauna and a dense population of the soft clam *Mya arenaria.* Ecotonal Coleoptera included one local indicator species only recently discovered in Ireland (Larne L.).

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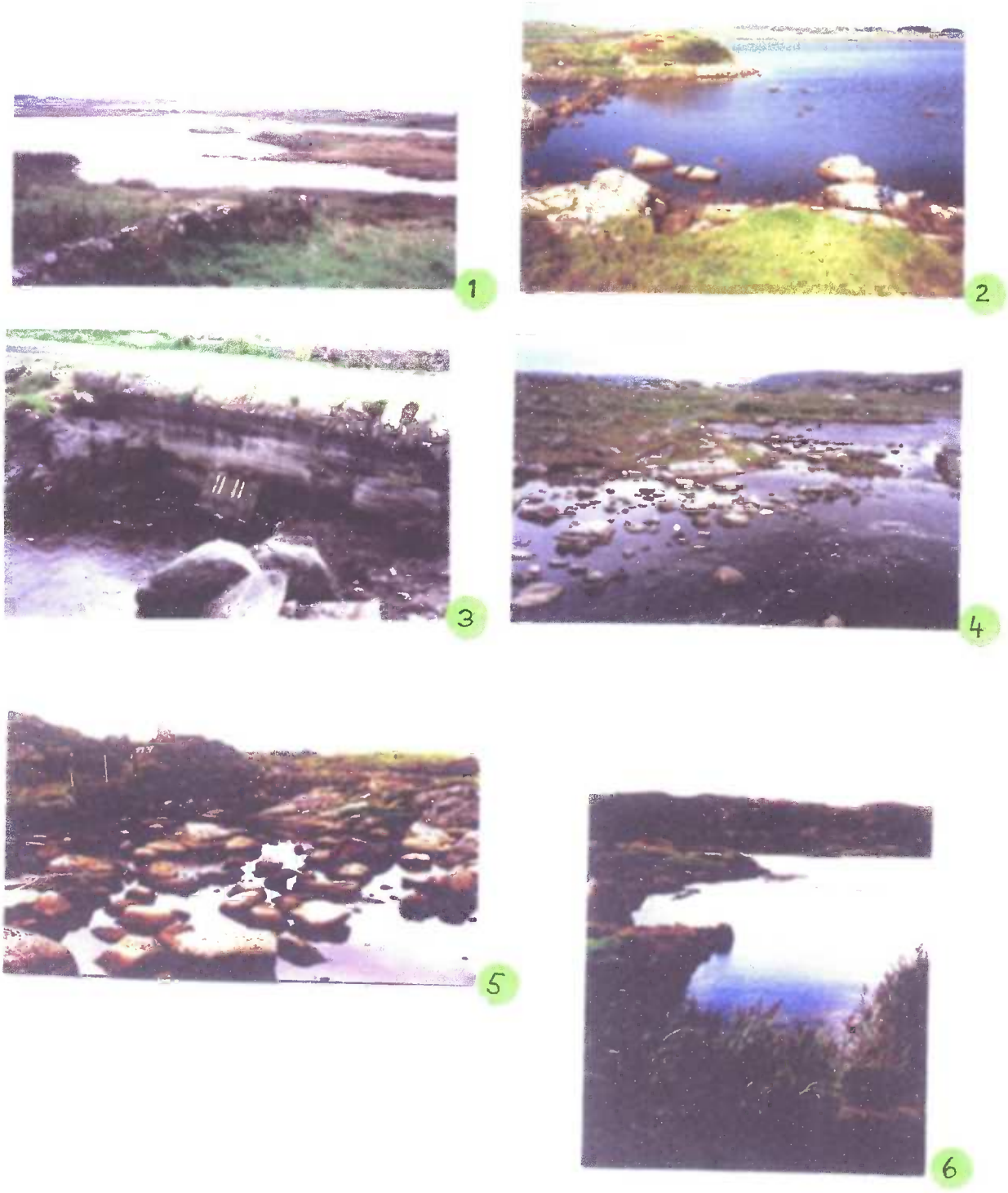

Plate 12. Maghery Lough, Co. Donegal. 1. Looking towards the sea from the north road; 2. East shore (faunal Stn 2); 3. Outlet with jammed sluice flap; 4. Shallow area near outlet; 5. Northwest corner near the outlet; 6. Southeast corner.

13. SALLY'S LOUGH, Co. Donegal

Sally's Lake

Location: B 718168; 54°59.7'N, 8°26.5'W. OS Sheet 1.
3 km north of Burtonport.

Lagoon type	saline lake lagoon with artificial inlet
Area	c10 ha
Salinity regime	poly-euhaline (29-34‰)
Maximum depth	5 m
Seawater entry	unsluiced, artificial outlet
Tidal range	exceptionally reaching 1 m
Conservation status	NHA No. 1141

Origin and history

This was apparently once a freshwater lake which became saline following excavation of a channel to the sea which would have involved blasting a ravine through rocks. The date of the works is not known. There are remains of a sluice but it is obviously some time since it was destroyed.

Geology, geomorphology and landscape

The lagoon lies in a landscape of small steep hills with winding roads, and many outcrops of Rosses granite.

Description of the system

The lagoon is long and narrow, lying in an east-west orientated valley between steep-sided hills with cliffs in places. The surrounding land is mainly heathland and rough pasture lightly grazed by cattle. The shores are mostly rocky and the bed shelves steeply except in an area on the north shore which is flat and peaty, with saltmarsh and a *Phragmites* bed, and at the west end where the lagoon narrows towards the outlet. The water here is shallower and the shores grassy. Where the lake narrows near its centre, steep granite cliffs drop to the lake floor at 4-5 m and a large submerged rock rises to within 1.5 m from the surface. The depth in the centre is 2.5-4 m and the substrate black, organic silt, with fine sand or gravel near the shores or fibrous peat below the salt mash on the north shore.

Easy access to the lagoon is limited to three points on the north shore.

Hydrology

A high salinity of 29-34‰ in 1996 and 1998 indicates a strong tidal flow and good mixing. Lower salinity could occur during periods of heavy rainfall which coincide with neap tides but is unlikely to persist. There are no significant point sources of fresh water, except possibly a drainage ditch by the saltmarsh on the north shore. A tidal range of about 1 m was observed during an exceptionally high spring tide in September, and water on this occasion flooded a road. Such tides only occur on a few days each year, however.

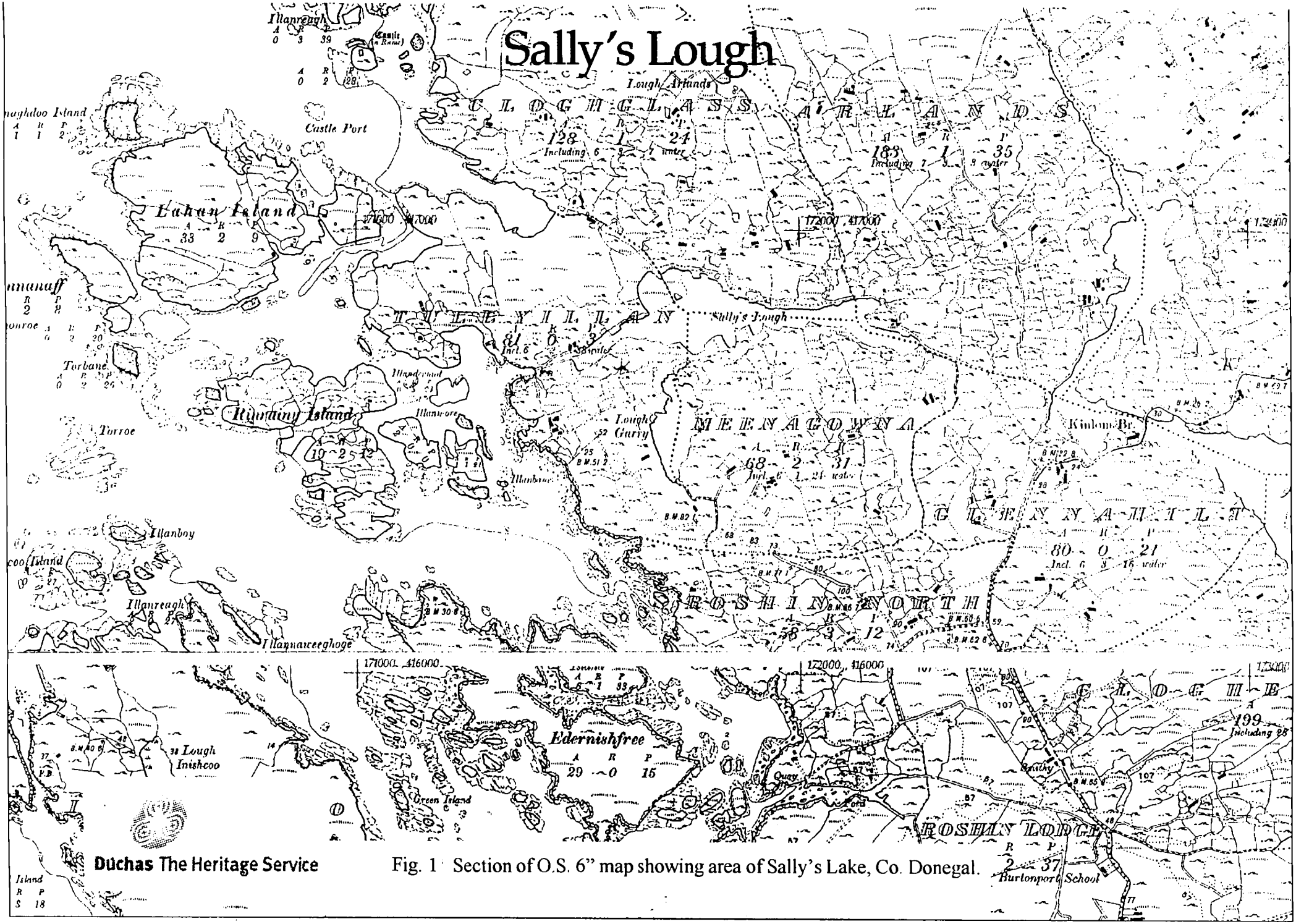

Fig. 1 Section of O.S. 6" map showing area of Sally's Lake, Co. Donegal.

Exploitation and threats

Small scale culture of Japanese oyster has been carried out for some time near the west end without obvious adverse effects to the biota. A licence to expand this venture has been refused. The black, anaerobic silt on the lagoon bed appears to be due to decomposing algae, and excess nutrients from agriculture or domestic sources are not suspected. The effect of repairing the sluice would be to lower the salinity, altering the composition of the lagoonal community and possibly affecting the important benthic vegetation. At present it appears to be unnecessary.

VEGETATION

Sally's lough is situated in an area of small granite hills separated by deep valleys. The surrounding country has an irregular topography, while the lake itself is bordered by cliffs and rocky ground except for an area of saltmarsh at the northwest end.

Underwater observations

This is a long lake joined to the sea by a narrow channel. The eastern part of the lake is shallow (2m) and floored with sand and soft mud. *Chaetomorpha linum* is common, *Ruppia* sp. and drifts of *Cladophora battersii* are occasional. Where the lake narrows (point 20) the bottom falls to 4-5m. Steep granite submerged cliffs drop to the lake floor. A very large submerged rock reaches to within 1.5m of the surface. Its vertical sides support a moderately diverse marine algal community. In the western part of the lake, the lake floor is at 3-4m, while *C. linum* and *C.battersii* occur, but *Ruppia* sp. was not found.

Sampling

The lake was surveyed on 6-7/9/1998. Marginal vegetation was sampled, benthic vegetation was examined by snorkelling and a phytoplankton sample taken.
6/09/1998
1-11 (17164168) were made in a large flat area of salt marsh.
12-17 (17164168) were made in small rock surrounded bays on the south shore.
18-22 (17194168) were made in the sublittoral.

Results

Sally's Lough is deep high salinity lagoon with areas of rock, underwater cliff and mud. The benthic vegetation includes macroalgae and *Ruppia* sp. The eastern shallower part of the lake (19,22) includes a sparse population of non-flowering *Ruppia* growing amongst *Chaetomorpha linum* and *Cladophora battersii*. In the deeper western part (20) large areas of bare mud and *Cladophora battersii* occur, a small amount of *Cladophora laetevirens* was also found.

Extensive underwater cliffs occur in the southwestern quarter, these support a moderately diverse macroalgal flora (21). *Furcellaria lumbricalis, Phyllophora pseudoceranoides, P. crispus, Anfeltia plicata, Chondrus crispus, Corallina officinalis, Coccotylus truncata, Plocamium cartilagneum, Dictyota dichotoma, Codium fragile tomentosum* and *Cladophora rupestris* are the predominant species. A reduced version of this flora occurs on rocks at (18) with coils of *Chaetomorpha linum* overlying on rocks with *Chondrus crispus, Phyllophora pseudoceranoides* and *Gracilaria gracilis*. Occasional brown algae including *Ascophyllum nodosum, Fucus spiralis* and *F. vesiculosus* were recorded close to the surface. This algal vegetation corresponds to OB23/OB24 of Covey and Thorpe.

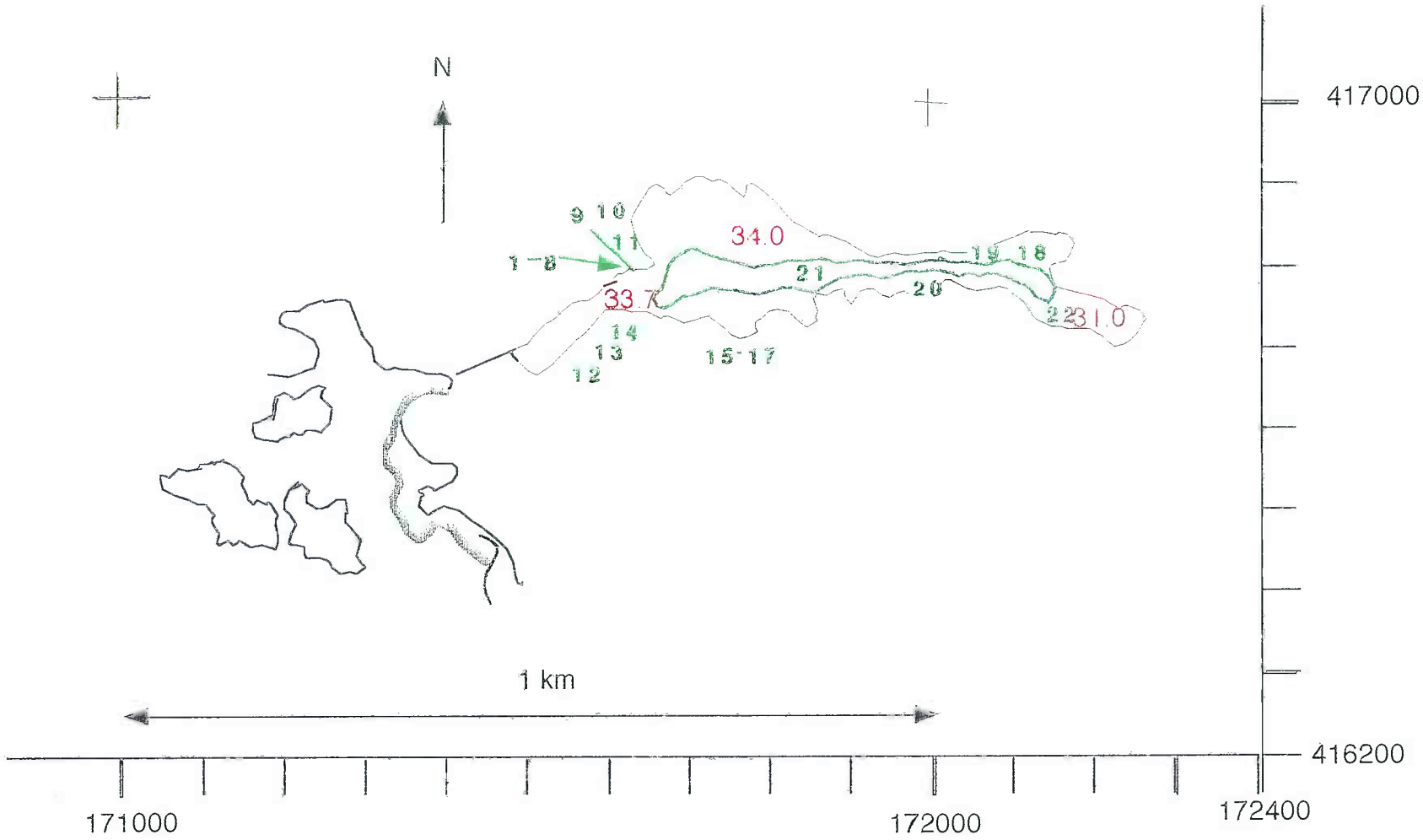

Fig. 2 Sketch map of Sallys Lake, Co. Donegal, showing sampling stations, 1998.

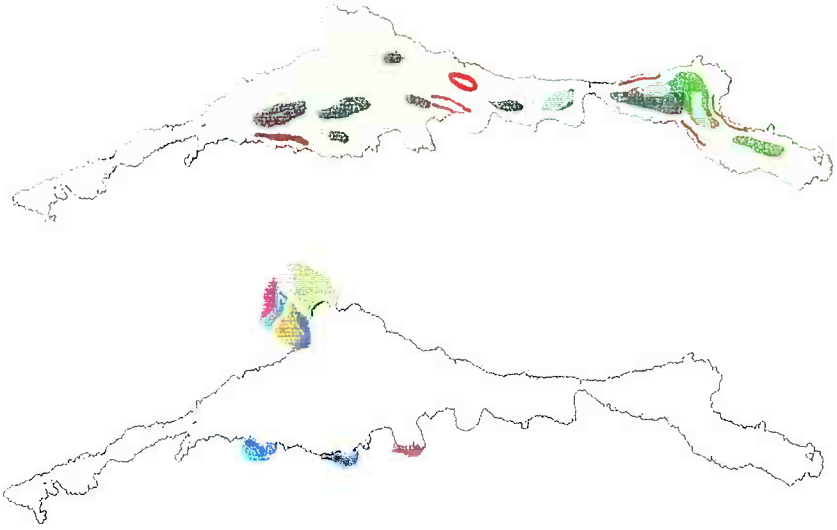

Fig. 3 Benthic and marginal vegetation of Sallys Lough

The phytoplankton of the lake was dominated by dinoflagellates, especially *Prorocentrum scutellatum*, a brackish water species. It occurred in huge quantities to judge from the density of the net haul.

Emergent vegetation includes a large stand of *Phragmites australis* and *Scirpus maritimus* (11).

The marginal vegetation includes a small area of salt marsh with Puccinellietum, *Juncus gerardii* and *Scirpus maritimus* communities present. The *Blysmus rufus* association was present in two places (1-10, 12-15). Much of the shoreline consists of rocky cliffs with some patches of grassland or saltmarsh by the shore, (16-17).

Notable plants

Cladophora battersii is a very rare alga which grows unattached on the lagoon bed. Its presence has been confirmed by Prof.. C. Van den Hoek, who also found *C. laetevirens* intermixed with it. *C. laetevirens* is common on Irish coasts. *Blysmus rufus* is common in two other places. This plant however is commoner in the north of Ireland than in the south and west (Scannell and Synott 1987).

Assessment

Sally's Lough is one of two sites where *C. battersii* was found. This probably rare species is common in the Lough. The remaining sublittoral vegetation was unexceptional and perhaps rather species poor given the size and depth of the site. Marginal vegetation is diverse but only covers a small area. There are no obvious threats to the vegetation even though a small neglected oyster farm operates near the entrance. Some dumped rubbish was seen under water.

AQUATIC FAUNA

Description

Sally's Lough is an (artificial ?) saline lake lagoon with tidal narrows. The lake covers approximately 10 ha and lies 3 km to the north of Burtonport (Fig. 4.13.1). According to local information it was formerly a freshwater lake which became tidal following excavation of a channel to the sea. Seawater enters the lake on most tides but the lake is surrounded by hills and is diluted by rainfall running off the surrounding hills. Depth is up to 4 m in the centre of the lake and salinity at the time of sampling was close to that of seawater (29.5 -34.3 ppt) throughout the lough, although 28 ppt was recorded in June 1998. Substrate was granite rock, stones and coarse sand with a deep layer of fine organic silt in sheltered areas and in parts of the centre. The lough is bordered by granite hills and moorland, rough grazing and *Phragmites* at the western end.

Sampling stations

The area was sampled briefly in June 1996, on 29/6/98 and from 5-7/9/98.

Five sampling stations were selected to reflect the influences of substrate, vegetation, freshwater and tidal inflows (Fig. 4). GPS positions at this site appear to be inaccurate.

Station 1 (B 72318 16688 ?) was located at the eastern end of the lake near the road. Depth varied from 0-1m and salinity measured 33.7 ppt. Substrate consisted of fine sand, coarse gravel and occasional stones overlain with peaty silt. The area was bordered by moorland, granite outcrops and rough grazing.

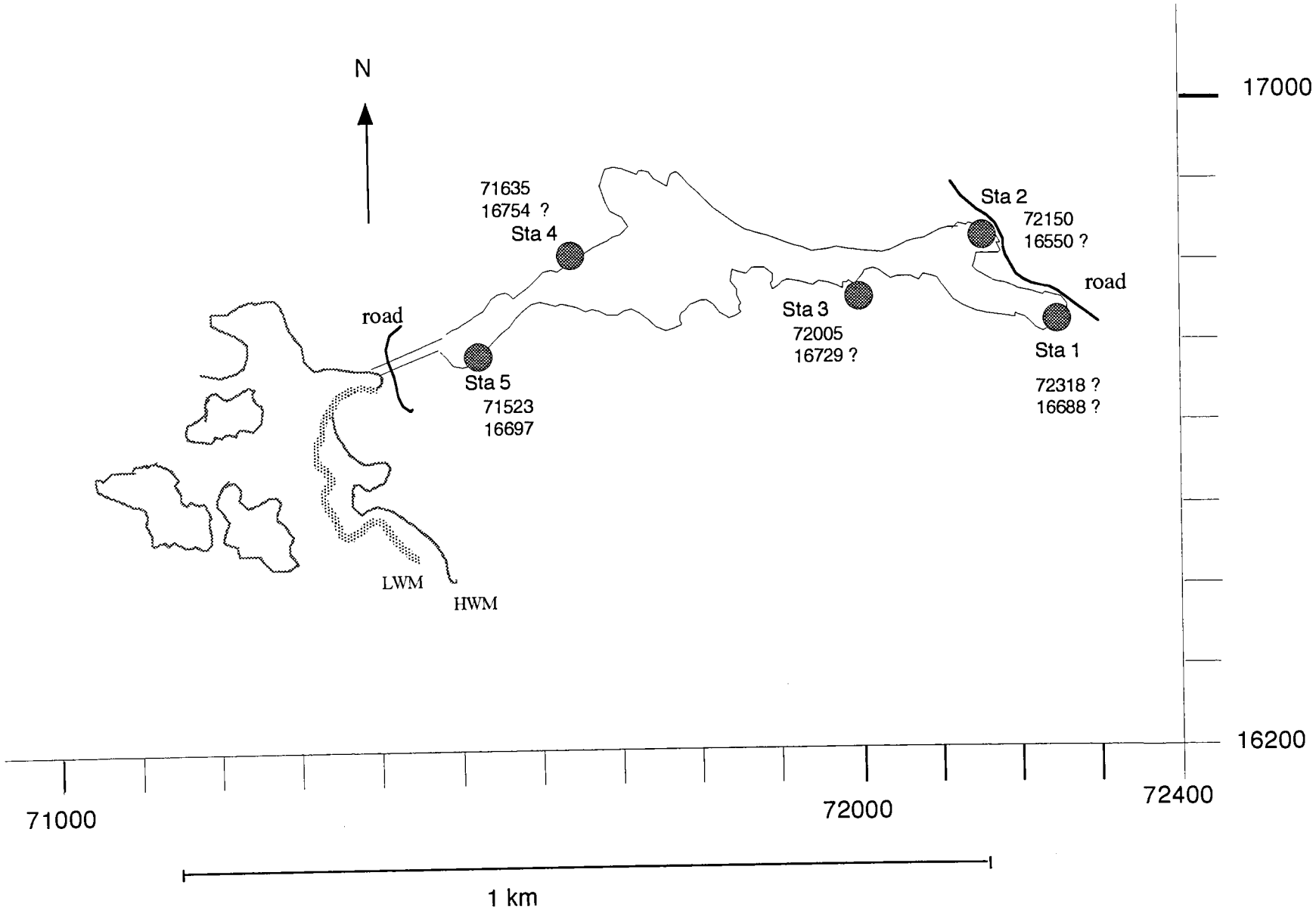

Fig. 4 Sketch map of Sally's Lake, Co. Donegal, showing sampling stations used for a survey of aquatic fauna, 1998.

Station 2 (B 72150 16550 ??) was located at the eastern end about 150 m from Sta 1. Depth varied from 0-1m and salinity measured 34 ppt. Substrate consisted of rock and stones along the shoreline with a deep layer of organic silt with decaying algae.

Station 3 (B 72005 16729) was located in a small bay on the south shore of the lough. Depth was up to 1.5m and salinity measured 33.4 ppt. Substrate was granitic sand and gravel with rocks and stones with finer organic silt in sheltered places.

Station 4 (B 71635 16754 ?) was located on the north shore of the widest part of the lough bordered by *Phragmites* and wet grassland. Depth was 0 - 0.5 m and salinity measured 29.5 - 31.5 ppt. Substrate consisted of fine organic silt and sand with coarse saltmarsh peat.

Station 5 (B 71523 16697) was located at the western end of the lough close to the artificial channel at the mouth of the lough. Depth was 0.2 - 1m and salinity measured 33.5ppt. Substrate consisted of fine sand with organic silt. The area was bordered by wet grassland saltmarsh.

Results

Table 1 shows the total species list for each station. The following is a list of species arranged in broad ecological categories based on the Venice system of salinity regimes (L* = lagoonal specialist in Britain):

Marine
- *Anthopleura ballii*
- *Lumbrinereis gracilis*
- *Platynereis dumerili*
- *Polyophthalmus pictus*
- *Pomatoceros sp.*
- *Scoloplos armiger*
- Spirorbidae indet.
- Sipunculidea indet.
- **Ampithoe ramondi*
- *Dexamine spinosa*
- *Microdeutopus anomalous*
- **Lembos longipes*
- *Cancer pagurus*
- *Asterias rubens*
- *Leptosynapta inhaerens*
- *Alcyonidium gelatinosum*
- *Clavelina lepadiformis*

Marine-polyhaline
- *Arenicola marina*
- *Corophium volutator*
- *Notodelphys sp*
- *Praunus flexuosus*
- *Crangon crangon*
- *Palaemon elegans*
- *P. serratus*
- *Littorina saxatilis*
- *Rissoa parva*
- *Mytilus edulis*
- *Ostrea edulis*
- *Amphipholis squamata*
- *Bowerbankia gracilis*
- *Cryptosula pallasiana*
- *Ascidiella aspersa*
- *Gobius niger*

Poly-mesohaline
- *Onoba aculeus* L*
- *Cerastoderma glaucum* L*
- *Pomatoschistus microps*

Euryhaline
- *Idotea chelipes* L*
- *Gammarus duebeni*
- *G. zaddachi*
- *Carcinus maenas*
- **Conopeum seurati* L*
- *Anguilla anguilla*
- *Gasterosteus aculeatus*
- Mugilidae indet.
- *Pleuronectes flesus*

A total of 49 taxa were recorded, of which 4 are regarded as lagoonal specialists in Britain and 3 species are possibly rare:

Conopeum seurati has been recorded at 16 of the 36 sites surveyed, but is not listed in a recent review of Irish marine Bryozoa (Wyse Jackson, 1991). Either the species is under recorded or a truly lagoonal specialist.

Ampithoe ramondi was recorded at Drongawn L. in 1996 and at Kilmore L., L. an Aibhnín, and L. Athola in 1998. According to Lincoln (1979) all records from

Britain are in the southwest. The record from this site may be the most northerly record for the species.

Lembos longipes was also recorded at Kilmore L. and L. an Aibhnin during this survey and at Drongawn L. and Furnace L. during the 1996 survey. There are only 3 previous records for Ireland (Costello *et al.* 1990).

Table 1 Aquatic fauna recorded at sampling stations in Sally's Lough, 1998.

Taxa		1	L.T. 1	2	L.T. 2	mid	3	L.T.3	4	L.T. 4	5
Cnidaria	*Anthopleura ballii*	c		a		a	a		a		a
Nemertea	indet.					+					
Annelida	*Arenicola marina*						c				
	Lumbrinereis gracilis					a					
	Platynereis dumerili					c					
	Polyophthalmus pictus					c					
	Pomatoceros sp.										+
	Scoloplos armiger					a					
	Spirorbidae indet.								+		+
Sipuncula	indet.						+				
Crustacea											
Ostracoda											a
Copepoda	*Notodelphys sp.*			+					+		+
Mysidacea	*Praunus flexuosus*	a	15	a	78	c	c	35	c	37	c
Isopoda	*Idotea chelipes*	o					+				
	Jaera sp.	1	1								+
Amphipoda		o	2	o	1	a	c	2	a	1	9
	Ampithoe ramondi					c	+		1		
	Corophium volutator	o	1	a		o	1	1	c		1
	Dexamine spinosa						1		1		
	Gammarus duebeni			o	1			1	1		
	G. zaddachi								1		
	Microdeutopus anomalous		1	o		a	8		32	1	9
	Lembos longipes								1		
Decapoda	*Cancer pagurus*								F=1		
	Carcinus maenas	F=65		+		+	+		F=35		+
	Crangon crangon										c
	Palaemon elegans	+		+		+		+	+		+
	P. serratus			+					+		
Acarina	indet.										+
Insecta	*Chironomidae*	+		+							

L.T. = light trap. F = Fyke net. + = present, o = occasional, c = common, a = abundant.

Table 1 cont.

Taxa		1	L.T. 1	2	L.T. 2	mid	3	L.T.3	4	L.T.4	5
Mollusca											
Prosobranchia	*Littorina saxatilis*	l		+			+				
	Onoba aculeus	o					+		+		
	Rissoa parva	+		+		l	+		+		+
	Skeneopsis planorbis			shells					shells		
Bivalvia	*Cerastoderma glaucum*	spat		spat		spat	spat		spat		spat
	Mya arenaria	shells		shells			shells		shells		shells
	Mytilus edulis								+		
	Ostrea edulis								+		
Bryozoa	*Alcyonidium gelatinosum*						+				
	Bowerbankia gracilis			+							
	Conopeum seurati			a							
	Cryptosula pallasiana	+					+				+
Echinodermata	*Amphipholis squamata*	c		c		c	c		c		c
	Asterias rubens										l
	Leptosynapta inhaerens			+		c			c		
Tunicata	*Ascidiella aspersa*	+		+			+		+		+
	Clavelina lepadiformis					+	+		+		+
Pisces	*Anguilla anguilla*	F=3		F=4			+		F=5		
	Gasterosteus aculeatus	+			3		o	2			
	Gobius niger	+							F=2		c
	Pleuronectes flesus			F=1							
	Pomatoschistus microps	+	10	+	5		+		+		c

Evaluation

The fauna of Sally's Lough is moderately rich but this is largely due to the marine influence. 4 species are listed as lagoonal specialists in Britain. Three species are possibly rare.

It seems that this lagoon is at least partly artificial and much of the central parts are covered in a deep layer of anoxic organic silt which supports very little fauna. Most of the species are marine or marine-polyhaline which presumably can enter or leave the lagoon quite freely depending on environmental conditions.

The lagoon is situated in an area of unspoilt natural beauty but the lagoon itself is not a particularly good example of its type.

ECOTONAL COLEOPTERA

This is a saline lake lagoon with an artificial inlet/outlet channel, mostly with rock/boulder shores and an area of peat shore with reed-beds and pasture near the outlet channel. Much of the reed-bed was utilized by cattle and partially flooded at the

time of sampling.

Sampling

Two areas were selected for sampling from 3/7 –4/8/98:
(1) (B 714 164) A narrow (several m) pasture margin on peat with *Juncus gerardii, Festuca rubra, Plantago maritima, Glaux maritima*, and *Triglochin maritima*, grading to grassland inland and with *Armeria maritima* sward towards the open water. (2) (B715 165) A moderately dense reed-bed on peat with *Phragmites australis, Juncus gerardii, Armeria maritima, Glaux maritima, Plantago maritima* and *Aster tripolium*, but with sparser plant cover (bare areas occurring) than at subsite 1. More frequent flooding occurs at this subsite.

Results

A total of eight species of carabid, thirteen species of staphylinid and two species of pselaphid were recorded, none of which are regarded as indicator species (Tables 2 and 3).

TABLE 2 Staphylinidae and Pselaphidae from saline lake peaty shores at Maghery Lough, Sally's Lough, Kincas Lough and Moorlagh (Co. Donegal). The same sampling techniques and effort were used at each site, with the exception of Maghery where shore debris and *Phragmites* litter was sieved. Indicator species are marked with an asterisk.

	Maghery	Sally's	Kincas	Moorlagh
Aleochara lanuginosa Grav.	1	-	-	-
Anotylus rugosus (Fab.)	1	-	-	-
Atheta aquatilis (Thoms.) *	3	-	-	-
Atheta fungi (Grav.)	1	-	-	7
Atheta graminicola (Grav.)	1	-	-	-
Bryaxis bulbifer (Reich.)	1	-	-	-
Cordalia obscura (Grav.)	1	1	-	-
Gyrohypnus angustatus Steph.	1	-	-	-
Lathrobium boreale Hochhuth	1	-	1	-
Lathrobium terminatum Grav.	5	-	2	-
Lesteva sicula Er.	17	-	-	-
Myllaena brevicornis (Matth.)	3	-	-	-
Myllaena infuscata (Kr.)	1	-	-	-
Olophrum fuscum (Grav.)	1	-	-	3
Olophrum piceum (Gyll.)	1	-	-	-
Oxypoda elongatula Aubé	1	-	-	1
Philonthus varians (Payk.)	1	-	-	-
Quedius maurorufus (Grav.)	10	-	-	-
Quedius nitipennis (Steph.)	3	-	-	-
Rugilus erichsoni (Fauv.)	1	-	-	-
Staphylinus dimidiaticornis Gemm.	16	18	8	-
Stenus bimaculatus Gyll.	6	-	-	-
Stenus brunnipes Steph.	3	-	6	1
Stenus clavicornis (Scop.)	3	6	-	-
Stenus juno (Payk.)	1	-	2	3
Tachinus marginellus (Fab.)	1	-	-	-
Tachinus signatus Grav.	5	27	-	4
Xantholinus linearis (Ol.)	1	-	-	-
Aloconota gregaria (Er.)	-	1	-	-
Amischa analis (Grav.)	-	1	-	-
Atheta amplicollis (Muls. Rey)	-	3	-	13
Atheta celata (Er.)	-	1	-	-

Ocypus aeneocephalus (DeGeer)	-	2	-	-
Philonthus cognatus Steph.	-	2	-	-
Philonthus laminatus (Creutz.)	-	5	-	-
Pselaphus heisei Herbst	-	1	-	1
Quedius fuliginosus (Grav.)	-	2	1	-
Reichenbachia juncorum (Leach)	-	1	-	3
Xantholinus longiventris Heer	-	2	-	-
Bryaxis bulbifer (Reich.)	-	-	2	23
Carpelimus corticinus (Grav.)	-	-	1	-
Dinaraea angustula (Gyll.)	-	-	1	-
Euaesthetus bipunctatus (Ljungh)	-	-	1	-
Gabrius coxalus (Hochh.)	-	-	1	-
Mycetoporus splendidus (Grav.) agg.	-	-	1	-
Lathrobium brunnipes (Fab.)	-	-	1	-
Ocypus olens (Müll.)	-	-	1	-
Othius punctulatus (Goeze)	-	-	1	-
Stenus canaliculatus Gyll.	-	-	7	-
Stenus fulvicornis Steph.	-	-	3	8
Stenus impressus Germ.	-	-	1	21
Stenus nitens Steph.	-	-	1	-
Stenus nitidiusculus Steph.	-	-	1	7
Tachyporus dispar (Payk.)	-	-	1	9
Gabrius trossulus (Nordm.)	-	-	-	1
Geostiba circellaris (Grav.)	-	-	-	2
Othius angustus Steph.	-	-	-	1
Quedius nemoralis Baudi	-	-	-	1
Stenus cicindeloides (Schall.)	-	-	-	1
Stenus pusillus Steph.	-	-	-	1
Tachyporus nitidulus (Fab.)	-	-	-	1

TABLE 3. Carabidae from saline lake peat shores with *Juncus* and grasses at Maghery Lough, Sally's Lough, Kincas Lough and Moorlagh (Co. Donegal). The same sampling techniques and effort were used at each site, with the exception of Maghery where shore debris occurred. Indicator species are marked with an asterisk.

	Maghery	Sally's	Kincas	Moorlagh
Agonum thoreyi Dej.	76	2	1	-
Bembidion mannerheimi Sahlb.	3	2	6	2
Elaphrus cupreus Dufts.	1	-	5	1
Leistus fulvibarbis Dejean	1	-	-	-
Leistus terminatus (Hellw.)	1	-	-	-
Loricera pilicornis (Fab.)	1	-	-	-
Pterostichus diligens (Sturm)	6	-	1	3
Pterostichus niger (Schal.)	1	-	-	-
Pterostichus nigrita (Payk.)	2	-	1	-
Agonum fuliginosum (Panz.)	-	5	2	-
Harpalus rufipes (DeGeer)	-	1	-	-
Notiophilus palustris (Dufts.)	-	1	1	-
Pterostichus crenatus (Dufts.)	-	5	3	-
Pterostichus strenuus (Panz.)	-	1	-	4
Pterostichus versicolor (Sturm)	-	1	-	-

Abax parallelepipedus (Pil. & Mit.)	-	-	1	-
Carabus granulatus L.	-	-	4	-
Dromius linearis (Ol.)	-	-	6	-
Pterostichus melanarius (Ill.)	-	-	1	-
Pterostichus minor (Gyll.)	-	-	1	-
Agonum albipes (Fab.)	-	-	-	6
Dromius melanocephalus Dej.	-	-	-	1
Nebria brevicollis (Fab.)	-	-	-	1
Ocys harpaloides (Serv.)	-	-	-	3

Evaluation

The site does not have conservation value for ecotonal fauna, as no indicator species were found. The composition of the fauna indicates some anthropogenic nutrient enrichment may be occurring.

SUMMARY

Although partly artificial in origin, Sally's L. is a good poly-euhaline lagoon with some interesting features. Aquatic vegetation includes well developed but patchy *Cladophora battersii*, a lagoonal species rare in Europe and only recorded elsewhere during the lagoon surveys in L. Athola, and a moderately diverse red algal community. Aquatic fauna was moderately diverse, dominated by marine-polyhaline species, with abundant *Leptosynapta inhaerens* (sea cucumber) in the benthos, and four lagoonal specialists. Ecotonal Coleoptera were poor, with no indicator species.

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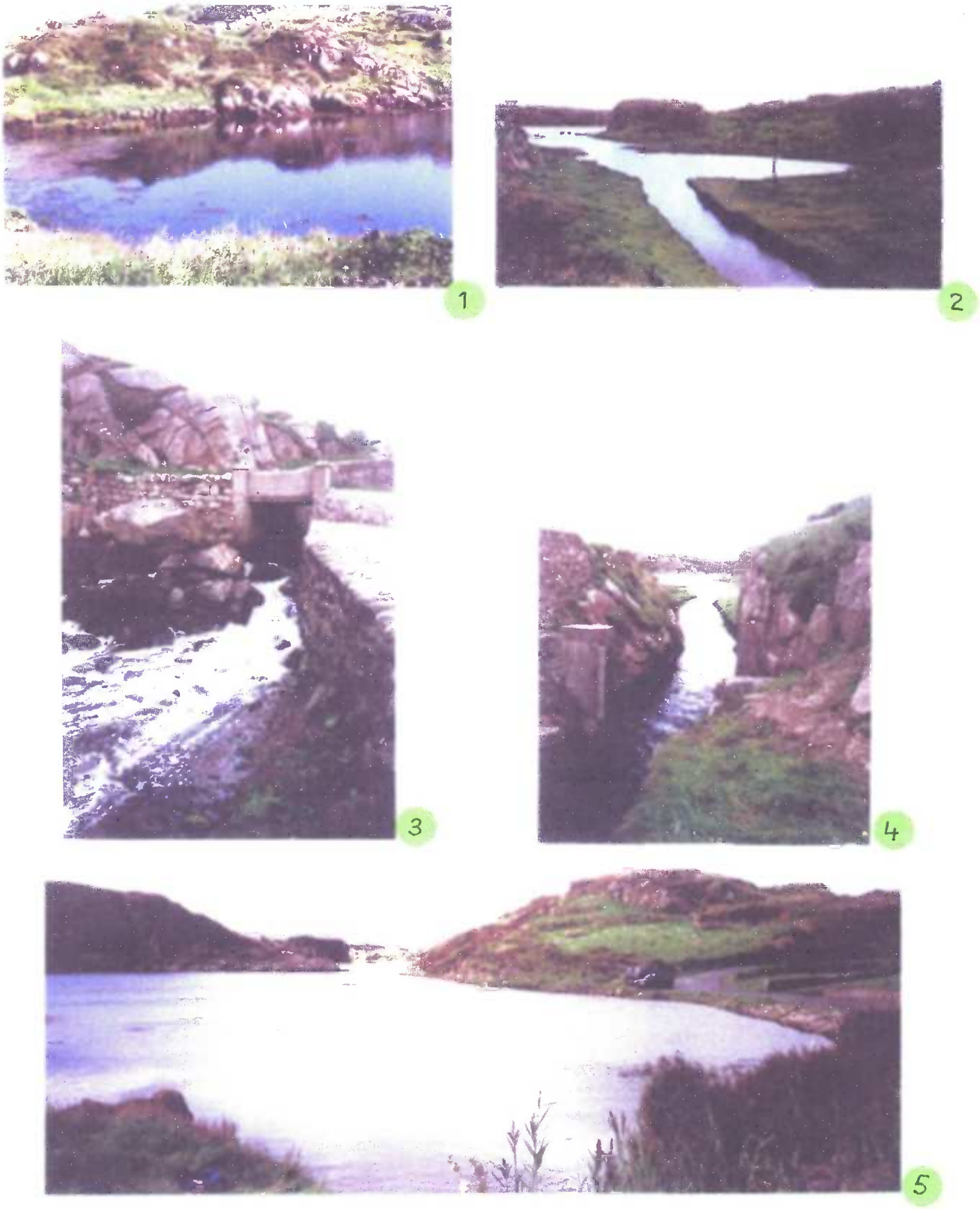


Plate 13. Sally's Lough, Co. Donegal. 1. East end of the lough (faunal Stn. 1), 2. Artificial outlet channel at west end (faunal Stn. 5), 3. Outlet seen from the sea at low water; 4. Outlet channel and remains of former sluice; 5. View from east end, faunal station 2 near cars on the right

14 KINCAS LOUGH, THE ROSSES, Co. Donegal

Loch Chionn Caslach

Location: B 752197; 55°01.5'N, 8°23'.0W. OS Sheet 1.
0.5 km east of Kincaslough.

Lagoon type	saline lake lagoon with modified silled inlet
Area	6 ha
Salinity regime	oligo-mesohaline at the surface, stratified
Maximum depth	5.5 m
Seawater entry	silled inlet
Tidal range	small
Conservation status	NHA No. 1141

Origin and history

The original lagoon has been altered within living memory but little could be discovered of its former conditions. Changes occurred following deepening of the natural stream which flowed into the lagoon from Mullaghderg L. which was needed to relieve flooding. It was then necessary to deepen the natural (?) outlet from Kincas L. to the sea. A sluice, probably installed at that time, is said never to have worked properly and is now broken.

Geology, geomorphology and landscape

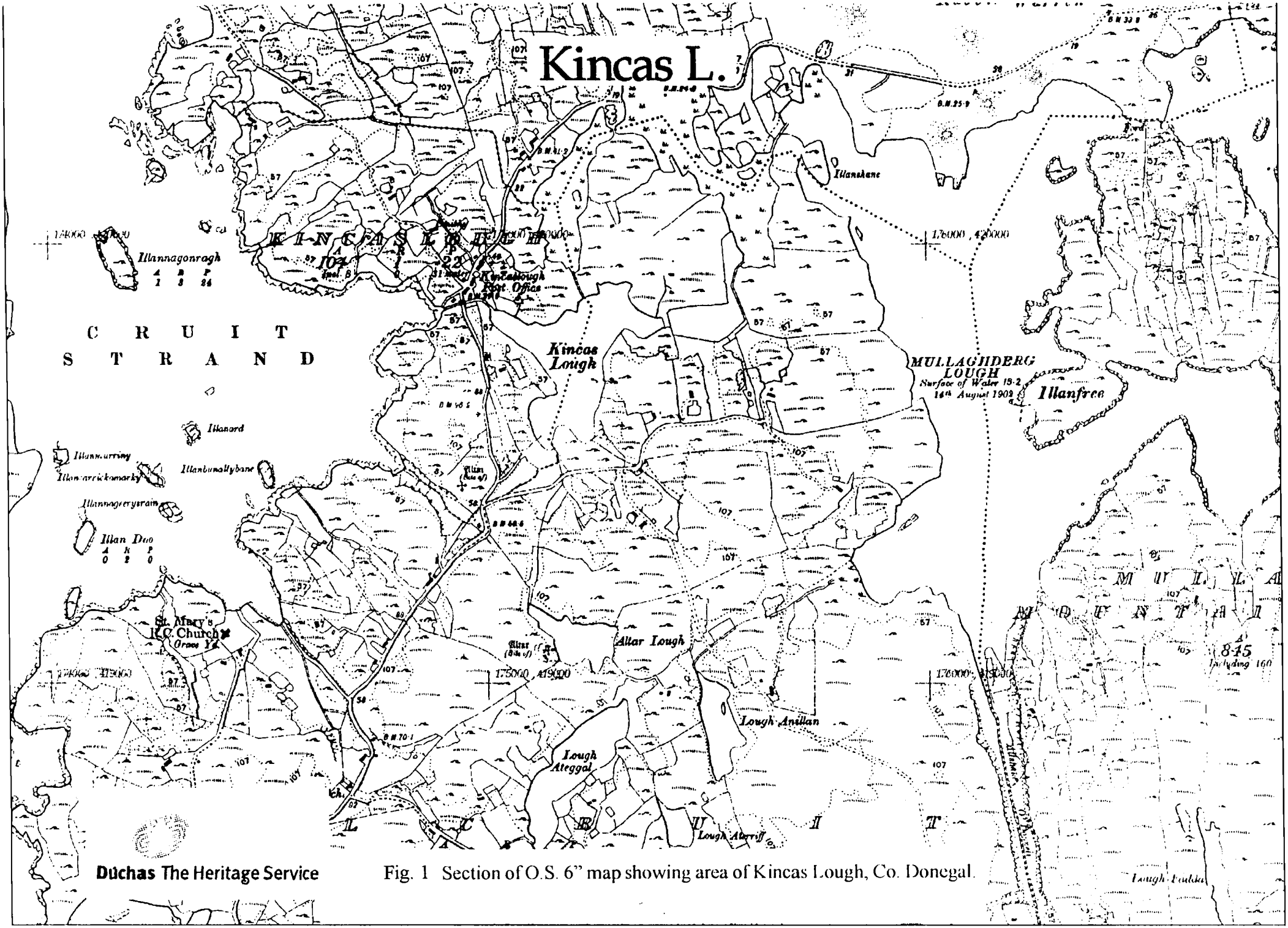
The lagoon is situated in the north-west part of The Rosses, a mountainous region with many lakes. The rock in the area is coarse-grained Rosses granite. Hills around the lagoon are steep-sided with deep, wooded valleys.

Description of the system

The lagoon is surrounded on all sides by hills, covered in most places with a species-rich heath community with *Juniperus communis, Arctostaphylos uva-ursis*, and *Empetrum nigra,* and deep, wooded ravines to the north-east. The shore is mainly rock and peat, with *Phragmites* beds in sheltered bays. There are wide reed beds in the south, and also on either side of the outlet channel which has straight sides indicating that the reeds may have been cleared to keep the channel open. Where the bed shelves gently, the substrate is gravelly with stones and rocks, but in most places rocky slopes descend steeply to 2-4 m. Below 1 m, the sediment is fine anoxic silt everywhere with white patches of *Beggiatoa*. The depth ranges from 1.5-3.5 in the west to 3.5-5.5 in the east. A road passes by the north shore of the lagoon providing easy access.

Hydrology

Seawater enters through the inlet only, and freshwater mainly from Mullaghderg L. The height of the sill, and therefore the frequency of tidal incursions, is not known. On 9 September 1998, during a spring tide and a period of high rainfall, the water was stratified, with a surface salinity of 9-15‰, a halocline at 0.5-1 m, and salinities below of 28-33.3‰. The water level at the time was exceptionally high due to heavy rain.



Dúchas The Heritage Service

Fig. 1 Section of O.S. 6" map showing area of Kincas Lough, Co. Donegal.

Exploitation and threats

There is no exploitation at present. Protection of Mullaghderg which is a trout fishery, and which will be necessary for the rare charophyte *Chara muscosa*, discovered during this survey, would result in clean effluent from it into Kincas L. The few houses around the lagoon are unlikely to cause significant nutrient enrichment, but there is a caravan park at Mullaghderg..

The lagoon contains no species or communities of special interest, and would not be harmed, therefore, by reinstallation of an effective sluice. A sluice would, in fact, reduce both the overall salinity and the amount of fluctuation, resulting in a more stable mesohaline regime which could be more favourable to fauna and vegetation.

Conservation status

The lagoon is part of an NHA. (and may be partly owned by the Rosses fishery)

VEGETATION

Kincas lough is situated in an area of small, steep rocky hills of granite.The surrounding hills carry a well developed heath with *Juniperus communis, Arctostaphylos uva-ursi, Empetrum nigrum* as well as commoner species such as *Erica cinerea and Calluna vulgaris*. The lake is connected to the sea by an artificially deepened channel. There is little marginal vegetation other than stands of *Phragmites australis*.

Underwater observations

This lake has extremely dark water, with little or no light penetrating below 3m. A surface stratified layer was evident. Because of bad light only a very imprecise idea of the sublittoral topography could be gained. Rocky slopes appear to descend to 2-4m. The bottom was muddy with white patches of *Beggiatoa* suggesting anoxia. *C. linum* formed dense masses along the slopes and a sparse *Ruppia* band grew near the surface.

The Lake was surveyed on two days (29/6/98 and 9/9/98) Benthic vegetation was surveyed by snorkelling, a plankton sample was taken.

Marginal vegetation was very difficult to survey as the water level was very high. The lake was difficult to survey as recent flooding had greatly reduced water transparency.

1 (17514198) was taken in the narrow shore zone. Unfortunately high water had flooded the site and it was difficult to make a complete plant list.
2-4 (17534198) were made on the steeply sloping lake bottom
50(17514198) was made on the shallow gravel sublittoral.

Results

Kincas is a deep stratified lagoon with a variety of benthic vegetation types . The sides of the lagoon are rocky with mud on the lake floor. In shallow water (50cm) *Chara aspera* stands occur on gravel. These were only found in one place (5).
Stands of *Ruppia cirrhosa* occur at 1m depth with *Cladophora vagabunda*.
Below 1-2m pure stands of often very dense *Chaetomorpha linum* occur.
Below 3-4m no further plants were found due to lack of light. Patches of a white

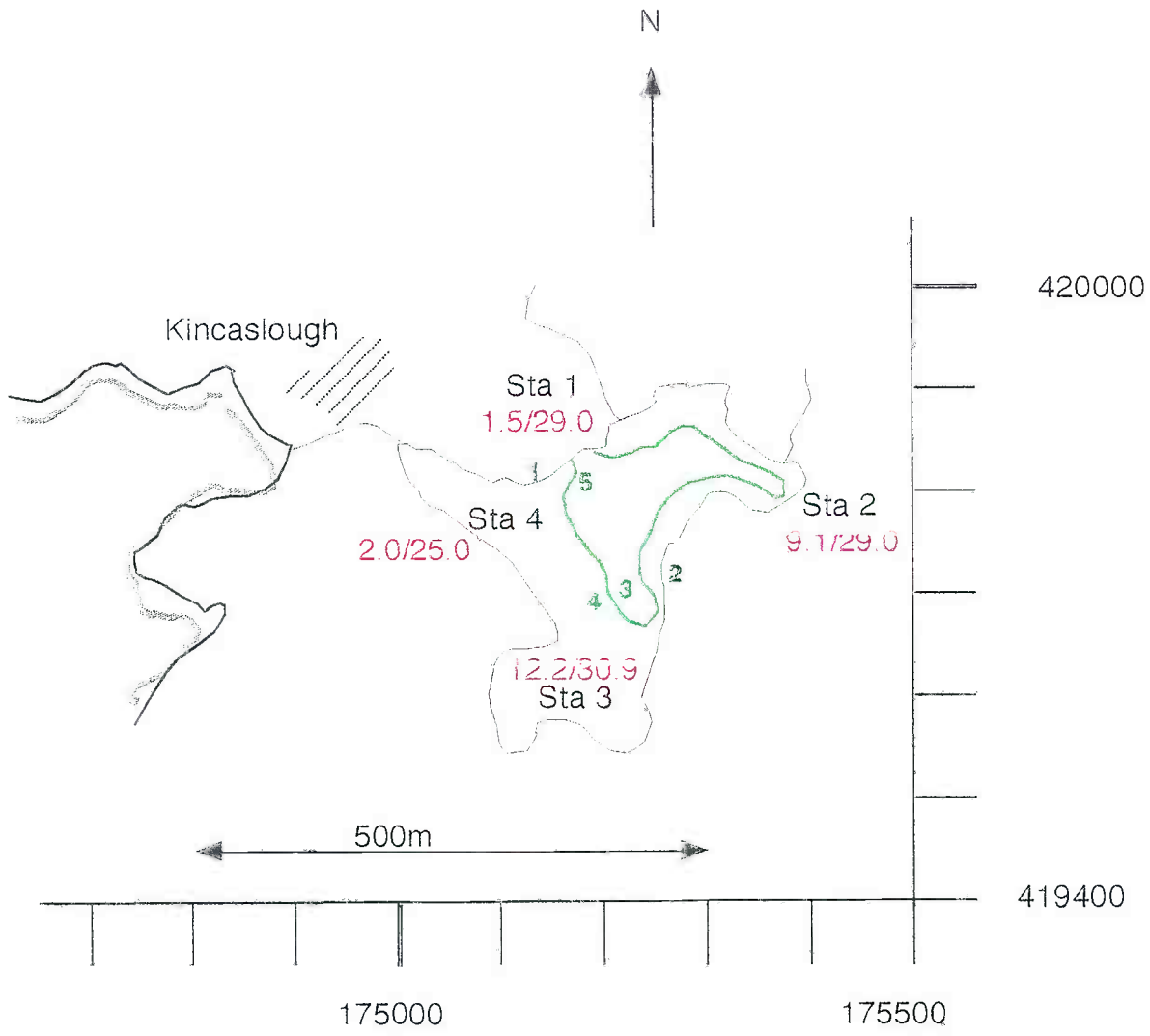


Fig. 2 Sketch map of Kincas Lough, Co. Donegal, 1998.

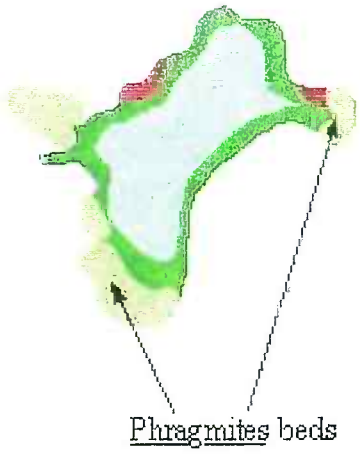


Fig. 3. Benthic vegetation of Kincas Lough.

growth, possibly the bacteria *Beggiatoa* were noted, perhaps indicating anoxic conditions.

Several large stands of *Phragmites australis* were recorded growing at the lake edge.

While it was not possible to adequately survey the marginal vegetation one stand of *Blysmus rufus* was noted. In general the steep shores preclude the development of extensive marginal vegetation.

The phytoplankton of the lake was dominated by freshwater species and detritus probably washed into the lake from the adjoining Lough Mullaghderg.

Notable plants include *Ruppia cirrhosa, Blysmus rufus* and *Chara aspera.*

Assessment

Kincas is a good example of a deep saline lake with a diverse benthic vegetation. but it shows signs of eutrophication, especially the very dense phytoplankton population and the development of a blanket of filamentous green algae in shallow water.

AQUATIC FAUNA

Description

Kincas Lough is a saline lake lagoon with an unsluiced artificial outlet. The small lake (c. 6 ha) lies opposite Cruit Island, approximately 6 kms west of Annagary (Fig 1). According to local information, the channel from Lough Mullaghderg was deepened in order to relieve flooding. As a result, this raised water levels in Kincas Lough and the tidal inlet was deepened in order to lower these water levels. Seawater enters from the west on most tides but the lakes also receive large volumes of freshwater from small streams and the channel which drains from Lough Mullaghderg to the north. The lough is up to 5m deep and surface salinity varied from 5-10 ppt on 19/6/96 and 7.4 - 13.1 ppt in September 1998 but 32-33 ppt below 1m. Substrate is rock, granitic sand and gravel with deep layer of anoxic silt in central areas. The lagoon is surrounded by high granite hills and moorland. It is believed that effluent from the caravan site at L. Mullaghderg has caused pollution in the lagoon.

Sampling stations

The area was sampled on 19/6/1996, briefly in 29/6/98, and 7-8/9/98
Four sampling stations were selected to reflect the influences of substrate, vegetation, freshwater and tidal inflows (Fig. 4).

Station 1 (B 75229 19885) was located at the north end of the lough near the inflow from Mullaghderg. Substrate consisted of gravel along the shoreline with scattered rocks and some stones. Depth was 0-1m and salinity 1.5 ppt at the inflow, 7.4 -8.6 along the shore and 29 ppt at 1m depth.

Station 2 (B 75385 19820) was located at the eastern end of the lough. Depth was 0.2 - 1m and salinity measured 9.1 ppt on the surface and 29 ppt at 1m. Substrate was sand and gravel with some rocks and soft anoxic silt with *Chaetomorpha* at 1m depth. The area was bordered by moorland.

Station 3 (B75278 19621) was located at the southern end of the lough bordered by *Phragmites*. Substrate consisted of fine, anoxic organic silt and clay with mats of reedbed rhizomes. Depth varied from 0.3 - 1m and salinity varied from 12.2 ppt at the surface to 30.9 ppt at 1m depth.

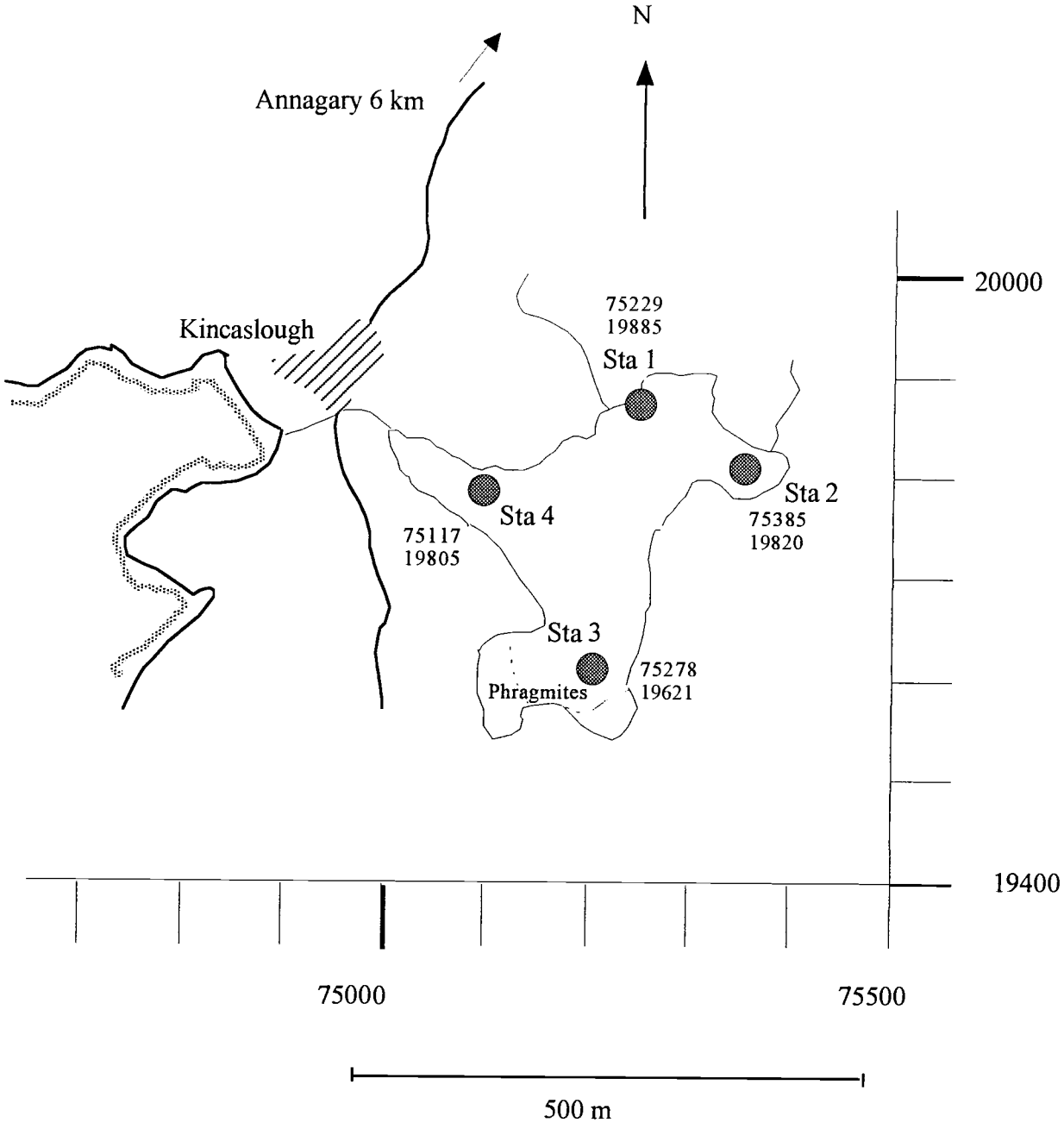


Fig. 4 Sketch map of Kincas Lough, Co. Donegal, showing sampling stations used for a survey of aquatic fauna, 1998.

Station 4 (B 75117 19805) was located at the edge of the reed bed at the northwest corner near the tidal inlet to the lough. Depth was 0.2 - 1m and salinity was 11.4 ppt at the surface and 27.5 ppt at 1m. Substrate consisted of *Phragmites* root mats ('scraw').

Results

Table 1 shows the total species list for each station. The following is a list of species arranged in broad ecological categories based on the Venice system of salinity regimes (L* = lagoonal specialist in Britain; L*IR = proposed as lagoonal specialist in Ireland; * = interesting or rare species):

Marine	
Astropecten irregularis	
Marine-polyhaline	
Fabricia stellaris	
Crangon crangon	
Hydrobia ulvae	
Skeneopsis planorbis	
Poly-mesohaline	
Pomatoschistus microps	
Euryhaline	
Jaera nordmanni	L*IR?
Neomysis integer	L*IR?
Gammarus duebeni	
Carcinus maenas	
Palaemonetes varians	L*
Potamopyrgus antipodarum	
**Conopeum seurati*	L*
Anguilla anguilla	
Gasterosteus aculeatus	
Pleuronectes flesus	
Meso-oligohaline	
**Cordylophora caspia*	L*IR?
Ischnura elegans	
Gyrinus caspius	
Oligohaline-limnetic	
Colymbetes fuscus	
Limnetic	
Agabus sturmii	
A. bipustulatus	
Uncertain	
Limnephilidae indet.	

A total of 27 taxa were recorded, of which 2 species are listed as lagoonal specialists in Britain and an additional 3 species are proposed as lagoonal specialists in Ireland. 2 species appear to be interesting:

Cordylophora caspia was also recorded at Inch L. during this survey, at Durnesh L. during the 1996 survey, at Rostellan, Co. Cork and Rinmore, Co. Galway during the Inventory and previously at Lady's Island L.(Healy *et al.*, 1982). According to Arndt (1984), it "appears to be an excellent bio-indicator for eutrophic brackish water in the horohaline zone". It is a proposed lagoonal specialist for Ireland.

Conopeum seurati has been recorded at 16 of the 36 sites surveyed, but is not listed in a recent review of Irish marine Bryozoa (Wyse Jackson, 1991). Either the species is under recorded or a truly lagoonal specialist.

Agabus sturmii is also characteristic of eutrophic or mesotrophic waters.

The hydrobiids were identified as *P. antipodarum* and *H. ulvae* although some live specimens showed pigmentation of the tentacles similar to that described for *H. neglecta*. However, all preserved specimens were identified as one of the former two species.

Table 1 Aquatic fauna recorded at sampling stations in Kincas Lough, 1998.

Taxa		1	L.T. 1	2	L.T. 2	3	L.T. 3	4	L.T. 4
Cnidaria	*Cordylophora caspia*	+							
						+			
Nemertea	*Fabricia stellaris*				1				
Annelida									
Crustacea					c				
Ostracoda	*Jaera nordmanni*	c		+		o			
Isopoda	*Neomysis integer*	0		o		o		o	1
Mysidacea		+	*2*	+	3			+	
Amphipoda	*Gammarus duebeni*	19	2	4	2	6		34	
	Carcinus maenas							F=15	
Decapoda	*Crangon crangon*	+	1	+					5
	Palaemonetes varians	o		o					
	indet.				4				
Acarina									
Insecta	*Ischnura elegans*					2		+	
Odonata	Limnephilidae indet.					cases		+	
Trichoptera						+		+	
Coleoptera	*Agabus sturmii*					1			
	A. bipustulatus					1			
	Colymbetes fuscus					1			
	Gyrinus caspius			1					
Diptera	Chironomidae indet.			+	2	+	5	+	
Mollusca		o		c	10	a	35	a	
Prosobranchia	*Hydrobiidae*					a		a	
	Hydrobia ulvae	o		c					
	Potamopyrgus antipodarum	+							
	Skeneopsis planorbis	shells							
Bivalvia	*(Cerastoderma glaucum)*			+					
Bryozoa	*Conopeum seurati*								
Echinodermata	*Astropecten irregularis*					+			
	Anguilla anguilla							F=21	
Pisces	*Gasterosteus aculeatus*	o	1	+	2	+			
	Pleuronectes flesus	+						F=2	
	Pomatoschistus microps	+	6	+	52	+	3	+	9
	Pleuronectes flesus	+						F=2	

L.T. = light trap; F = Fyke net; + = present, o = ocasional, c = common, a = abundant

Evaluation

It is possible that Kincas Lough was a freshwater lake before the channel to the sea was deepened. The lagoon is now stratified with almost fully saline water below 1m depth.

The fauna is not rich and is dominated by euryhaline and marine/polyhaline species, most of which are highly mobile and able to enter and leave the lagoon freely. At least 2 of the species appear to indicate eutrophic conditions.

The hydrobiids would be worth further investigation, but otherwise the fauna is not particularly interesting, and at least two species are characteristic of eutrophic conditions.

The lagoon is situated in an area of scenic interest but the lagoon is not a particularly good example of its type.

ECOTONAL COLEOPTERA

This is a saline lake lagoon, with an artificial channel inlet/outlet, with rock/boulder shores and peaty shores with reed-beds, sedgebeds and *Sphagnum / Menyanthes* marsh. The lake is relatively sheltered.

Sampling

Two areas were selected for sampling from 3/7 –5/8/98:
(1) (B 750 197) An area of Carices, *Eriophorum* sp. and *Eleocharis* sp. on peaty cobble/boulder shore with *Phragmites australis* in standing water.
(2) (B 751 196) An area of *Phragmites australis* and *Juncus maritimus* (sparse cover) in standing water grading into *Juncus gerardii, Triglochin maritima, Samolus valerandi, P. australis* and carices on peat, with *Pteridium aquilinum, Osmunda regalis, Calluna vulgaris*, and *Erica* sp. heath vegetation inland.

Results

In total thirteen species of carabid, twenty species of staphylinid and one species of pselaphid were recorded, none of which are regarded as indicator species (Tables 2 and 3).

TABLE 2. Staphylinidae and Pselaphidae from saline lake peaty shores at Maghery Lough, Sally's Lough, Kincas Lough and Moorlagh (Co. Donegal). The same sampling techniques and effort were used at each site, with the exception of Maghery where shore debris and *Phragmites* litter was sieved. Indicator species are marked with an asterisk.

	Maghery	Sally's	Kincas	Moorlagh
Aleochara lanuginosa Grav.	1	-	-	-
Anotylus rugosus (Fab.)	1	-	-	-
Atheta aquatilis (Thoms.) *	3	-	-	-
Atheta fungi (Grav.)	1	-	-	7
Atheta graminicola (Grav.)	1	-	-	-
Bryaxis bulbifer (Reich.)	1	-	-	-
Cordalia obscura (Grav.)	1	1	-	-
Gyrohypnus angustatus Steph.	1	-	-	-
Lathrobium boreale Hochhuth	1	-	1	-
Lathrobium terminatum Grav.	5	-	2	-
Lesteva sicula Er.	17	-	-	-
Myllaena brevicornis (Matth.)	3	-	-	-
Myllaena infuscata (Kr.)	1	-	-	-
Olophrum fuscum (Grav.)	1	-	-	3
Olophrum piceum (Gyll.)	1	-	-	-

Oxypoda elongatula Aubé	1	-	-	1
Philonthus varians (Payk.)	1	-	-	-
Quedius maurorufus (Grav.)	10	-	-	-
Quedius nitipennis (Steph.)	3	-	-	-
Rugilus erichsoni (Fauv.)	1	-	-	-
Staphylinus dimidiaticornis Gemm.	16	18	8	-
Stenus bimaculatus Gyll.	6	-	-	-
Stenus brunnipes Steph.	3	-	6	1
Stenus clavicornis (Scop.)	3	6	-	-
Stenus juno (Payk.)	1	-	2	3
Tachinus marginellus (Fab.)	1	-	-	-
Tachinus signatus Grav.	5	27	-	4
Xantholinus linearis (Ol.)	1	-	-	-
Aloconota gregaria (Er.)	-	1	-	-
Amischa analis (Grav.)	-	1	-	-
Atheta amplicollis (Muls. Rey)	-	3	-	13
Atheta celata (Er.)	-	1	-	-
Ocypus aeneocephalus (DeGeer)	-	2	-	-
Philonthus cognatus Steph.	-	2	-	-
Philonthus laminatus (Creutz.)	-	5	-	-
Pselaphus heisei Herbst	-	1	-	1
Quedius fuliginosus (Grav.)	-	2	1	-
Reichenbachia juncorum (Leach)	-	1	-	3
Xantholinus longiventris Heer	-	2	-	-
Bryaxis bulbifer (Reich.)	-	-	2	23
Carpelimus corticinus (Grav.)	-	-	1	-
Dinaraea angustula (Gyll.)	-	-	1	-
Euaesthetus bipunctatus (Ljungh)	-	-	1	-
Gabrius coxalus (Hochh.)	-	-	1	-
Mycetoporus splendidus (Grav.) agg.	-	-	1	-
Lathrobium brunnipes (Fab.)	-	-	1	-
Ocypus olens (Müll.)	-	-	1	-
Othius punctulatus (Goeze)	-	-	1	-
Stenus canaliculatus Gyll.	-	-	7	-
Stenus fulvicornis Steph.	-	-	3	8
Stenus impressus Germ.	-	-	1	21
Stenus nitens Steph.	-	-	1	-
Stenus nitidiusculus Steph.	-	-	1	7
Tachyporus dispar (Payk.)	-	-	1	9
Gabrius trossulus (Nordm.)	-	-	-	1
Geostiba circellaris (Grav.)	-	-	-	2
Othius angustus Steph.	-	-	-	1
Quedius nemoralis Baudi	-	-	-	1
Stenus cicindeloides (Schall.)	-	-	-	1
Stenus pusillus Steph.	-	-	-	1
Tachyporus nitidulus (Fab.)	-	-	-	1

TABLE 3. Carabidae from saline lake peat shores with *Juncus* and grasses at Maghery Lough, Sally's Lough, Kincas Lough and Moorlagh (Co. Donegal). The same sampling techniques and effort were used at each site, with the exception of Maghery where shore debris occurred. Indicator species are marked with an asterisk.

	Maghery	Sally's	Kincas	Moorlagh
Agonum thoreyi Dej.	76	2	1	-
Bembidion mannerheimi Sahlb.	3	2	6	2
Elaphrus cupreus Dufts.	1	-	5	1
Leistus fulvibarbis Dejean	1	-	-	-
Leistus terminatus (Hellw.)	1	-	-	-
Loricera pilicornis (Fab.)	1	-	-	-
Pterostichus diligens (Sturm)	6	-	1	3
Pterostichus niger (Schal.)	1	-	-	-
Pterostichus nigrita (Payk.)	2	-	1	-
Agonum fuliginosum (Panz.)	-	5	2	-
Harpalus rufipes (DeGeer)	-	1	-	-
Notiophilus palustris (Dufts.)	-	1	1	-
Pterostichus crenatus (Dufts.)	-	5	3	-
Pterostichus strenuus (Panz.)	-	1	-	4
Pterostichus versicolor (Sturm)	-	1	-	-
Abax parallelepipedus (Pil. & Mit.)	-	-	1	-
Carabus granulatus L.	-	-	4	-
Dromius linearis (Ol.)	-	-	6	-
Pterostichus melanarius (Ill.)	-	-	1	-
Pterostichus minor (Gyll.)	-	-	1	-
Agonum albipes (Fab.)	-	-	-	6
Dromius melanocephalus Dej.	-	-	-	1
Nebria brevicollis (Fab.)	-	-	-	1
Ocys harpaloides (Serv.)	-	-	-	3

Evaluation

Conservation value was not indicated at this site because no indicator species were found, despite 34 species being recorded.

SUMMARY

Kincas Lough is an average example of a relatively deep, silled saline lake lagoon. It was stratified with an oligo-mesohaline surface layer extending into shallow water but possibly subject to wide changes in salinity. The aquatic vegetation was unexceptional except for a poor charophyte zone in shallow water and dense *Chaetomorpha linum* in deeper zones. Marginal vegetation could not be fully assessed due to high water levels but a *Blysmus* community was identified. The aquatic fauna was typical but rather poor. No indicator species of ecotonal Coleoptera were identified.

References

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Plate 14. Kincas Lough, Co. Donegal. 1. View from hill in the southwest; 2. East shore; 3. Bridge over stream from Mullaghderg; 4. South end overgrown with *Phragmites*; 5. View from the north shore.

15. MOORLAGH, THE ROSSES, Co. Donegal

An Morlach

Location:
B 790187; 55°00.8'N, 8°19.5'W. OS Sheet 1.
0.5 km south of Annagary, (Annagry).

Lagoon type	silled saline lake lagoon with sluiced inlet
Area	9.5 ha
Salinity regime	oligo-mesohaline, wide fluctuations
Maximum depth	1.5 m
Seawater entry	sluiced inlet
Tidal range	>20 cm?
Conservation status	Just outside NHA No. 1141

Origin and history -nothing known

Geology, geomorphology and landscape

The lagoon lies in a valley at the eastern edge of the mountainous region of The Rosses. A 106 m peak, Annagry Hill, rises from the east shore of the lagoon. The rock is coarse-grained Rosses granite. The hills support rocky heath and rough grazing.

Description of the system

The lagoon is very shallow with an average depth of 1 m. The surrounding land is mainly bog/heath, with marshy grassland on peat on parts of the west shore, and tree plantations in the south where streams enter. The shores vary from vertical peat banks with overhangs in the west to gravelly edges with or without rocks in the east, and rocky shallows with stones and soft silt near the inlet. The central bed is mainly silty sand, with some hard peat and soft peaty areas. A ridge of rocks runs north-south in the centre of the lagoon. Three culverted outlets under the road, each with a flap sluice, empty on to a gently sloping rocky shore, bordered by small areas of salt marsh. The easiest access to the lagoon is from the road near the west shore.

Hydrology

The sluices appear to leak badly and the lagoon is probably to some extent tidal on all tides. Freshwater enters chiefly from streams at the southern end. Because the lagoon is so shallow, it is subject to wide tidal fluctuations in salinity. During a period of spring tides and heavy rainfall in September 1998, the water was stratified, even in depths of only 0.75 m in depth. At one point, 0.5-2‰ was measured at the surface and 27-29‰ at 1 m depth.

Exploitation and threats

The lagoon is not exploited.

Conservation status

None?

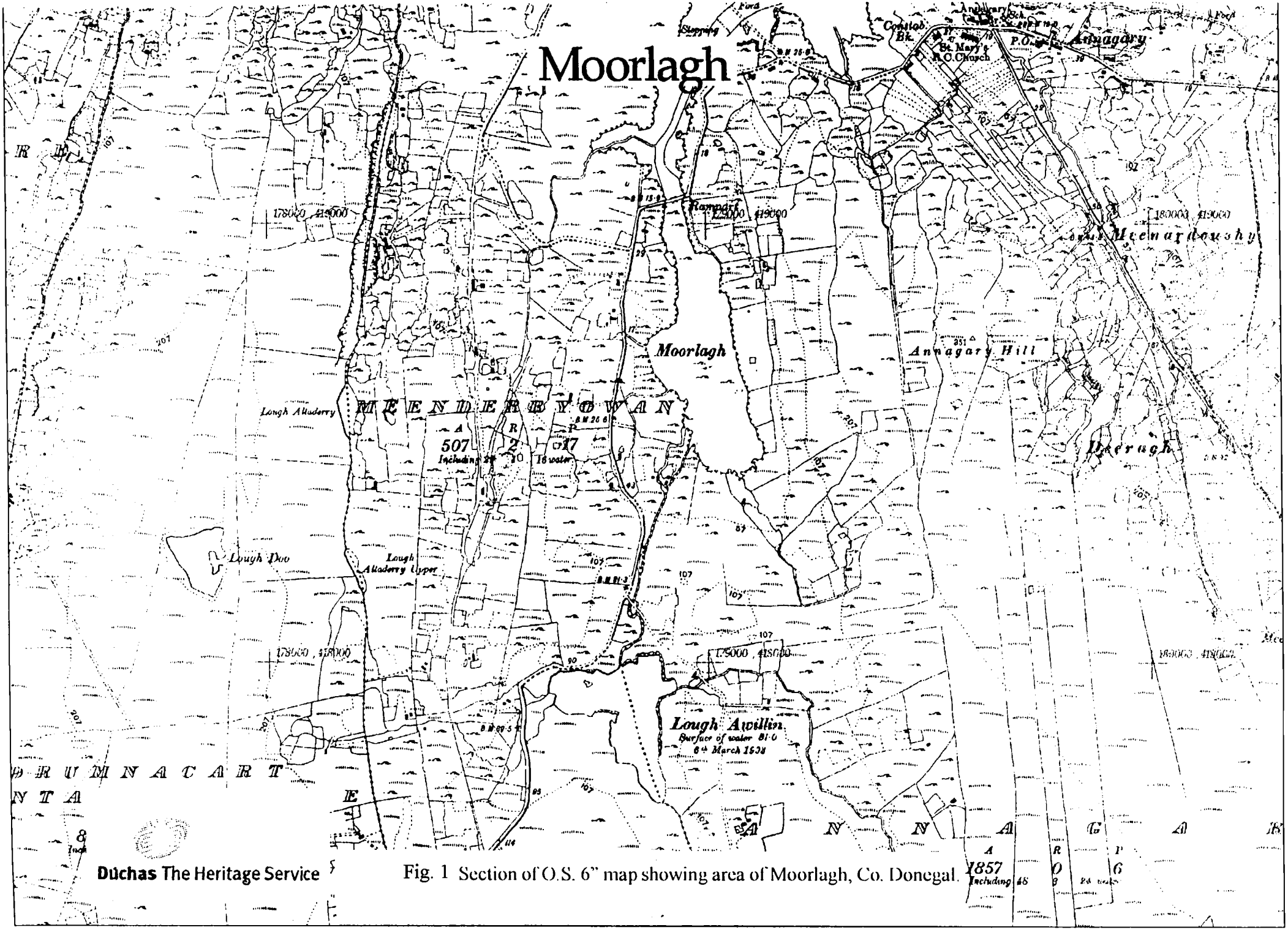


Fig. 1 Section of O.S. 6" map showing area of Moorlagh, Co. Donegal.

VEGETATION

Moorlagh is a small lagoon separated from the sea by a shallow channel which is crossed by the main road from Annagary to Kincaslagh. The lagoon is surrounded by low granite hills. Areas of peat adjoin the lagoon on the western and southern side. The nearby hills support heath and rough grazing. Some houses adjoin the lake at the northern end.

Underwater observations

Moorlagh is an extremely shallow sandy lake. Despite the size of the lake, depth rarely exceeded 1m. The bottom consisted mainly of sand with some areas of flooded peat. A ridge of rocks run north-south in the centre of the lake. The bottom flora is a very uniform mixture of *Ruppia* sp. and drift *Cladophora*.

Sampling

The lagoon was sampled on two days (27/6/98 and 10/9/98). Shore samples and a snorkelling survey were carried out. The lake was too shallow for a net plankton sample. Samples 1-5 (17884186) were taken on the western shore. The lake edge is marked by a small peat cliff. Above the cliff areas of *Juncus maritimus* and rough grazing are found. 6 (17904187) was taken in the sublittoral in the centre of the lake at a depth of 1m.

Results

Only one extensive vegetation type was found: *Ruppia* sp. with a *Cladophora* tentatively identified as *C. vagabunda* (6). Rocks were covered with some macroalgae, mainly *Fucus ceranoides* and *Enteromorpha*. The whole lake is very shallow and the bottom consists of hard peat and sand with protruding rocks.

Marginal vegetation included stands of *Juncus maritimus* (1,2), *Festuca rubra* (3,4) and the *Juncus gerardii* association (5).

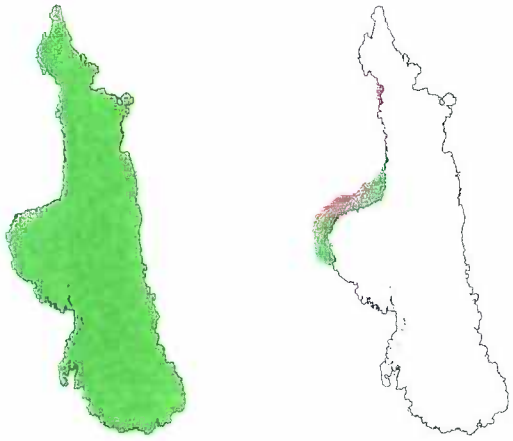
None of the *Ruppia* could be identified to species as no fruiting plants were found.

No other notable plants were found.

Assessment

Moorlagh appears to have no distinctive floristic or vegetational features of note.

Fig. 3 Benthic and marginal vegetation of Moorlagh



AQUATIC FAUNA

Description

This small lake (c. 9.5 ha) lies 0.5 km south of Annagary. A causeway has been built across the outlet with 3 culverted channels each with a wooden sluice. Seawater enters from the north on most tides but large streams enter from the south. Depth is very shallow (less than 0.75m) and salinity probably varies considerably. In August salinity measured 0 ppt at the tidal inlet but up to 9-17 ppt in September and on spring tides is likely to be much higher. On the surface of the main body of the lake 7.3 - 9.7ppt was recorded, and up to 30.1ppt at 0.75m but 0.5 - 2ppt at the southern end of the lough. Substrate is granite rocks, stones, silty sand and gravel. The surrounding land is rocky heath with hills to the east.

Sampling stations

The area was sampled in 1996, briefly in 29/6/98, and from 9 -11/9/98. Five sampling stations were selected to reflect the influences of substrate, vegetation, freshwater and tidal inflows.

Station 1 (B 78906 19056) was located at the north end of the lough near the tidal inlet. Substrate consisted of gravel in the channel with rocks and fine peaty sand and silt in sheltered areas. Depth was 0-0.5m and salinity measured 14.8 - 17 ppt at 11 am and 9ppt at 5pm on the same day.

Station 2 (B 78934 18736) was located on the west shore of the lough about 250m from the tidal inlet. Depth varied from 0 - 0.75 m and salinity measured 7.3 -8.5 ppt. Substrate was gravel on the shore with sandy silt in deeper water with scattered rocks. The area was bordered by granite stones and moorland with peat cliffs and isolated peat clumps along the shoreline.

Station 3 (B78870 18723) was located midway along the western shore in a small bay where a drainage channel enters. Substrate consisted of soft peaty silt with occasional rocks and clay with mats of reedbed rhizomes covered with dense growths of *Potamogeton/Ruppia*. Depth varied from 0 - 0.75 m and salinity measured 9.7ppt at the surface and 18.5 ppt at 0.75m. The area was bordered by wet moorland with peat cliffs along the shoreline.

Station 4 (B 79054 18710) was located midway along the eastern shore. Depth was very shallow (less then 30cm) and salinity measured 6.8 - 7.8ppt. Substrate consisted of gravel with peaty silt and the area was bordered by moorland, rock and stone walls. This was the most exposed shoreline to prevailing winds.

Station 5 (B78925 18518) was located at the southern end of the lough where a small river enters. Depth was 0 -1m and salinity measured 0.5 - 2 ppt at the surface and 27 - 29ppt at 1m depth. Substrate consisted of peaty silt and the area was bordered by moorland and wet grassland with a small conifer plantation on one side.

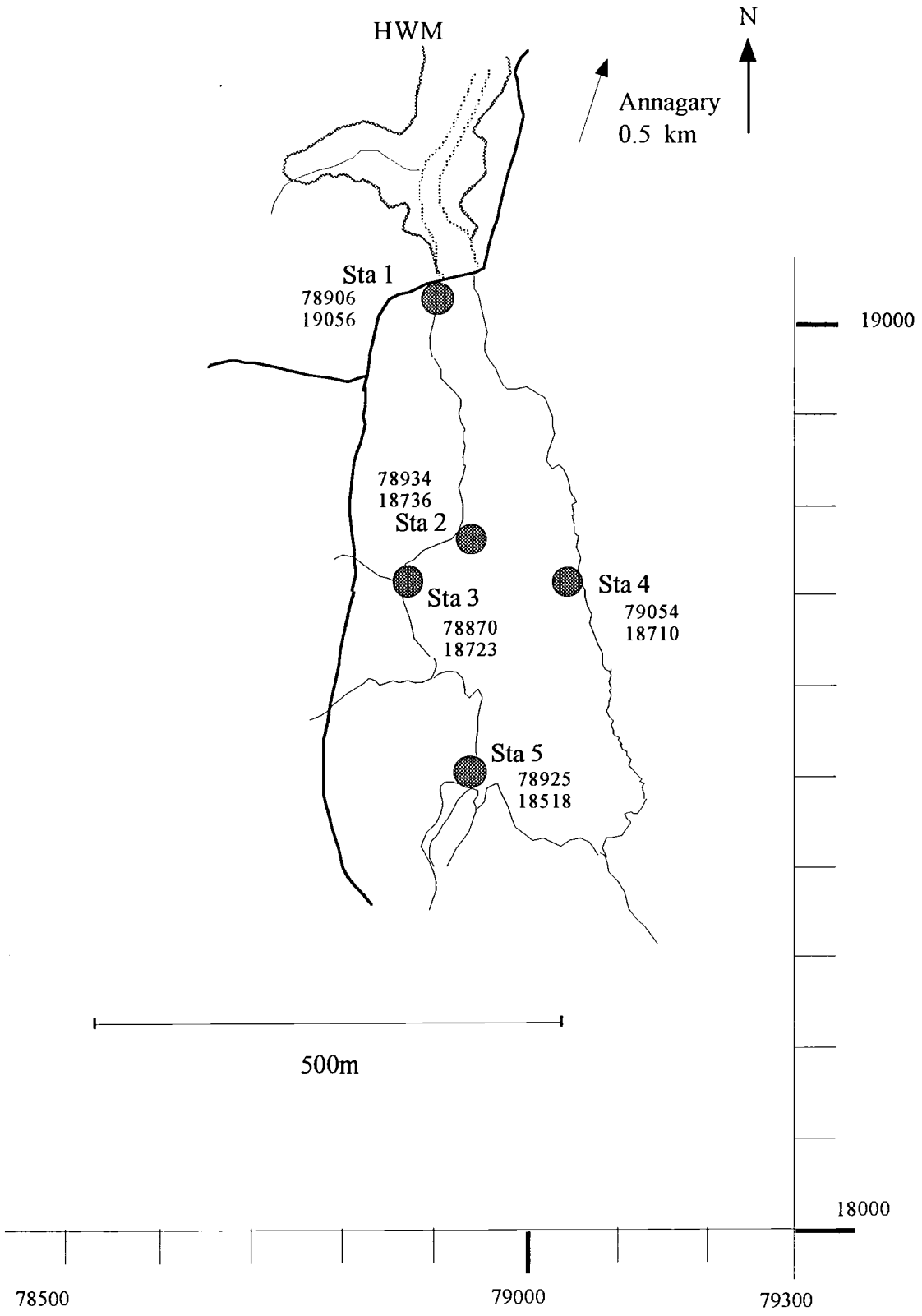


Fig. 4 Sketch map of Moorlagh, Co. Donegal, showing sampling stations used for a survey of aquatic fauna, 1998

Results

Table 1 shows the total species list for each station. The following is a list of species arranged in broad ecological categories based on the Venice system of salinity regimes (L* = lagoonal specialist in Britain, L*IR = proposed as lagoonal specialist in Ireland. Species in brackets refer to previous records):

Marine	
Tetrastemma melanocephalum	
Marine-polyhaline	
Praunus flexuosus	
Melita palmata	
Crangon crangon	
Hydrobia ulvae	
Skeneopsis planorbis	
Poly-mesohaline	
**(Jaera ischiosetosa) (1996)*	L*IR?
H. ventrosa	L*
Pomatoschistus microps	
Euryhaline	
J. nordmanni	L*IR?
Lekanesphaera hookeri	L*
Neomysis integer	L*IR?
Gammarus zaddachi	
Meso-oligohaline	
Ischnura elegans	
Oligohaline-limnetic	
Hydrometra stagnorum	
Haliplus rufficollis	
Limnetic	
Gerris lacustris	
Gyrinus substriatus	
Helophorus brevipalpis	
Aeschnidae indet.	
Haliplus fulvus	
H. lineolatus	
Carcinus maenas	
Palaemonetes varians	L*
Potamopyrgus antipodarum	
Anguilla anguilla	
Pleuronectes flesus	
Salmo trutta	

A total of 29 taxa were identified, all of which were identified to species; 3 species are listed as lagoonal specialists in Britain and 3 are proposed lagoonal specialists in Ireland (1 of these was recorded only in 1996).

The fauna is poor and dominated largely by euryhaline and marine/polyhaline species most of which are highly mobile and able to enter and leave fresh or seawater freely. The Coleopteran species may easily have been washed into the lagoon as a result of high rainfall and freshwater discharge from the streams.

Only one species is considered to be rare and none are particularly abundant.

Jaera ischiosetosa was recorded at L.an Chara, L. Athola and Maghery L. in 1998 and at this site and L. Murree and Furnace L. in 1996. The only previous record appears to be for L. Hyne. Co. Cork (Goss Custard *et al.*, 1979).

Evaluation

Very few species were recorded in Moorlagh and only one is considered to be rare, although several are lagoonal specialists.

The lagoon is very shallow and undoubtedly undergoes extreme variations in salinity and could be described as what Hartog (1974) refers to as a "shock system", which could explain the paucity of resident species.

The lagoon is at least partly artificial and although it is set in an area of scenic value, the lagoon itself is not a particularly good example of its type.

Table 1 Aquatic fauna recorded at sampling stations in Moorlagh, 1998.

		1	L.T. 1	2	L.T. 2	3	mid	4	L.T. 4	5	L.T.5
Nemertea	*Tetrastemma melanocephalum*			+							
Crustacea											
Isopoda	*Jaera ischiosetosa*	(+)									
	J. nordmanni	c		2							
	Lekanesphaera hookeri	a	120	+	60	+		+	12	+	5
Mysidacea	*Neomysis integer*	c	5	+	5	+	+	+	15		5
	Praunus flexuosus	c									
	Amphipoda	+				+				+	5
	Gammarus zaddachi	20		1		6	2	3		2	5
	Melita palmata			2			1				1
Decapoda	*Carcinus maenas*	+								F=1	
	Crangon crangon	c	20	+							
	Palaemonetes varians	c		+	2	+	+	+		+	
Insecta											
Odonata	Anisoptera.			+							
	Ischnura elegans					o				o	
Heteroptera	*Gerris lacustris*									c	
	Hydrometra stagnorum							o			
Coleoptera	*Gyrinus substriatus*									1	
	Haliplus fulvus									2	
	H. lineolatus									5	
	H. rufficollis									2	
	Helophorus flavipes					1					
Diptera	Chironomidae indet.	+								+	
Mollusca											
Prosobranchia	Hydrobidae indet.	+		+	+	+	+	+		+	a
	Hydrobia ulvae	+			2						
	H. ventrosa						+				
	Potamopyrgus antipodarum			c				c		c	
	Skeneopsis planorbis	+			+						
Bivalvia	*Mya arenaria*	o									
Pisces	*Anguilla anguilla*	+	1	F=2						F=5	
	Gasterosteus aculeatus	(+)									
	Pleuronectes flesus									F=7	
	Pomatoschistus microps	+		+							
	Salmo trutta			F=2						F=1	

L.T. = light trap; F = Fyke net; + = present, o = occasional, c = common, a = abundant. ( ) = previous record

This is a saline lake with a causeway and artificial sluice barrier, with eroded rock and boulder shores, and shores of peat cliff. There is an area of ungrazed *Juncus maritimus* sward on the west shore. The water level appears to fluctuate frequently.

Sampling

Two areas were selected for sampling from 4/7 –16/8/98:
(1) (B 788 186) An area (c. 0.3 ha) of ungrazed *Juncus maritimus, Agrostis stolonifera, Festuca rubra, Triglochin maritima, Juncus gerardii, Plantago maritima*, etc., with a slightly raised bank of *Festuca*, other grasses, *Leontodon autumnalis* and *Trifolium repens* before a c. 1m peat cliff into standing water of the lake. This graded inland into wet grassland and heath. Offshore (0.5 m) salinity was 0 ‰ (4 viii 1997).
(2) (B791 183)A small, flat, duck loafing area c. 1m offshore with *Juncus maritimus, J. gerardii, Samolus valerandi, Glaux maritima, Plantago maritima, Agrostis stolonifera, Senecio palustris*, etc. Inland there was pasture, with *Eriophorum* sp., *Juncus effusus, Molinia caerulea*, etc. Duck and swan droppings were frequent. Offshore (0.5 m) salinity was 0 ‰ (4 viii 1997).

Results

A total of eight species of carabid, eighteen species of staphylinid and three species of pselaphid were recorded, none of which are regarded as indicator species (Tables 2 and 3).

TABLE 2 Staphylinidae and Pselaphidae from saline lake peaty shores at Maghery Lough, Sally's Lough, Kincas Lough and Moorlagh (Co. Donegal). The same sampling techniques and effort were used at each site, with the exception of Maghery where shore debris and *Phragmites* litter was sieved. Indicator species are marked with an asterisk.

	Maghery	Sally's	Kincas	Moorlagh
Aleochara lanuginosa Grav.	1	-	-	-
Anotylus rugosus (Fab.)	1	-	-	-
Atheta aquatilis (Thoms.) *	3	-	-	-
Atheta fungi (Grav.)	1	-	-	7
Atheta graminicola (Grav.)	1	-	-	-
Bryaxis bulbifer (Reich.)	1	-	-	-
Cordalia obscura (Grav.)	1	1	-	-
Gyrohypnus angustatus Steph.	1	-	-	-
Lathrobium boreale Hochhuth	1	-	1	-
Lathrobium terminatum Grav.	5	-	2	-
Lesteva sicula Er.	17	-	-	-
Myllaena brevicornis (Matth.)	3	-	-	-
Myllaena infuscata (Kr.)	1	-	-	-
Olophrum fuscum (Grav.)	1	-	-	3
Olophrum piceum (Gyll.)	1	-	-	-
Oxypoda elongatula Aubé	1	-	-	1
Philonthus varians (Payk.)	1	-	-	-
Quedius maurorufus (Grav.)	10	-	-	-
Quedius nitipennis (Steph.)	3	-	-	-
Rugilus erichsoni (Fauv.)	1	-	-	-
Staphylinus dimidiaticornis Gemm.	16	18	8	-

Stenus bimaculatus Gyll.	6	-	-	-
Stenus brunnipes Steph.	3	-	6	1
Stenus clavicornis (Scop.)	3	6	-	-
Stenus juno (Payk.)	1	-	2	3
Tachinus marginellus (Fab.)	1	-	-	-
Tachinus signatus Grav.	5	27	-	4
Xantholinus linearis (Ol.)	1	-	-	-
Aloconota gregaria (Er.)	-	1	-	-
Amischa analis (Grav.)	-	1	-	-
Atheta amplicollis (Muls. Rey)	-	3	-	13
Atheta celata (Er.)	-	1	-	-
Ocypus aeneocephalus (DeGeer)	-	2	-	-
Philonthus cognatus Steph.	-	2	-	-
Philonthus laminatus (Creutz.)	-	5	-	-
Pselaphus heisei Herbst	-	1	-	1
Quedius fuliginosus (Grav.)	-	2	1	-
Reichenbachia juncorum (Leach)	-	1	-	3
Xantholinus longiventris Heer	-	2	-	-
Bryaxis bulbifer (Reich.)	-	-	2	23
Carpelimus corticinus (Grav.)	-	-	1	-
Dinaraea angustula (Gyll.)	-	-	1	-
Euaesthetus bipunctatus (Ljungh)	-	-	1	-
Gabrius coxalus (Hochh.)	-	-	1	-
Mycetoporus splendidus (Grav.) agg.	-	-	1	-
Lathrobium brunnipes (Fab.)	-	-	1	-
Ocypus olens (Müll.)	-	-	1	-
Othius punctulatus (Goeze)	-	-	1	-
Stenus canaliculatus Gyll.	-	-	7	-
Stenus fulvicornis Steph.	-	-	3	8
Stenus impressus Germ.	-	-	1	21
Stenus nitens Steph.	-	-	1	-
Stenus nitidiusculus Steph.	-	-	1	7
Tachyporus dispar (Payk.)	-	-	1	9
Gabrius trossulus (Nordm.)	-	-	-	1
Geostiba circellaris (Grav.)	-	-	-	2
Othius angustus Steph.	-	-	-	1
Quedius nemoralis Baudi	-	-	-	1
Stenus cicindeloides (Schall.)	-	-	-	1
Stenus pusillus Steph.	-	-	-	1
Tachyporus nitidulus (Fab.)	-	-	-	1

TABLE 3. Carabidae from saline lake peat shores with *Juncus* and grasses at Maghery Lough, Sally's Lough, Kincas Lough and Moorlagh (Co. Donegal). The same sampling techniques and effort were used at each site, with the exception of Maghery where shore debris occurred. Indicator species are marked with an asterisk.

	Maghery	Sally's	Kincas	Moorlagh
Agonum thoreyi Dej.	76	2	1	-
Bembidion mannerheimi Sahlb.	3	2	6	2
Elaphrus cupreus Dufts.	1	-	5	1
Leistus fulvibarbis Dejean	1	-	-	-
Leistus terminatus (Hellw.)	1	-	-	-

Loricera pilicornis (Fab.)	1	-	-	-
Pterostichus diligens (Sturm)	6	-	1	3
Pterostichus niger (Schal.)	1	-	-	-
Pterostichus nigrita (Payk.)	2	-	1	-
Agonum fuliginosum (Panz.)	-	5	2	-
Harpalus rufipes (DeGeer)	-	1	-	-
Notiophilus palustris (Dufts.)	-	1	1	-
Pterostichus crenatus (Dufts.)	-	5	3	-
Pterostichus strenuus (Panz.)	-	1	-	4
Pterostichus versicolor (Sturm)	-	1	-	-
Abax parallelepipedus (Pil. & Mit.)	-	-	1	-
Carabus granulatus L.	-	-	4	-
Dromius linearis (Ol.)	-	-	6	-
Pterostichus melanarius (Ill.)	-	-	1	-
Pterostichus minor (Gyll.)	-	-	1	-
Agonum albipes (Fab.)	-	-	-	6
Dromius melanocephalus Dej.	-	-	-	1
Nebria brevicollis (Fab.)	-	-	-	1
Ocys harpaloides (Serv.)	-	-	-	3

Evaluation

Conservation value was not indicated at this site because no indicator species were found.

SUMMARY

Moorlagh is a good example of a shock lagoon in which strong tidal flow and significant freshwater inflow results in alternating high and low salinity. Both vegetation and aquatic fauna were poor, dominated by eurytopic species. Ecotonal Coleoptera were diverse but none were indicator species.

References

Goss Custard, S., J. Jones, J.A. Kitching and Norton T. A. 1979. Tidepools of Carrigathorna and Barloge Creek. Philosophical Transactions of the Royal Society of London. Series B 287: 1-44.

Hartog, C. den, 1974 Brackish-water classification, its development and problems. Hydrobiological Bulletin 8: 15-28.

16. INCH LOUGH, LOUGH SWILLY, Co. Donegal

Location: C 352230; 55°03.0'N, 7°27.0'W.
East shore of Lough Swilly, about 9 km south of Buncrana

Lagoon type	artificial lagoon, sluiced outlet
Area	160 ha
Salinity regime	oligohaline, locally mesohaline (0-20‰)
Maximum depth	2 m
Seawater entry	sluices, some percolation
Tidal range	none
Conservation status	SPA No. 140, NHA No. 166

Origin and history

The lagoon was created by construction of two causeways connecting Inch Island to the mainland. The northern one carries a road and is unsluiced, the southern one has seven pipes with flap valves at its southern end. Railway embankments along the east shore, dating from around 1870, protect the low-lying Inch Levels from flooding. The railway was discontinued around 1950 following a major accident and has been dismantled. The land behind the embankment was reclaimed (in the 1920s?) by pumping water from a series of ditches into the lagoon. The present pump, situated near the ford in the middle of the lagoon (marked "sluice" on the map), is automatic. The embankment has recently been strengthened.

Geology, geomorphology, and landscape

The geology of the region is complex. Two types of rock occur on Inch Island: the Fahan slate formation with laminations of pelites and sandstone, and Fahan grit formation consisting of grits and slags. Rocks to the east of the lagoon are undifferentiated schists belonging to the Lough Foyle Succession.

Inch Island is hilly, with steep, south-facing slopes affording good views of the lagoon from the road, while land to the east and north-west is low-lying with poor natural drainage. The region is intensively farmed.

Description of the system

The lagoon is everywhere shallow, with many areas less than 1 m and a maximum depth near the southern barrier of 2 m. The shores are gently sloping, in many places grading to freshwater marshes. The substrate consists of former estuarine deposits of sand, gravel and shells. It is sandy and firm in the southern sector, but more muddy near the centre and in the north, especially where there are accumulations of algae or other organic matter. Rocks are scarce except near barriers. Dense beds of *Schoenoplectus tabernaemontani* fringe the northern sector.

Hydrology

Freshwater is pumped automatically from the polders of Inch Levels into the lagoon and enters from two rivers, the Burnfoot and the Skeoge, midway along the east shore. Water exits through the seven sluices. Although two of the sluices are recent additions, they are unable to prevent some flooding of low-lying land around the lagoon. Salinity gradients indicate that the seawater enters mainly through the sluices, but small amounts percolate through the northern barrier.

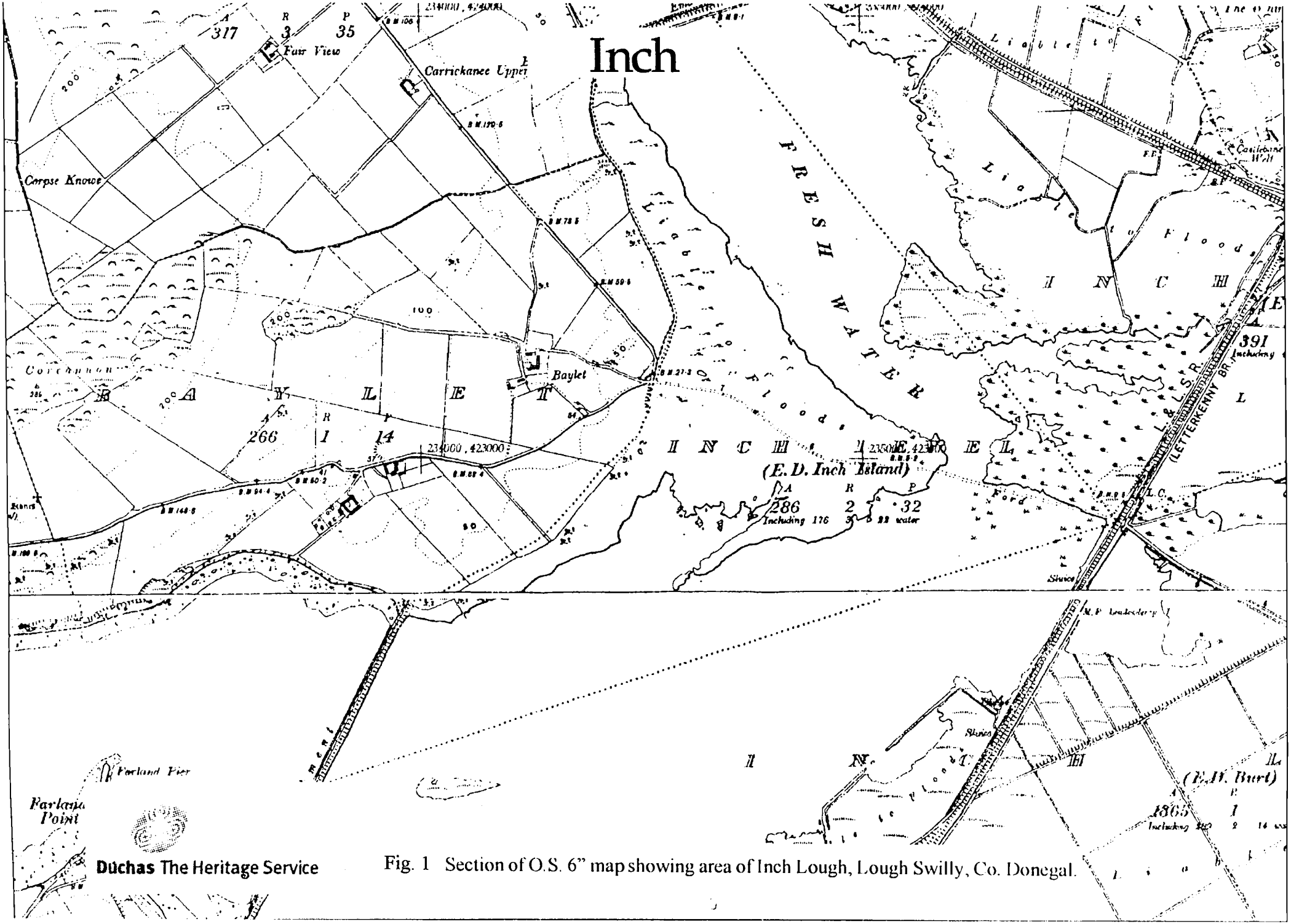


Fig. 1 Section of O.S. 6" map showing area of Inch Lough, Lough Swilly, Co. Donegal.

Exploitation and threats

The lagoon is protected from exploitation by its conservation status as an SPA. There is some controlled duck-shooting. The chief threat is from eutrophication due to fertilisers used on the polders. Thick rafts of floating *Enteromorpha* were present near the shore in June 1998, especially near the northern causeway, and decaying algae becoming incorporated into the sediment created anaerobic conditions. They indicate nutrient enrichment, probably from surrounding farmland.

Conservation status

The lagoon is an SPA.

VEGETATION

Inch lagoon lies between the mainland and Inch in Lough Swilly. It is an artificial impoundment with dykes at the northern and south-west ends. The lake level is controlled by sluice gates and pumps on the south-west dyke and eastern embankment. The eastern shore is embanked for much of its length, but the greater part of the shore is low lying and marshy. Two rivers, the Burnfoot and the Skeoge enter the lagoon midway along the east shore. The hinterland of the lagoon both on the mainland and Inch is intensively farmed. A road crosses the lagoon by means of a ford at the narrowest point. Very extensive beds of *Schoenoplectus tabernaemontani* occur north of the ford.

Underwater observations

Only the south-west section of Inch was explored by snorkelling. The lake is shallow 1-2 m The bottom is mostly sand or towards the centre, soft mud. In the south-west section plant growth was very sparse. Some *P. pectinatus* was seen along with *Cladophora* sp.

It proved possible to explore the greater part of the lake using chest waders. However the central one third of the northern basin was too deep and was not examined. The lagoon bottom was mainly sand along the perimeter and much of the southern section. The northern basin had a greater proportion of soft mud.

Sampling

The lagoon was surveyed on 26/6/98 and 17-19/9/98. The survey included snorkelling, wading and shore sampling. With the exception of an area in the centre of the eastern half, all the surface of the lagoon and its surrounding vegetation was examined.

Relevés of the marginal and benthic vegetation were made and a plankton sample was collected.

1-7 (23454225) were made along the marshy Inch shore, where stands of *Schoenoplectus tabernaemontani* mark the waters edge.

8-14 (23484238) were made along the north-eastern mainland shore; here the shoreline has many small pools and inlets along the waters edge.

15,16 (23524230) were made in shallow water near the ford.

17-19 (23494227) were made in the western part of the lagoon at a depth of 1-1,5m,

20 23464238) and 25 (23514235) were made in the north-eastern part of the lagoon at depths of 1-1.5m.

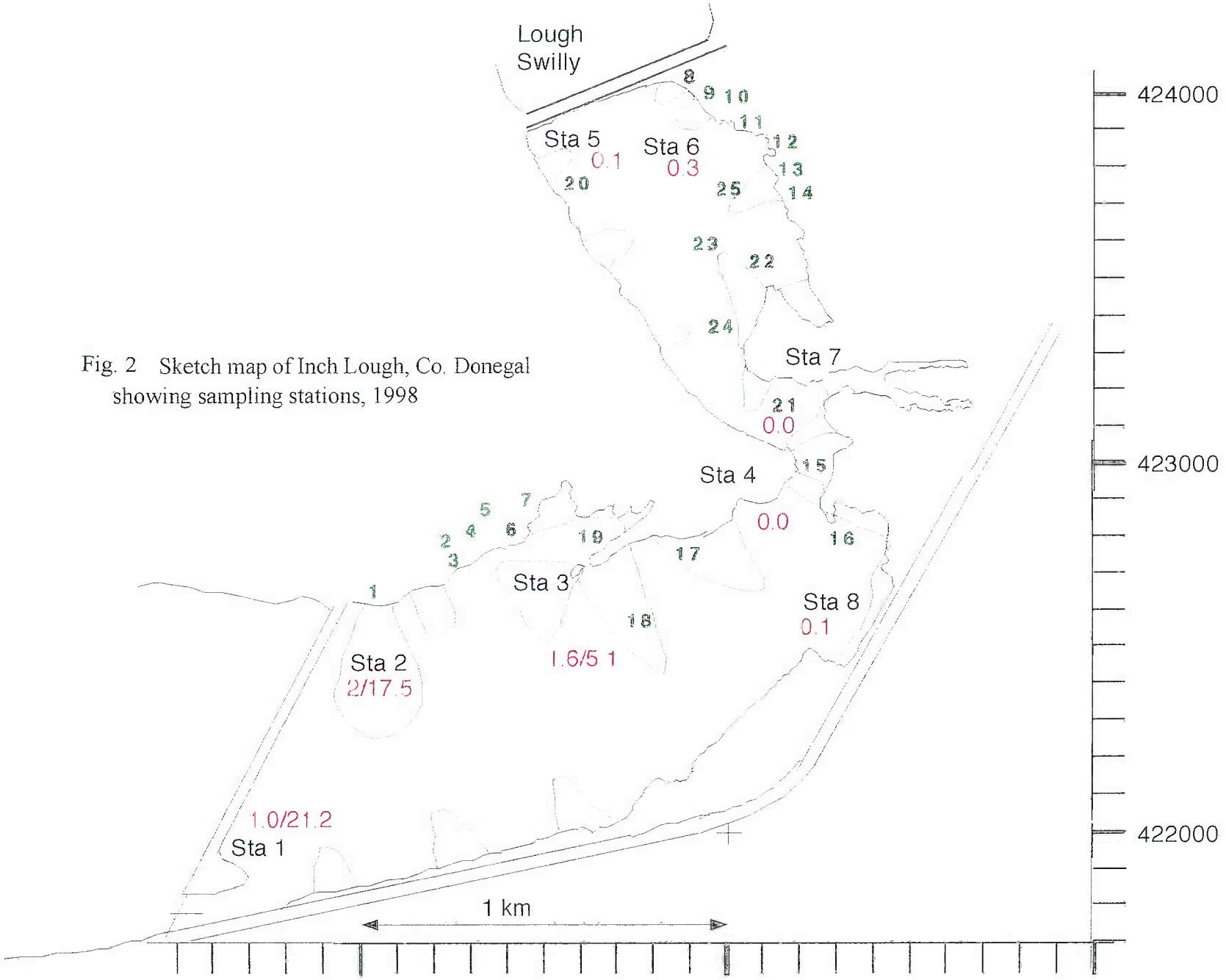


Fig. 2 Sketch map of Inch Lough, Co. Donegal showing sampling stations, 1998

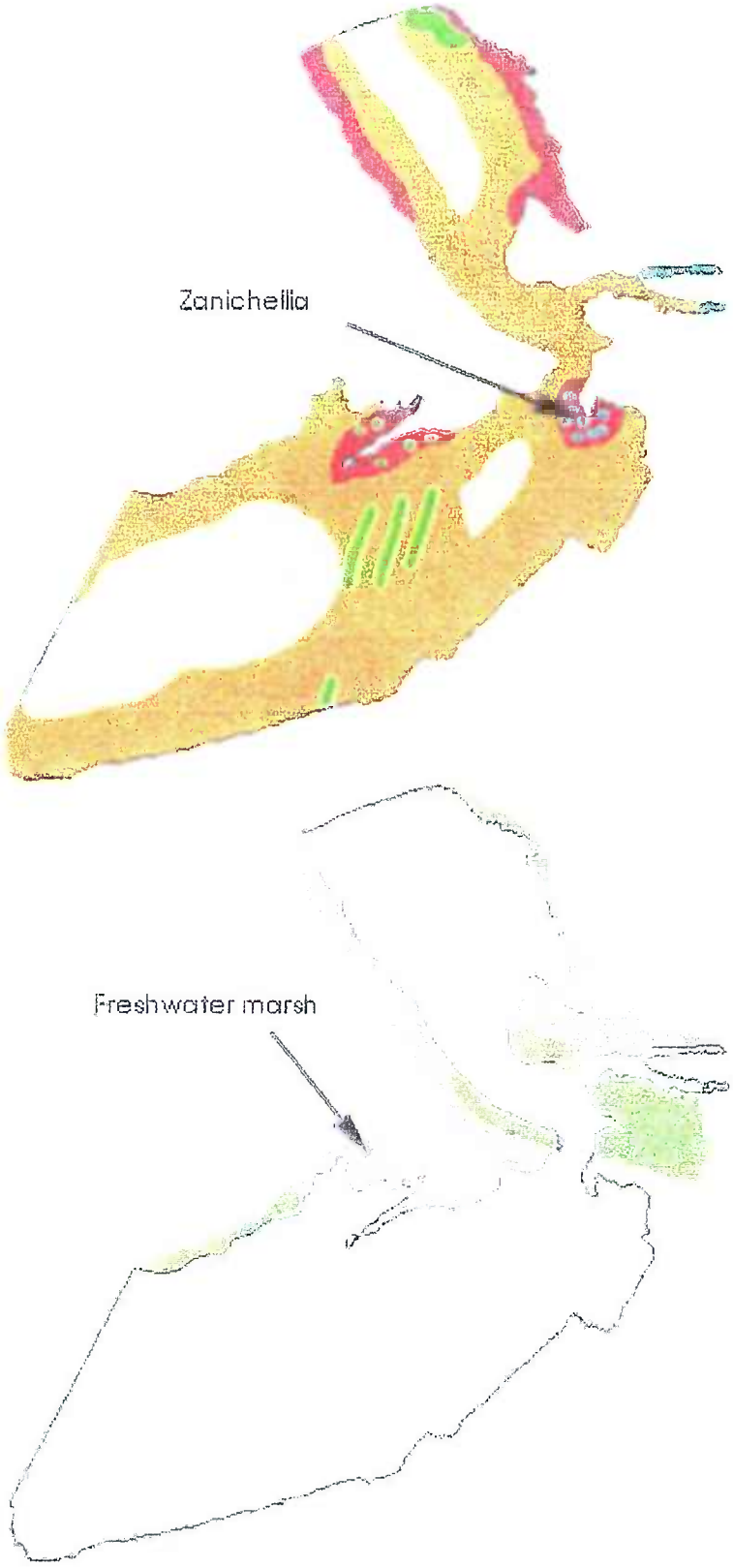


Fig. 3. Benthic and marginal vegetation of Inch Lough.

Results

Five types of vegetation were recorded, these are listed in order of areal extent:
(1) *Potamogeton pectinatus* communities, sometimes with *Myriophyllum spicatum*, mainly on mud (21,24,25).
(2) *Ruppia/P. pectinatus* communities on sandy ground (18).
(3) Charophyte communities with *C. aspera* and *C. canescens* (17,20,22).
(4) Areas of mud with drifting *Enteromorpha* and *Cladophora*. Large areas of the centre of the lagoon consist of soft mud with no vegetation other than loose clumps of these species.
(5) *Zanichellia palustris* community occurs on sand in one area in the centre of the lagoon (16).

Marginal vegetation consists of:
(1) small areas of the *Potentilla anserina* variant of the *Juncus gerardii* association (2,8,10,11,).
(2) *Eleocharis* communities (1,4,14),
(3) very extensive stands of *Schoenoplectus tabernaemontani* (3,5,6,7,9,12,13,).
(4) In the eastern half a large area of freshwater swamp vegetation occurs. While this vegetation is outside the definition of lagoonal vegetation, as it lacks any maritime species, it is of interest in its own right. Species include *Hippuris, Myosotis* sp. *Mentha aquatica, Baldellia ranunculoides, Caltha radicans, Galium palustre, Lythrum salicaria, Agrostis stolonifera.*

Phytoplankton was dominated by an unidentified dinoflagellate and consisted mainly of freshwater algae typical of eutrophic conditions.

Notable plants

This site contains a very large population of *Chara canescens*, the largest encountered in the survey and probably the largest in the country. Only a small number of *Ruppia* plants were in fruit. These were unusual with short fruit stalks, thus resembling the variety *brevirostris* of *Ruppa maritima.* Verhoeven (1980) notes that this variety occurs with *Zannichelia palustris* in brackish water. Inch was the only lagoon surveyed with a *Zannichelia* population.

Assessment

The flora of Inch includes a very large population of *Chara canescens* -a Red Data book species. The vegetation of Inch is varied compared with other lagoons and it is perhaps the best example of low salinity shallow lagoon in the survey. *Zannichelia palustris* and *Ruppia maritima* var. *brevirostris* communities were not found in other lagoons although the *Ruppia* variety may occur in the channels at Ballyteige.

AQUATIC FAUNA

Description

Inch Lough is a large artificial saline lagoon with two artificial barriers and one sluiced outlet.

The lake is situated on the Inishowen Peninsula, between the mainland and Inch Island, approximately 12 km to the west of Derry. Open water covers an area of approximately 160 ha and was formed by construction of 2 barriers from the mainland to

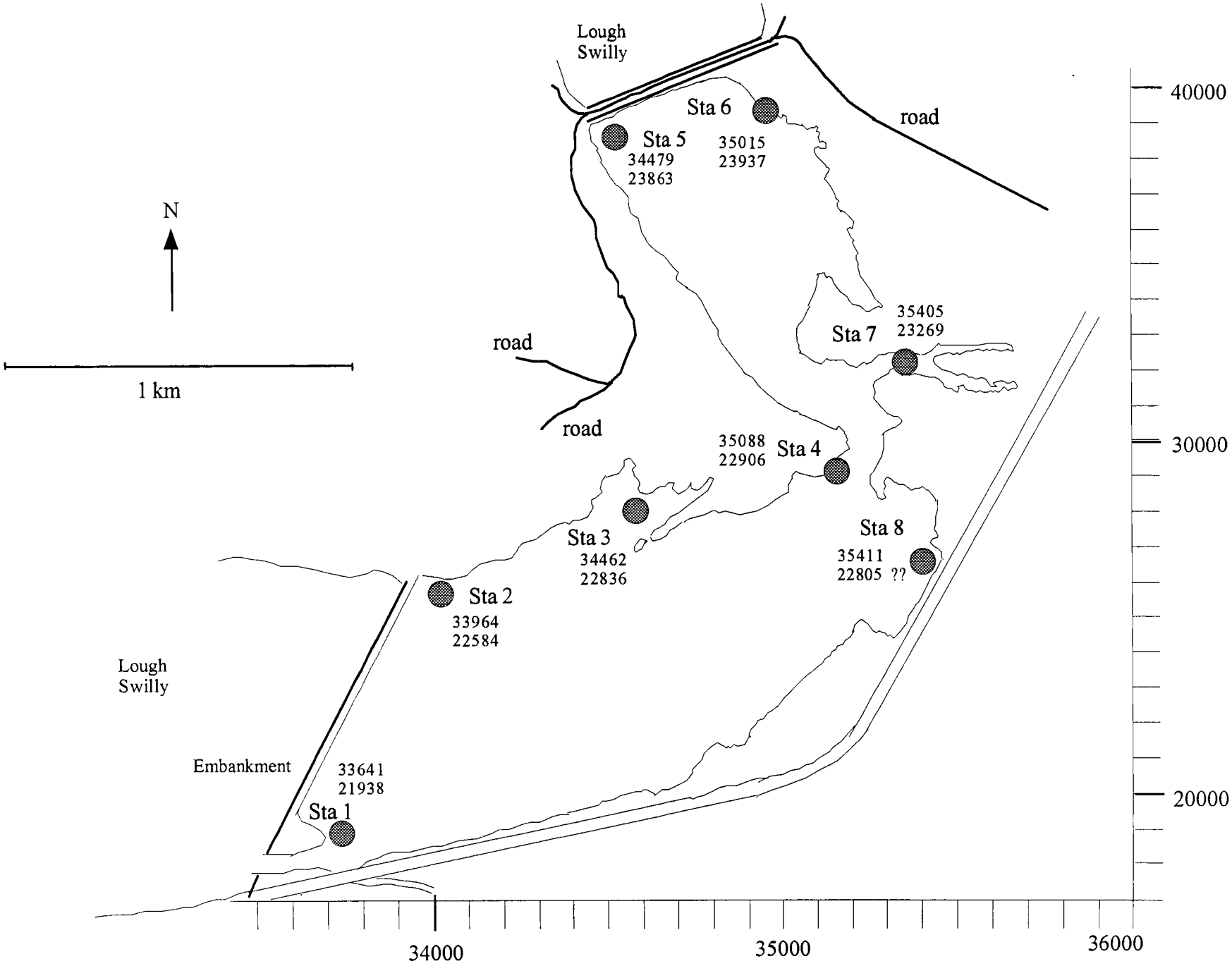


Fig. 4 Sketch map of Inch Lough, Lough Swilly, Co. Donegal, showing sampling stations used for a survey of aquatic fauna, 1998.

Inch island and a railway embankment along the eastern shore. There may have been an intention to reclaim this previously tidal area between the island and the mainland, but it is now flooded and water is pumped into it from the surrounding polderland. The lake is shallow throughout (less than 2m) and substrate consists of previously estuarine sediments of sand, gravel, and shells. Seawater presumably enters on the highest spring tides through gaps in the sluice flaps but also by percolation through the barrier. However, large volumes of freshwater enter from drainage ditches and by pumping from the polderland. Salinity is generally low (0 -2ppt) but up to 20ppt were measured along the southern causeway at 2m depth.

The polderland is now mostly part of one large 3,000 acre farm owned by the local creamery and managed by agreement between the NPWS and the creamery. The lake holds large numbers of waterfowl in the winter and is generally of great ornithological value (Hutchinson 1986, Sheppard 1993).

Sampling stations

The area was sampled in June 1996, briefly on 27/6/ 98, and from 11 - 15/9/98. Eight sampling stations were selected to reflect the influences of substrate, vegetation, freshwater and tidal inflows (Fig 4).

Station 1 (C33641 21938) was located at the south-west end of the lough near the causeway and sluice. Depth was up to 2m and salinity increased from 1ppt on the surface to 13.8ppt at 1m and 21.2ppt at 2m depth. Substrate consisted mostly of stones, coarse sand and fine sediments in sheltered areas. The area was bordered by the stone embankment, overhanging bushes and patches of wet grassland.

Station 2 (C3395 2265) was located at the north end of the southern embankment on the shoreline of Inch island. Water levels were particularly high (up to 1.5m) and substrate consisted partly of flooded wet grassland with gravel and stones in deeper water. Salinity measured 2 - 5ppt along the shore and up to 17.5ppt at 1.5m. The area was bordered by the stone embankment and patches of wet grassland.

Station 3 (C34462 22836) was located on the south eastern shoreline of Inch island inside a small bay formed by a spit running to the southwest. Depth varied from 0 - 1.2m and salinity from 1.6 - 5.1ppt, respectively. Substrate consisted of flooded wet grassland and *Scirpus,* marine sediments with soft mud and some stones. at depth.

Station 4 (C35088 22906) was located on the western shore of the central narrowest part of the lake where a track runs across a ford from the mainland to the island. Depth was up to 0.75m and salinity measured 0ppt (115 mg/l). As water levels were so high substrate was mostly flooded grassland at the time of sampling, but was seen to consist of stones along the ford and fine muddy sand on previous visits.

Station 5 (C34479 23863) was located at the north west corner of the lake beside the northern embankment. Depth was up to 1m and salinity measured 0.1 - 0.2ppt (311 - 365mg/l). Substrate consisted of stones and fine silty sand. The area was bordered by the stone embankment, alder woodland and *Scirpus* along the shoreline with a floating mat of decaying green algae.

Station 6 (C35015 23937) was located on the northeast shore of the lake. Depth was from 0.2 -0.75m and salinity measured 0.3ppt (450mg/l). Substrate was presumably silty sand but covered with a thick layer of decaying algae. The area was bordered by alder woodland and *Scirpus* along the shoreline.

Station 7 (C35405 23269) was located on the eastern shore of the lake where the river enters. Depth varied from 0.3 - 0.75m and salinity measured 0ppt (86mg/l). Substrate was mostly flooded grassland with softer sediments in the river channel. The area was bordered by *Scirpus, Juncus* and *Phragmites.*

Station 8 (C35611 22865) was located on the eastern shore of the lake just north of the pumping station. Depth was 0 - 1m. Salinity measured 0.1ppt (292 mg/l). Substrate was mostly flooded grassland, stones and soft silty mud. The area was bordered by flooded grassland and emergent vegetation.

Results

Table 1 shows the total species list for each station. The following is a list of species arranged in broad ecological categories based on the Venice system of salinity regimes (L* = lagoonal specialist in Britain, L*IR = proposed as lagoonal specialist in Ireland; * = interesting or rare species. Species in brackets refer to previous records):

Marine-polyhaline
- *Lumbricillus sp.*

Poly-mesohaline
- Tubificidae indet.
- *Corophium volutator*
- *Crangon crangon*
- *Pomatoschistus microps*

Euryhaline
- *? Procerodes littoralis*
- *Jaera nordmanni* L*IR
- *Lekanesphaera hookeri* L*
- *Neomysis integer* L*IR
- *Gammarus duebeni*
- *Carcinus maenas*
- *Palaemonetes varians* L*
- *Potamopyrgus antipodarum*
- **Conopeum seurati* L*
- *Anguilla anguilla*
- *Gasterosteus aculeatus*
- *Pleuronectes flesus*

Meso-oligohaline
- **Cordylophora caspia* L*IR
- *Ischnura elegans*
- *Corixa panzeri*
- *Sigara stagnalis* L*

Oligohaline-limnetic
- *Callicorixa praeusta*
- *Notonecta glaucum*
- *Sigara concinna* L*
- *Helophorus brevipalpis*
- *Laccobius biguttatus*
- *Noterus clavicornis*
- *Ochthebius dilatatus*
- *Lymnea peregra*
- *Rutilus rutilus*
- *Salmo trutta*

Limnetic
- *Hygrotus inaequalis*
- **H. novemlineatus*
- *Gerris odontogaster*
- *Sigara dorsalis*
- *S. scotti*
- *S. wollastoni*
- *Anisus leucostoma*
- **Aplexa hypnorum*
- *Limnaea palustris*
- *Oxyloma pfeifferi*
- *Physa fontinalis*
- *Vertigo antivertigo*

Uncertain
- *Cercyon convexiusculus*
- *Helophorus obscurus*
- *Propylea quatro- decimpunctata*

A total of 53 taxa were recorded and 43 were identified to species of which 5 are listed as lagoonal specialists in Britain and an additional 3 species are proposed lagoonal specialists in Ireland. Several species appear to be of particular interest:

Cordylophora caspia was also recorded at Kincas L. during this survey, and at Durnesh L. during the 1996 survey, at Rostellan, Co. Cork and Rinmore, Co. Galway during the Inventory and previously at Lady's Island L.(Healy *et al.*, 1982). According to Arndt (1984) it " appears to be an excellent bio-indicator for eutrophic brackish water in the horohaline zone". It is a proposed lagoonal specialist for Ireland.

Aplexa hypnorum appears to be an uncommon species in the north of the country (Kerney, 1976).

Hygrotus novemlineatus appears to have declined in Northern Ireland, mirroring the trend in England (Nelson *et al.* 1997).

Conopeum seurati has been recorded at 16 of the 36 sites surveyed, but is not listed in any review of Irish marine Bryozoa (Wyse Jackson, 1991). Either the species is under recorded or a truly lagoonal specialist.

Table 1. Aquatic fauna recorded at stations in Inch Lough, Lough Swilly, Co. Donegal. 1998.

		Stations														
Taxa		1	L.T. 1	2	L.T. 2	3	4	L.T. 4	5	L.T. 5	6	L.T. 6	7	L.T. 7	8	L.T.8
Cnidaria	*Cordylophora caspia*	+														
Turbellaria	*? Procerodes littoralis*			o										1		
Oligochaeta	*Lumbricillus sp.*			+												
	Naididae indet.								+							
	Tubificidae indet.								+							
Crustacea																
Copepoda												c500				
Mysidacea	*Neomysis integer*								c	66						
Isopoda	*Jaera nordmanni*	o														
	Lekanesphaera hookeri	c	31	a	270	o	o	5	c	6					o	7
Amphipoda		o	1	o	15		o	2	o	1			o			
	Corophium volutator			p	1											
	Gammarus duebeni	19	1	4	12		1	2	11	1			47		2	
Decapoda	*Carcinus maenas*	F = 17														
	Crangon crangon	a	7													
	Palaemonetes varians	o		o		o										
Insecta																
Odonata	*Ischnura elegans*								o							
Heteroptera	Corixidae indet					+		8	a	c300	c	c250	c	16	c	30
	Callicorixa praeusta								c	3	o	1	o	1		
	C. wollastoni										o	1				
	Corixa panzeri								a	11	a	10	o	1	o	3
	Gerris odontogaster						o		o						+	
	Notonecta glaucum												o		o	
	Sigara concinna										o	1				
	S. dorsalis										o	2	c	3		
	S. scotti								c	5	c	5				
	S. stagnalis						c	8	o	1	c	6	c	4	a	25
		F = Fyke net; L.T. = light trap; + = present, o = occasional, c = common, a = abundant.														

Table 1 (cont.) Aquatic fauna recorded at stations in Inch Lough, Lough Swilly, Co. Donegal. 1998.

Taxa		1	L.T. 1	2	L.T. 2	3	4	L.T. 4	5	L.T. 5	6	L.T. 6	7	L.T. 7	8	L.T.8
Coleoptera	*Cercyon convexiusculus*								1							
	Haliplus wehnckei								1				1			
	Helophorus brevipalpis	1					2									
	H. minutus														2	
	H. obscurus						3				1					
	Hygrotus impressopunctatus														2	
	Hygrotus inaequalis						1		3							
	H. novemlineatus								1							
	Laccobius biguttatus										3		1			
	Noterus clavicornis								1							
	Ochthebius dilatatus						10									
	Propylea quatrodecimpunctata								1							
Diptera	Chironomidae indet.			c									+		+	
	Ephydridae indet.			c												
Mollusca	*Anisus leucostoma*								+				+			
	Aplexa hypnorum			+									o		+	
	Lymnaea palustris			+					+		+		o			
	L. peregra	+					+	1	+				c		+	1
	Oxyloma pfeifferi			o			+		+		o		+	2	+	
	Physa fontinalis												+			
	Potamopyrgus antipod	o		a	6	c			c		+		+		+	5
	Vertigo antivertigo	+							+		+					
Bryozoa	*Conopeum seurati*	+														
Pisces	*Anguilla anguilla*	F = 9											F=4		F=8	
	Gasterosteus aculeatus	c	5	a	17		a	70	c	48	c	16	a	47	a	465
	Pleuronectes flesus	F = 35											F=6		F=7	
	Pomatoschistus microps		6		6											
	Rutilus rutilus														F=1	
	Salmo trutta												F=1			
		L.T. = light trap; F = Fyke net; + = present, o = occasional, c = common, a = abundant.														

Evaluation

Although totally artificial, Inch Lough is one of the largest lagoonal habitats in the country.

The species list is fairly extensive due to the abundance of oligohaline/limnetic species of Heteroptera and Coleoptera but many of the other species are euryhaline with several lagoonal specialists and interesting species.

The lough is protected as a bird reserve but should also be valued for its invertebrate fauna.

ECOTONAL COLEOPTERA

This is a large saline lake formed from a doubly impounded island arm of estuary with causeway sluice doors allowing seawater ingress, and with a pumped inflow from a large reclaimed area of agricultural land. The site supports large numbers of breeding and wintering waterfowl (site is designated as an SPA). There is extensive freshwater marsh and wet pasture.

Sampling

Two areas were selected for sampling from 5/7 – 6/8/98:
(1) (C351229) An area of lightly-grazed pasture shore (c. 7 m width; flooded at high water) used as a loafing area by swans and waterfowl (many swan droppings were present), with *Potentilla anserina, Plantago major, Glaux maritima, Juncus gerardii* and *Agrostis stolonifera*. Offshore (0.5 m) salinity was 8‰ (5 vii 1998).
(2) (C342226) An area of shelly sandy beach with a sparse (c. 50%) cover of *Agrostis stolonifera, Poa* sp. and *Juncus bufonius* grading into dense *Agrostis stolonifera, Potentilla anserina, Plantago major, Senecio palustris*, etc. The sediment was organic-rich, and offshore (0.5 m) salinity was 4‰ (5 vii 1998). The amplitude of water fluctuations was high in spring and summer 1998.

Results

A total of thirteen species of carabid and thirty-seven species of staphylinid were recorded, four of which are regarded as indicator species (Tables 2 and 3).

Bembidion bipunctatum is a halotolerant shore species, occurring inland and in coastal shingle and brackish water pools (Koch 1989, Hyman and Parsons 1992). It is widespread but local in Great Britain (Hyman and Parsons 1992), and recorded from Ireland (Speight *et al.* 1982). It occurs from North Africa to west Siberia, and is common at least in northern Germany, although rarer further west (Freude 1976).

Bembidion aeneum is a stenotopic halobiont species, occurring in the salt spray zone above the upper shore and near brackish pools (Koch 1989). Although it is not listed as rare or notable in Great Britain (Hyman and Parsons 1992), and is listed as Irish without annotation by Speight et al. (1982), it is local in Britain and Ireland according to Lindroth (1974).

TABLE 2. Staphylinidae from an impounded estuarine inlet lagoon shore at Inch Lough (Lough Swilly, Co. Donegal). Indicator species are marked with an asterisk.

Aloconota gregaria (Er.)	3
Amischa analis (Grav.)	1
Anotylus rugosus (Fab.)	2
Atheta amplicollis (Muls. Rey)	5
Atheta graminicola (Grav.)	6
Atheta zosterae (Thoms.)	1
Encephalus complicans Kirby	1
Gabrius coxalus (Hochh.)	1
Lesteva sicula Er.	1
Omalium laeviusculum Gyll.	1
Oxypoda exoleta Er.	1
Philhygra elongatula (Grav.)	1
Philhygra melanocera (Thoms.)	1
Philonthus carbonarius (Grav.)	6
Philonthus cognatus Steph.	13
Philonthus concinnus (Grav.)	1
Philonthus furcifer Renk. *	1
Philonthus laminatus (Creutz.)	19
Sepedophilus nigripennis (Steph.)	1
Staphylinus dimidiaticornis Gemm.	1
Stenus boops Ljungh	1
Stenus brunnipes Steph.	7
Stenus canaliculatus Gyll.	7
Stenus cicindeloides (Schall.)	12
Stenus clavicornis (Scop.)	1
Stenus formicetorum Mannh.	3
Stenus fulvicornis Steph.	22
Stenus juno (Payk.)	4
Stenus melanopus (Marsh.)	4
Stenus nanus Steph.	4
Stenus picipes Steph.	16
Stenus similis (Herbst)	4
Tachinus laticollis Grav.	1
Tachinus signatus Grav.	15
Tachyporus dispar (Payk.)	1
Tachyporus obtusus (L.)	1
Tachyporus tersus Er.	3

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Agonum marginatum (L.)	13
Agonum muelleri (Herbst)	6
Amara plebeja (Gyll.)	1
Bembidion aeneum Germ. *	27
Bembidion bipunctatum (L.) *	2
Bembidion mannerheimi Sahlb.	1
Bembidion tetracolum Say	4
Carabus granulatus L.	4
Loricera pilicornis (Fab.)	3
Pelophila borealis (Payk.) *	2
Pterostichus diligens (Sturm)	1
Pterostichus nigrita (Payk.)	11

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Pelophila borealis (Payk.) *	2
Pterostichus diligens (Sturm)	1
Pterostichus nigrita (Payk.)	11

Evaluation

The presence of four indicator species (the highest number recorded at any lagoon or saline lake) indicates significant conservation value for this site. The occurrence of a sandy substrate, large areas of marshy habitat, and the presence of large numbers of waterfowl make this site similar in several respects to lagoons like Lady's Island Lake, despite the fact that Inch L. is artificial.

SUMMARY

Inch lough is a good example of a large, shallow lagoon with very low salinity. High salinities are present in some areas near the bottom. Vegetation is diverse and interesting with well developed charophyte communities, including a large population of *Chara canescens* with *Zannichellia*, and a mixed *P. pectinatus/ Ruppia* community. Fruiting *Ruppia* resembled the var. *brevirostris*. Emergent and marginal vegetation was also diverse. Aquatic fauna included freshwater as well as oligohaline and euryhaline species. 8 lagoonal specialists were recorded. Beetles and heteropterans were diverse. Ecotonal Coleoptera included four indicator species, including one stenotopic halobiont.

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COLOUR CODES FOR VEGETATION MAPS

BENTHIC VEGETATION

Beggiatoa

Cladophora battersii

C. aegagropila

Chaetomorpha linum

Zostera marina

Ruppia/Lamprothamnium

Ruppia sp.

Potamogeton pectinatus

Chara spp

No vegetation

Red algae

MARGINAL VEGETATION

Puccinellietum

Juncus maritimus comm.

Juncus gerardii typicum comm.

J. gerardii comm. *Potentilla* var.

Blysmus assn.

Festuca rubra comm.

Eleocharis comm.

Scirpus maritimus

S. tabernaemontani

Phragmites australis

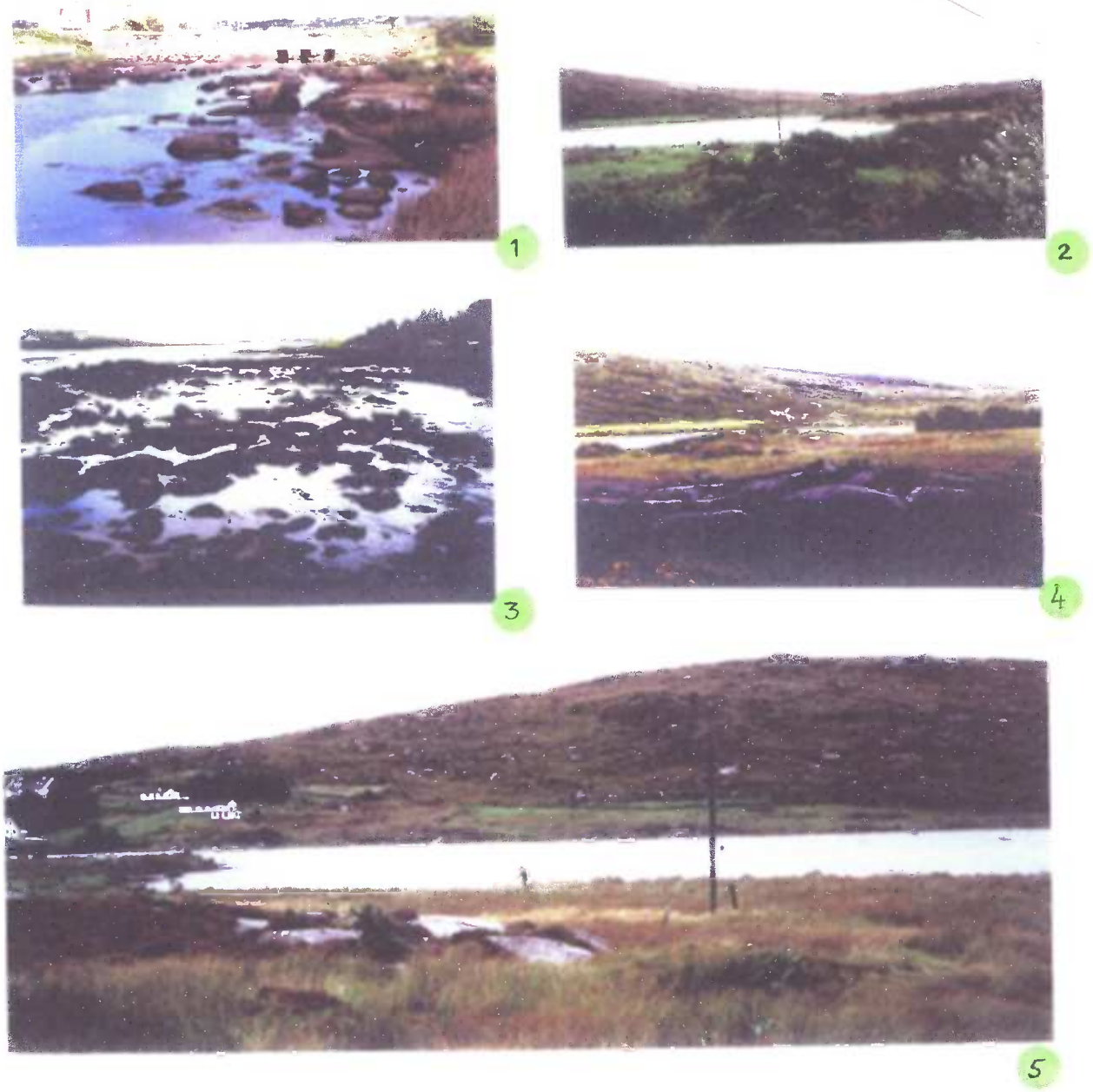

Plate 15. Moorlagh, Co. Donegal. 1. Causeway and sluices; 2. View from road looking southeast; 3. Outlet to the sea; 4. View from road looking southeast; 5. View from road looking east (faunal Stn. 3 in the foreground, Stn. 4 in the distance).

Plate 16. Inch Lough, Co. Donegal. 1. View from the west embankment, 2. Sluices at west embankment, 3. View of the central region from Inch Island, bed of *Schoenoplectus tabernaemontani* in the foreground, 4. west embankment, Inch Island in the distance, 5. *Enteromorpha* near the north embankment, 6. *Scirpus maritimus* near the west embankment with Pat Hatch collecting.

SUMMARY

Inch lough is a good example of a large, shallow lagoon with very low salinity. High salinities are present in some areas near the bottom. Vegetation is diverse and interesting with well eveloped charophyte communities, including a large population of *Chara canescens* with *Zannichellia*, and a mixed *P. pectinatus/ Ruppia* community. Fruiting *Ruppia* resembled the var. *brevirostris*. Emergent and marginal vegetation was also diverse. Aquatic fauna included freshwater as well as oligohaline and euryhaline species. 8 lagoonal specialists were recorded. Beetles and heteropterans were diverse. Ecotonal Coleoptera included four indicator species, including one stenotopic halobiont.

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