A SURVEY OF THE FLORA AND VEGETATION OF SIXTEEN IRISH COASTAL LAGOONS

PART THREE OF 1998 LAGOON SURVEY

CILIAN M. RODEN

TABLES OF CONTENTS

Chapter 1
Introduction

This report describes a vegetation and flora survey of 16 Irish lagoons and saline lakes. The survey was comissioned by Dúchas, the Parks and Wildlife Service . The purpose of the survey was to determine the conservation value of these lagoons. This was to be done by examining the sublittoral, emergent and marginal plants and vegetation of the chosen sites. This data was then to be analysed and the results used to rank the lagoons in order of conservation importance.

The work is part of a national lagoon survey which was led by Dr B. Healy . As part of this survey, botanical fieldwork on a further twenty lagoons has already been carried out by Mr P. Hatch in 1996. The results of his work are included in reports made to Dúchas in 1996 and have recently been published (Hatch and Healy 1998).This work greatly increased our knowledge of the botany of Irish lagoons. Notable discoveries included: (1)The addition of *Chara baltica* to the Irish flora, (2) new stations for very rare charophytes including *Chara canescens* and *Lamprothamnion papulosum,* (3) The supposedly rare *Ruppia cirrhosa,* (e.g. Webb and Scannell, 1983) was shown to be more widespread than previously realised, (4) a new plant community including *R.cirrhosa, L.papulosum* and *Zostera marina* was found in two Connemara lagoons. The present study attempts to extend the knowledge of Irish lagoons obtained by the 1996 survey team. Unfortunately in 1996 it was not possible to sample the deeper sublittoral nor was the species composition of the more difficult marine algal groups such as *Cladophora* investigated. Consequently in the 1998 survey more emphasis was placed on studying the sublittoral benthic vegetation by means of snorkelling and identifying the more difficult marine algae.

In a rapid preliminary survey in June and July 1998 the survey team of Dr B. Healy, Dr J. Good, Mr G. Oliver and Dr C. Roden selected sixteen sites for detailed study. The selected sites were; Ballyteige Channels, Co. Wexford, Kilmore Lake, Whiddy Island, Co. Cork, An Loch Mór, Inish Oírr, Co. Galway, Loch an Chara, and Loch Phort Chorrúch, Árainn, Co. Galway, Cara Fionnla, Loch Fhada, Loch an Aibhnín, Loch an tSáile and Lough Athola, Connemara Co. Galway , Lough Bofin, Inish Bofin, Co. Galway, Maghery Lough, Sallys Lough, Kincas Lough, Moorlagh Lough and Inch Lough, Co. Donegal.

In Chapter 2, study methods are outlined, In chapter 3, lagoonal vegetation is described; in chapters 4-19 the botany and vegetation of individual sites is described and in Chapter 20 the conservation value of the sixteen sites is discussed and an overall ranking of the 16 sites surveyed in 1998 and the twenty sites surveyed in 1996 is presented.

Chapter 2
Methods

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 sublittoral diversity of each site. For every subjectively recognized 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. Specimens were collected and examined on shore. 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 snorkelling 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 Lugols 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 an 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.

Most species identifications were easily made using standard floras (Burrows 1991,Clapham, Tutin and Moore 1987, Dodge 1982, Maggs and Homersand 1993, Moore 1986,Tomas 1996,). 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 supports 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. Samples were collected from all fruiting populations and these are currently being studied by C.D.

Preston.

Potamogeton, only one species, the easily recognized *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 recognized. 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 recognized 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 in *green* on a map carrying the Irish National Grid. From this map the location of each sampling point is taken. Mr G. Oliver's salinity data are shown in *red*. When salinity stratification was recorded, two figures are given for each station the first shows the surface value, the second the deepest reading made. These values are also used in the vegetation tables. In the vegetation tables, in certain cases the salinity had to be estimated by extrapolating from the nearest field data available. Finally the location of Mr Oliver's sampling stations are printed in *black*. A brief account of the sampling points is presented in the text. A list of all species found at each point is given in the appropriate vegetation table. In these tables sampling points are identified by a site name and sampling point number, e.g. Maghery 5, which are shown in the top rows of each table. Species abundance is given using the Braun-Blanquet scale of abundance.

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

Chapter 3
Vegetation

Plankton

Plankton more than any other plant community changes in species composition over each year. Therefore the single samples analysed in this study represent only a partial picture. Three elements can be distinguished, i) species of coastal sea water, ii) species known to favour brackish conditions and iii) freshwater species. The species recorded are shown in table I . As might be expected species distributions reflect water salinity. The diversity of brackish water dinoflagellates, especially in the genus *Prorocentrum* , is most interesting as these species are seldom encountered, probably due to infrequent sampling (Dodge 1982). Equally, the very distinctive species *Stephanosphaera pluvialis* in Loch an Ghadaí was unexpected. It is more usually a species of rainwater pools in limestone karst in Ireland.

Further analysis of the planktonic flora of the sites is beyond the scope of this report, but the ecological role of plankton in lagoons should not be overlooked. Extremely dense blooms of dinoflagellates and other species were found at several sites, to the extent that lagoon water was very noticeably more turbid than fresh or seawater. This cloudiness accounts in part for the poor light at depth in some lagoons and the consequent restriction of macrophyte growth. A possible explanation is that lagoons are places where sea and freshwater mix. Algal growth in the former is known to be nitrogen limited while the in the latter it is phosphorus limited. Intermediate water may benefit from an adequate supply of both nutrients.

Benthic macrophytic vegetation on soft sediments.

Table II combines all the relevés taken on sublittoral soft sediments during the survey. In nearly all cases species diversity is low with less than 5 species recorded in most samples. The vegetation can be divided into five broad categories;
Charophyte communities,
Potamogeton pectinatus communities
Ruppia sp. communities
Zostera marina communities
Unattached Cladophoracean algal communities.

Charophyte communities.

Five different species of Charophyte were recorded., *Chara aspera*, *C.baltica*, *C.canescens*, *C.virgata* and *Lamprothamnion papulosum*. All four *Chara* species occurred close to the shore in water 0.5-1.5m in depth, usually on sand or gravel substrates at salinities of < 10 p.p.t. *L.papulosum* was most frequent as a member of *Ruppia sp.* communities growing on mud or silt in the centre of several shallow lagoons. *Chara* species tended to occur as single species populations or occasionally associated with other charophyte species, *Ruppia sp.* or *P. pectinatus*. Drift filamentous algae very frequently were entangled with *Chara* plants . The most developed *Chara* communities were found in Inch. Here both *C. canescens* and *C. aspera* were common over large areas close to the shore. Gravel patchs in shallow water along the edges of stratified saline lakes (e.g. Loch an tSáile, Loch Fhada, Kincas Lough) supported populations of *C. aspera* and rarely *C.virgata* (Loch an tSáile only). This is also the habitat of the rare *C. baltica* both in Loch An Aoire (Hatch and Healy 1998) and Loch an tSáile.

Brackish water charophyte communities are placed in the Charetum canescentis by

Corillion (1957) . He states that this association is found in shallow brackish water on sandy mud. It frequently borders *Ruppia* communities. However, in this association *C. canescens* is commoner than *C. aspera* while the reverse is the case in the present study. Krause (1997) states that *C. aspera, C.baltica* and *C. canescens* occur with *P. pectinatus* in the Baltic bordering *Ruppia* communities. Verhoeven (1980) describes a *Ruppia* association in the Baltic which includes all three *Chara* species mentioned, as well as *P.pectinatus* and *Zanichellia palustris*. The plants of this community are all found at Inch except for *C.baltica*. It is of interest that Verhoeven's community includes *Ruppia maritima* var *brevirostris*, a form that occurs at Inch. He also describes a *Ruppia* community from the Camargue in southern France which includes *C.aspera* as well as two *Tolypella* species which were not recorded in this survey. Several accounts of brackish Lochs in Scotland show that *Chara aspera* is common while *C.baltica* and *C.aspera* have been recorded from Loch Stenness in Orkney (Covey and Thorpe 1994, Dunn 1937). As *C. aspera* is the commonest *Chara* species encountered in the present study and in the 1996 survey, it would appear that the Irish and Scottish *Chara* communities are very similar. However the abundance of *C. canescens* in Inch lagoon suggests that this lagoon has close affinities to European mainland brackish *Chara* communities.

<u>*Potamogeton*</u> communities

Extensive single species stands of *P.pectinatus* occur in several of the sites surveyed. The plant occurred in lower salinities (<10 p.p.t.) with the exception of some aberrant plants in Maghery and Loch an tSáile. In Inch lagoon the plant was found in muddy rather than sandy ground, while on the Aran lagoons, it grew in the sediment trapped in submerged limestone grykes. Multispecies stands were less common but at Inch, *Myriophyllum spicatum* accompanied *P.pectinatus*, as did *P. berchtoldii* in a very limited area. Mixed *Ruppia/P.pectinatus* stands also occurred, these are discussed below. Drift *Enteromorpha* and less frequently drift *Cladophora* are often entangled with *P.pectinatus*.

In Loch an tSáile and Maghery Lough a form of *P. pectinatus* was found in high salinity water. (>15 p.p.t.). It may be the *flabellatus* variant (C.D. Preston pers. com) which has blunt tipped short strap like leaves. In Loch atSáile it grew sparsely with *Zostera marina* at 2-3m depth.

The essentially freshwater species *P. polygonifolius* was found in the upper basin of Lough a tSáile. In this basin a halocline divides fresh from brackish water. *P. polygonifolius* only grew in the upper water mass.

P.pectinatus communities are known to grow in brackish water along the coast of western Europe (Preston 1995, Verhoeven 1980) and the communities described in this report seem typical, except for the occurrence of the *flabellatus* form at high salinities. Hatch (1996 survey) reports that *P.pectinatus* occurred in eight of his sites while Covey and Thorpe (1994) characterise a biotope OB32 as brackish mud with *Potamogeton (pectinatus).*

<u>*Ruppia* communities</u>.

Plants of the genus Ruppia constituted the greater part of the benthic vegetation of the sixteen sites visited. Table II shows that a number of different plants are associated with *Ruppia* sp. The following sub divisions of *Ruppia* grouping can be made;

i) *Ruppia sp. /P.pectinatus* stands in low salinity water (3-13 p.p.t.)

ii) *Ruppia/ Lamprothamnion papulosum* stands in a wide range of salinities (4-30 p.p.t.)

iii) *Ruppia sp./Chaetomorpha linum* stands in salinities 10-30 p.p.t.

iv) *Ruppia sp., Zostera marina* stands in higher salinities (>15 p.p.t.)

v) Single genus stands of *Ruppia* over a wide salinity range.

This division is somewhat unsatisfactory as no distinction is made between *Ruppia maritima* and *Ruppia cirrhosa.* As previously explained this omission is due to the fact that non fruiting specimens were impossible to name correctly in the field and the great majority of plants were not in fruit. Table III shows that both species were recorded in nearly all the sites examined. In a few cases it was possible to determine which species was the more abundant.
Ruppia cirrhosa was commoner in the *Zostera* variant in Loch an Aibhnín, in the *Lamprothamnion* variant in Cara Fionnla, Loch Fhada, Lough Bofin and Lough an Ghadaí, as a single species in Loch Phort Chorrúch and in the channel at Ballyteige.
Ruppia maritima var brevirostris was the only species positively identified at Inch, it also occurred in the shallow seawater ditch at Ballyteige.
Ruppia maritima var maritima was commoner in Loch an Chara
Both species were common in the eastern basin of Loch an tSáile, while only *R.cirrhosa* was seen at depth, in the upper basin.
Covey and Thorpe (1994) group all *Ruppia* records from Scottish lagoons into a single biotope OB31 but state that considerable variation occurs within the grouping. Verhoeven (1980) made a detailed study of *Ruppia* communities in Europe. He distinguishes two *Ruppia* associations in Northern Europe and two in the Mediterranean.
i) Ruppietum brevirostris in temporary pools in Mediterranean Europe with *R. maritima brevirostris* as the sole character species
ii)Cladophoro-Ruppietum cirrhosae in permanent water bodies in Mediterranean Europe. Character species *Ruppia cirrhosa*, differential species *Cladophora vagabunda, C. fracta*
iii)Ruppietum maritimae, in shallow brackish water in northern Europe. Character species *Ruppia maritima.*
iv) Ruppietum cirrhosae in deeper brackish water in northern Europe. Character species *Ruppia cirrhosa,*
These associations are further divided into sub associations based on the occurrence of differential species, which include *R. maritima* in one sub association of the Cladophoro-Ruppietum cirrhosae and *R. cirrhosa* in one sub association of the Ruppietum maritimae.

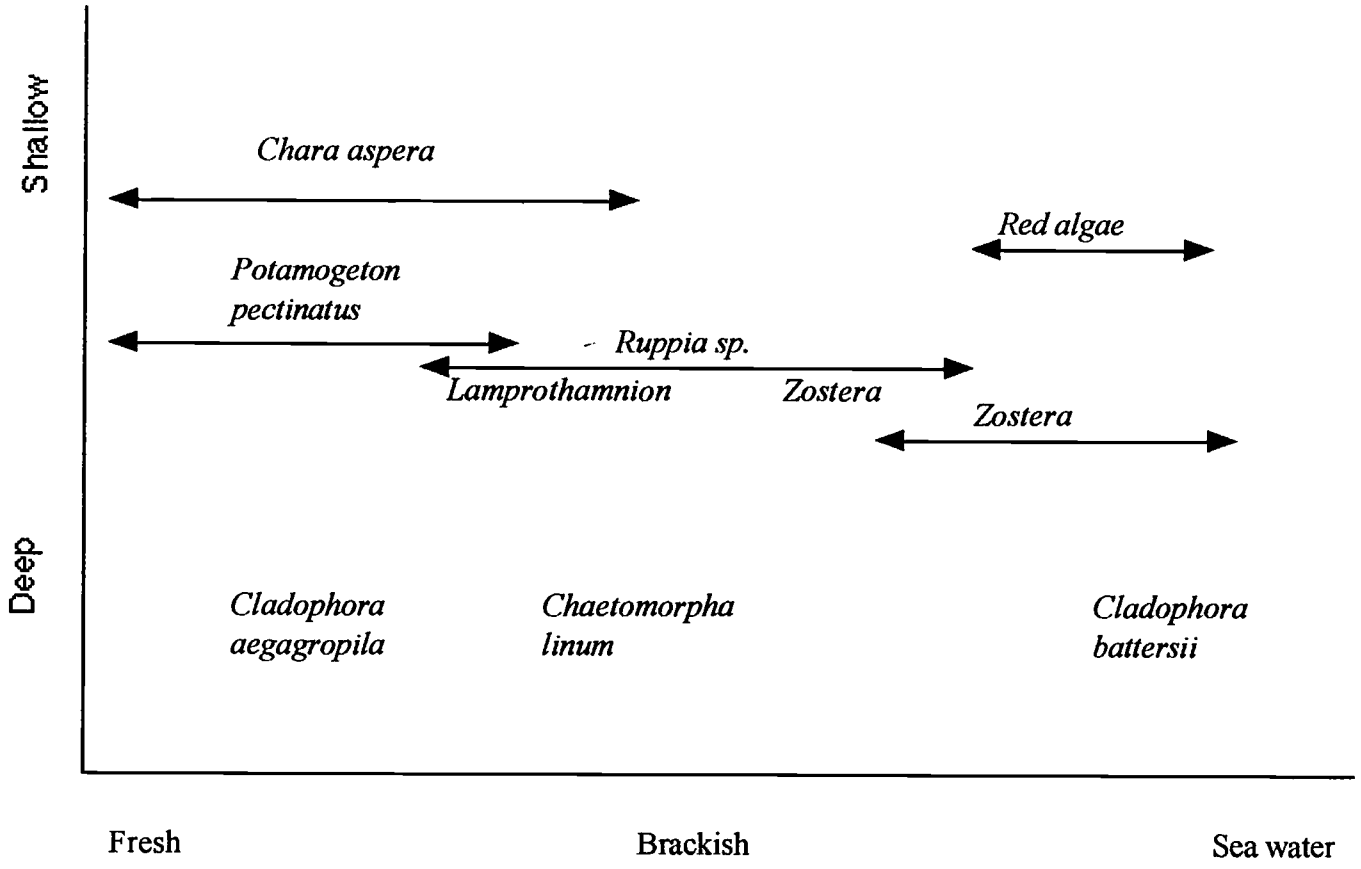
Given the identification difficulties of the genus this classification is not easily applied to the present data. Certain communities e.g. the *Ruppia/Lamprothamnion* samples are not represented in Verhoeven's data. Furthermore associations thought to be limited to Mediterranean Europe, e.g. the Cladophoro-Ruppietum cirrhosae would appear to be present in Ireland given the occurrence of C.vagabunda in several lagoons. This may reflect the fact that none of Verhoeven's data was collected from the Atlantic coast of Europe, with the exception of some data from the rather atypical community that peviously existed at Corragaun Lough in Co. Mayo. However when sufficient fruiting material was available Verhoeven's central observation that *R. maritima* was a plant of shallow, possibly temporary water bodies while *R. cirrhosa* was a plant of deeper permanent water was supported by the results of this survey. But it is debatable that this distinction is very clearcut. On several occasions underwater observations showed occasional *R. maritima* plants in swards of *R.cirrhosa* plants and vice versa. Table IV attempts to equate the communities described in this report and Verhoeven's data. In general a reasonable correspondence exists but the following discrepancies can be seen.
1) The *Ruppia /Lamprothamnion papulosum* stands are not represented in Verhoeven's data however Corillion (1957) recognizes a *Ruppia, Althenia, Lamprothamnion* community on the Mediterranean and Atlantic coasts of France. This contains species not known from Ireland but *L. papulosum* occurs from the Baltic to the Black Sea (Krause 1997). Scottish lagoons in the outer Hebrides are also known to support *Ruppia sp. /L. papulosum* communities (JNCC, unpublished data).So a European wide *Ruppia/L. papulosum* community would appear to exist. In this study it was found in seven sites and was also found by Hatch in Lough Muree

although *P.pectinatus* also occurred.
2) A related community including *Ruppia (cirrhosa), Zostera marina, L. papulosum* and *Sporochnus paradoxus* was well developed in Loch an Aibhnín and was also recorded by Hatch at Loch Tanaí and Lettermullen Pool.
3) Prof. Van Den Hoek confirmed the presence of *Cladophora vagabunda* in Irish lagoons. This species was only recorded by Verhoeven in his Mediterranean relevés and he made it a differential species within the Cladophoro-Ruppietum cirrhosae. Its presence in Irish stands of *R.cirrhosa* e.g. Loch an Ghadaí suggests that the difference between Mediterranean and western European *Ruppia* communities is less than thought.
3) The *Ruppia* associations are not clearly defined and transitional stands are very common , as is the case with all the vegetation discussed in this chapter.

Zostera communities.
Zostera marina communities were only noted in two sites, Loch an Aibhnín and the lower basin of Loch an tSáile . In the first site a large part of the centre of the lagoon was occupied by dense swards of *Z. marina* with the orange ascidian *Ciona intestinalis* attached to the plants. In Loch an tSáile the sward was more sparse with more *Chaetomorpha linum.* Covey and Thorpe define a *Zostera* biotope in Scottish lagoons, OB30.

Cladophoralean algal communities.
A striking aspect of the lagoonal sublittoral is the presence at depth, of dense masses of *Chaetomorpha* and *Cladophora* species. Both genera are members of the green algal group, the Cladophorales. This abundant growth at depth may reflect a capacity to grow at low light intensities. It is noticeable that no photosynthetic macrophytes were found at greater depths than these plants.
Three species were found, *Cladophora aegagropila* covered a large part of the upper basin of Loch an tSáile, *Cladophora battersii* was common on the muddy floor of Sallys Lough and Lough Athola, while *Chaetomorpha linum* occurred in several lagoons. Other than stray plants from adjoining communities multispecies mixtures were not found. It is possible that salinity differences account for the species distribution. *C. battersii* was confined to high salinity lagoons, *C.linum* had a general distribution while *C. aegagropila* was confined to a lake with a freshwater upper layer.
Several other species of *Cladophora* were also recorded. Prof. Van Den Hoek identified *C.vagabunda* from two sites, Loch an Chara and Loch an Ghadaí and as previously explained it probably occurs at many other sites. Burrows (1991) states that the species was only recorded from Clare and Antrim, but it is probably under recorded. It grows in loose strands often twined around *Ruppia* sp. and other macrophytes, it also forms floating masses in some lagoons.
C. liniformis was also identified from Loch Fhada by Prof.. Van Den Hoek, this species has apparently not been recorded from Ireland previously (Burrows 1991), most probably because it has been overlooked rather than because it is very rare.

The relationship of the benthic lagoonal communities are shown in terms of depth and salinity in figure 3.1 . This diagram explains much of the vegetation's variability but certain communities overlap and the environmental factors which influence them must be more complex than salinity and depth.



3.1 This diagram shows the distribution of the more important species of macrophyte in relation to depth and salinity in the lagoons studied.

Benthic communities of hard substrates.

Lagoons formed as impoundments of bays by gravel or sand rarely have extensive areas of outcropping rock. However, many of the present sites are rock basins which have been partially inundated by the sea. This type of lagoon is rare in western Europe and Scottish examples are perhaps the most similar to those described in the present study. In table V species found on rock are listed, while in tableVI species lists from different locations are compared. Table V shows that only the higher salinity sites have an extensive algal flora. Insufficient work was carried out to rigorously define the macro-algal communities present, but it is possible to provide a general outline of these communities.

The most noticeable feature of the macroalgal vegetation is the minor role played by the Brown algae or Phaeophyceae. Several species of *Fucus* were recorded but these very rarely formed extensive beds as on tidal shores. Instead Red algae were the most conspicuous species. The following communities can be recognized;

1) a species poor community with *Phyllophora pseudoceranoides, Chondrus crispus, Hildenbrandia sp., Cladophora rupestris* and entangled *Chaetomorpha linum*. This grouping occurred on flat or vertical rocks in shallow water with salinity >20 p.p.t. It was found at four lagoons (Loch an Aibhnín, Loch Fhada, Sallys Lough and Maghery Lough). It resembles OB24 of Covey and Thorpe (1994) "hard substratum with algal turf including *Phyllophora pseudoceranoides"*.

2) A richer variant with *Furcellaria lumbricalis* dominant occurred in Loch an Aibhnín , Maghery and Sallys Lough. This was commonest on flat surfaces and again can be related to a biotope in described in Covey and Thorpe (1994) OB23 "Bedrock and boulders with *Polyides/Furcellaria"*.

3) In the deep holes near the sills of Loch an Aibhnín and Lough Athola, a diverse algal community is found. The existence of a depression just inside the sill suggests some type of excavation by tidal currents of the soft peaty sediments, that fill much of the basins of these two lagoons. Significantly, the floor of both holes was comprised of stones and gravel while the sides were of submerged peat. However during exploration there was no indication of rapid water movement, possibly due to the very small volume of water exchanged through the narrow entrance channels. The community has some similarity to OB21 of Covey and Thorpe "deep tidal rapids with kelps and coralline algae". Kelps were not prominent at either site while *Cystoseira* species were occasional.

4) Many rock surfaces in Loch an Aibhnín had a distinctive and richer flora than in types 1 and 2. *Laurencia obtusa, Chyllocladia verticilliata, Chondria dasyphylla* and *Cladophora pellucida* were common; these species have a southern range and are not mentioned in Covey and Thorpe (1994).

5) The vegetation on shallow rocks in Lough Athola is very distinctive with the southern species *Chondracanthus acicularis* and *Pterocladia capillaris* dominant. It is discussed in more detail under the Lough Athola site description. There is no equivalent type in Covey and Thorpe (1994).

6) The entrance channel of Loch an tSáile supports a submerged vegetation of *Fucus serratus* and *F. vesiculosus*, this corresponds to OB14 of Covey and Thorpe (1994) "sublittoral fucoid zone in microtidal brackish water"

7) Scattered plants of *Fucus ceranoides* are found in the stoney sub littoral of several lagoons, these were intermixed with *Ruppia* or *P. pectinatus* stands but can be equated to OB15 of Covey and Thorpe (1994), "sublittoral zone of *Fucus ceranoides*".

8) Bare rock in low salinity lagoons supports a species poor green algal vegetation with *Enteromorpha sp. Cladophora sp.* and in deeper water (>1m) *Chaetomorpha linum* . This is

equivalent to OB19 of Covey and Thorpe (1994) boulders and bedrock with filamentous algae. It is found in nearly all the sites investigated.As explained in the methods section the commonest *Cladophora* and *Enteromorpha* species encountered in this habitat were *C. vagabunda* and *E. intestinalis.*

Vegetation of lagoon margins

All the lagoons described in this report had some form of halophytic vegetation bordering their shores. The extent of this vegetation was determined in large part by the nature of the lagoon in question. Lagoons formed in rock basins tend to have steep cliff like shores with a rapid transition from lagoonal communities to terrestrial communities. Lagoons with shores of sand, peat or mud have more gradual transitions and larger areas of marginal vegetation. As the lagoons have a wide range of salinities, marginal vegetation ranges from halophytic vegetation such as salt marsh to freshwater marsh and grassland. The limit of marginal vegetation was arbitrarily defined as the point at which halophile or coastal plants disappeared .

Irish coastal vegetation has been studied intensively by many ecologists (e.g. Wymer 1984, Sheehy Skeffington and Wymer,1991 and Curtis and Sheehy Skeffington,1998) and a framework of associations has been defined in accordance with the Zurich Montpellier method. Wymer (1984) gives a comprehensive account of salt marsh communities and the results of this survey are interpreted with reference to his work.

In tables (VII--X) the results of the marginal vegetation survey are presented. The vegetation is divided into a number of broad categories;

i) *Puccinellia* communities
ii) *Juncus maritimus* communities
iii) *Festuca rubra* communities
iv) *Juncus gerardii* communities
v) *Eleocharis* communities
v) *Phragmites, Schoenoplectus* and *Scirpus* communities.

In the following account relevés are referred to by site name and sampling point number (shown in green on the reference maps). These are shown in the first two rows of each table.

Puccinellia communities (Table VII, Maghery 6-Sallys 12)

These relevés can be included in the armerietosum sub association of the Puccinellietum maritimae association proposed by Wymer. He notes that this sub association is both widespread in western Ireland and characterized by the presence of *Armeria maritima* or *Glaux maritima*, species which are more usually confined to the upper levels of salt marsh. In this study the Puccinellietum association had a very limited distribution at the waters edge of the most saline lagoons.

Juncus maritimus communities. (Table VII, Loch an tSáile 6-Sallys 13)

The *Juncus maritimus* relevés can be subdivided into those with *Armeria maritima*, those with *Festuca rubra* and species poor stands with *Agrostis stolonifera.* Wymer defines a *Juncus maritimus* armerion community which closely resembles the data presented here, however it contains more halophile species such as *Aster tripolium.* In contrast *Samolus valerandii* and *Leontodon autumnalis* are less frequent. The present data appears to be a species poor variant of this community.

While Wymer states that the *Juncus maritimus* community is found in the upper saltmarsh it is striking that in most lagoons, this community occurs at the waters edge. It is one of the commonest communities encountered and forms large stands around Loch an Aibhnín, Loch

Fhada, Loch an tSáile and Loch Athola.

Festuca rubra community (Table VIII, Athola 2-Sallys 17)
A sward of *Festuca rubra* with some associated species occurs locally around several of the lagoons. Floristically it closely resembles the *Festuca rubra* community defined by Wymer but Springer (1999) suggests that the constant presence of *A.stolonifera* justifies the recognition of a separate lagoonal community.

Juncus gerardii communities (Table VIII, Bofin 1-Athola 17)
These relevés can be grouped together on the basis that *Juncus gerardii*, *Glaux maritima* and *Agrostis stolonifera* are usually present. This type of vegetation is extremely common around most of the sites described although very often it does not cover a large area. There is great floristic variation but it can be related to the *Juncus gerardii* communities described by Wymer. Four variants can be distinguished
i) with *Potentilla anserina* and *Leontodon autumnalis*,
ii) with *Samolus valerandii*,
iii) with *Plantago maritima* and *Triglochin maritima*,
iv) With *Blysmus rufus*,

i) was also described by Wymer from Loch an Chara, Loch Phort Chorrúch and Ladys Island Lake as the *Juncus gerardii Potentilla anserina* community. In this study it was also found at Inch and Lough Bofin. Wymer notes the absence of several halophile species compared to the Juncetum gerardii of many Irish salt marshes.
ii) This variant occurs in patches along the shores of several Connemara sites.
Both these variants are poor in halophiles and are possibly lagoonal variants of upper salt marsh *Juncus gerardii* communities.
iii) This variant with a greater number of halophiles can be correlated with the Juncetum gerardii typicum of Wymer. The association is widely distributed in Irish salt marshes but in this study was only found beside high salinity lagoons.
iv) *Blysmus rufus* is a local plant around the Irish coast. It was found beside three higher salinity lagoons (Loch an Aibhnín, Lough Athola and Sallys Lough). Wymer follows established precedents and included his data in the Blysmetum rufi association which resembles the Juncetum gerardii except for the presence of *Blysmus*. The species reported here agree closely with those listed by Wymer. The association is not widespread but occurs in small patches bordering *Juncus maritimus* and *Juncus gerardii* communities.

Eleocharis communities (Table IX, Ghadaí 4-Bofin 10)
Eleocharis uniglumis was recorded from a number of sites. It is known to occur near brackish water and has already been recorded from several of the sites under discussion. However little Irish data on *E. uniglumis* associations are available (White and Doyle 1981). In this survey *E.uniglumis* was sometimes mixed with the similar *E.palustris* and *Agrostis stolonifera* was a constant associate. Halophile species include *Triglochin maritima*, *Glaux maritima* and *Plantago maritima* but these were not present in all relevés. A division based on the present of *Leontodon autumnalis* or *Juncus articulatus* may reflect wetter or drier conditions.
Rocky lake shores have an open vegetation including *E.uniglumis* , *Plantago maritima* and *P.coronopus* in which *A.stolonifera* is absent or scarce. This occurs along the edge of several of the less saline loughs, (Table IX, Loch Mór 4- Loch Mór 7).

Emergent vegetation (Table X).
Three tall sedges or grasses formed very conspicuous elements of the vegetation, *Phragmites australis*, *Schoenoplectus tabernaemontani* and *Scirpus maritimus*. In many cases these species form single species stands in shallow water but some species groupings were also encountered these are possibly transitional to single species stands. Wymer included the Loch Phort Chorrúch stands in the Halo-Scirpetum maritimi, while the *S. tabernaemontani* stands are distinguishable by the presence of freshwater marsh species. Both communities are common in Ireland.

Wymer's classification of Irish salt marsh communities provides an adequate framework for most of the marginal communities encountered in this survey. The present data differs in two significant ways;
i) Communities which Wymer found to occur at the top of tidal salt marshes are found close to the waters edge in the case of lagoons. The communities of the lower salt marsh e.g. Salicornietum strictae did not occur while the Puccinellietum was poorly developed and confined to the more saline lagoons.
ii) The lagoonal communities differed from tidal marshes in having fewer halophile species such as *Aster tripolium*, and additional non halophile species, for example *Potentilla anserina*, were more common.

A comparison of the vegetation units recorded at each site.
A large number of vegetation units have been described in this survey for planktonic, benthic, emergent and marginal vegetation. The various tables show that these communities replace each other as salinity varies. In table XI the different vegetation units recorded at each site are shown with the lagoons listed in order of increasing salinity. The table shows that vegetation types in the different habitats can be correlated, thus high salinity lagoons have red algal communities on rock faces and are bordered by Puccinellietum communities, while the *Potentilla anserina- Juncus gerardii* community borders lagoons with stands of *Potamogeton pectinatus* and a predominantly freshwater phytoplankton. These correlations are obviously not absolute but they demonstrate that it is possible to classify lagoons as ecological units in which the different vegetation units co-vary. Here four different groups are recognised.
1) Lagoons with little or no *Ruppia*, with red algal communities on exposed rock, *Cladophora battersii* at depth on mud and marginal vegetation with Puccinellia, Juncus gerardii typicum and *Blysmus* communities. Marine phytoplankton.

2) Abundant *Ruppia* with *Zostera* and *Lamprothamnion papulosum*, red algae on exposed rock, marginal communities and plankton as in (1).

3) *Ruppia* and *Lamprothamnion* common,*Potamogeton* occasional or absent. Red algae very poor or absent, *Fucus, Cladophora* and *Enteromorpha* on rock, Pure stands of *C. linum* at depth, *Chara aspera* occasional, *Puccinellia* or Juncetum gerardii typicum rare or absent, *Juncus maritimus* common in marginal vegetation.

4) *Potamogeton pectinatus* common , *Ruppia* occasional or absent, no *Lamprothamnion*, *Chara aspera* or *C. canescens* occasional, *Enteromorpha* and *Cladophora* on rock, *Fucus* rare or absent. Marginal vegetation includes *Eleocharis* communities, *P. anserina* variant, No *Juncus maritimus.*

Chapter 4

Ballyteige Slob Channels
Co. Wexford T9506

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) 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 are filled by 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 (internal report to Duchás by R. FitzGerald).
Underwater observations. The main channel in Ballyteige is about two metres deep. The banks shelves 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 recognized 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).

Species lists were made at the following locations
(2937068) Small brackish pond (point 2)
(29401065) Main channel at 1m depth, turbid water and muddy bottom (point 4) Main channel at 1m depth, turbid water and muddy bottom (point 5).
(29461056) 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 4.1 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 phytoplankton is given in table I. The dominant species, *Skeletonema costatum* is a common coastal diatom which blooms in nutrient rich water.

Notable plants. The flora of the smaller channel contains some unusual species. *Chaetomorpha linum,* 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 features of the site are 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.

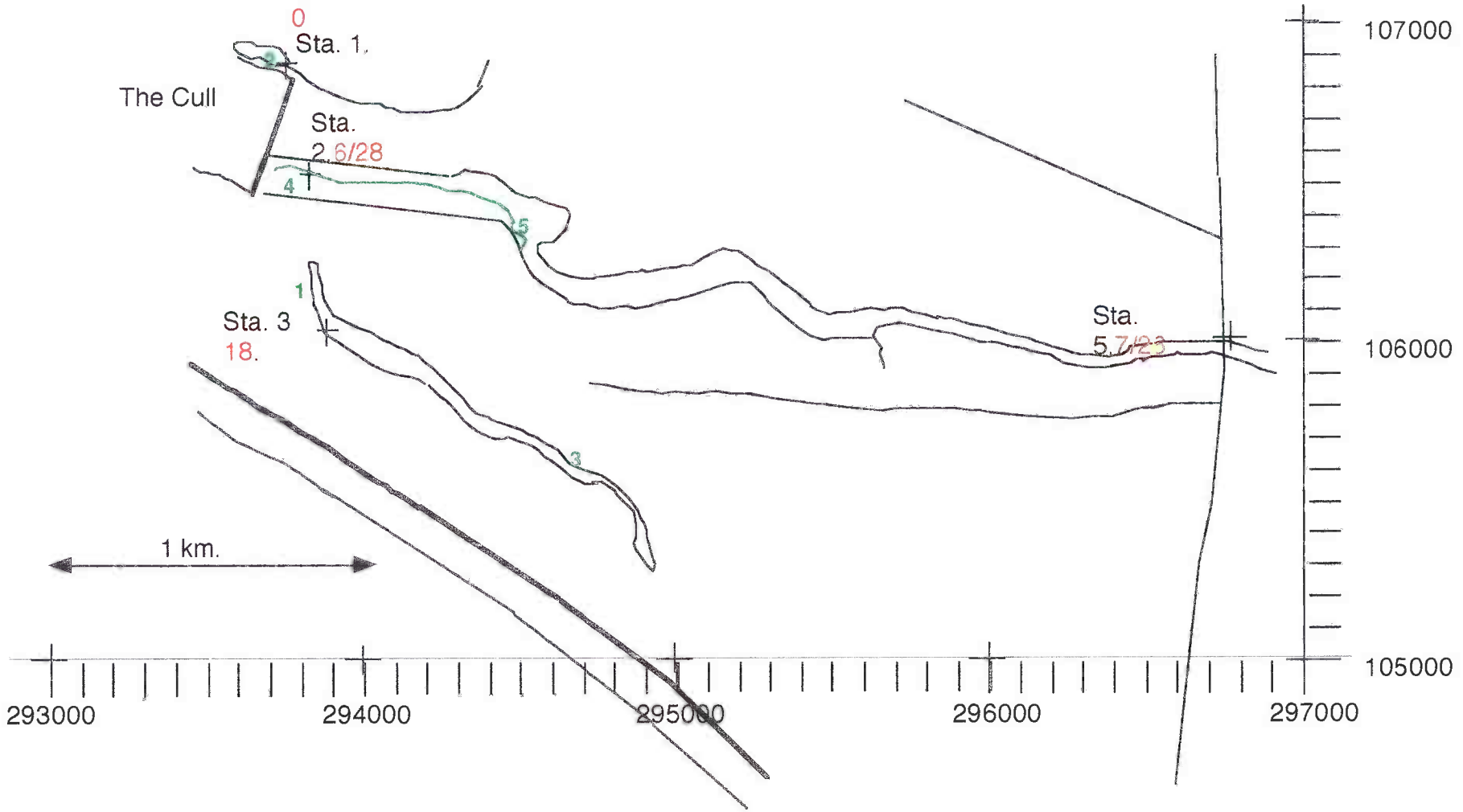


Fig. 3. Sampling stations on Ballyteige drainage channels, Co. Wexford. 1998

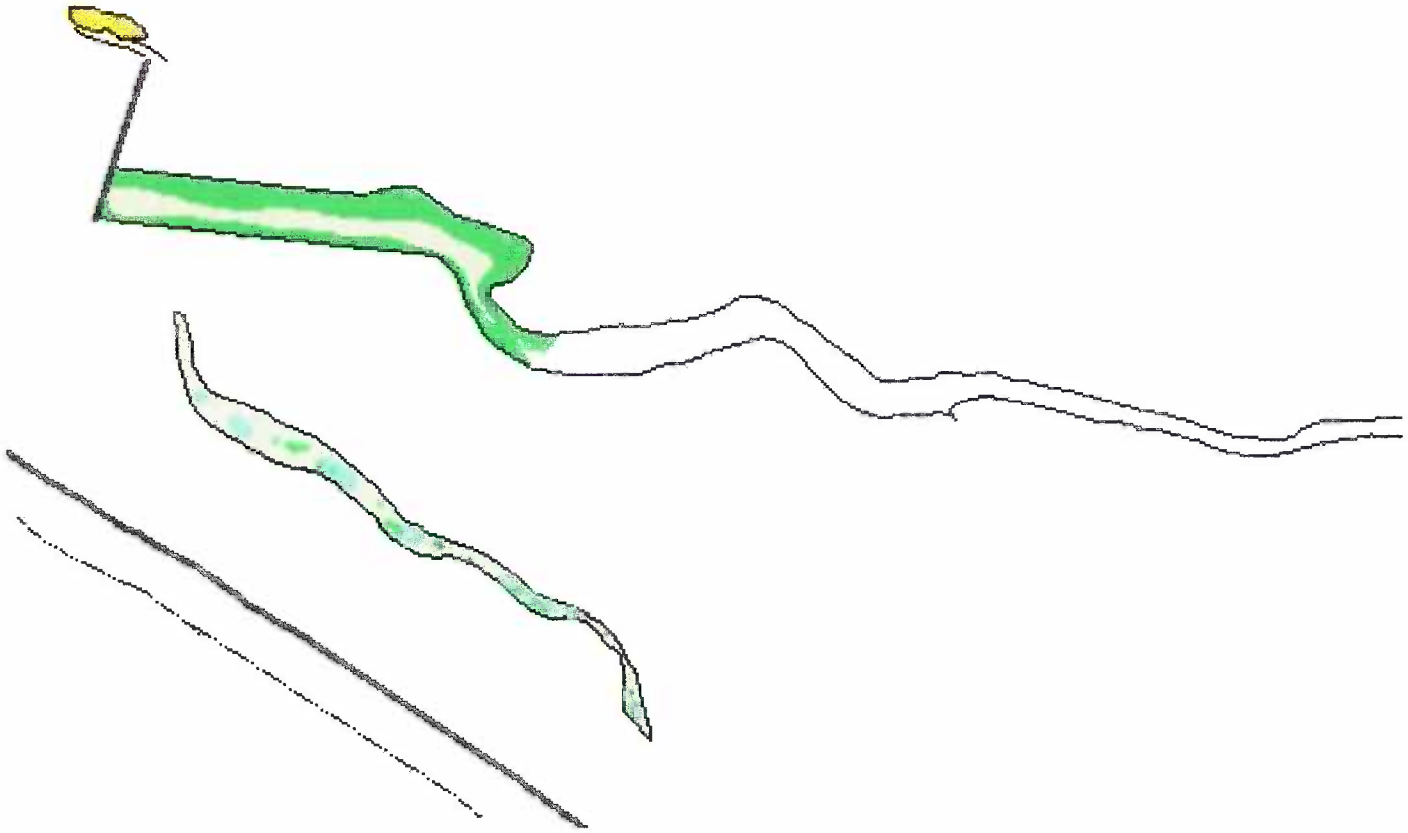


Fig. 4. Ballyteige drainage channels. Benthic vegetation.

Chapter 5

Kilmore Lake, Co. Cork
V958489

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 erosion of material, to the point where Kilmore Lake 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.
(09580489) is the grid reference for the snorkelling route in the lake.

Results
Kilmore Lake had no benthic vegetation except for a few seaweeds. *Gracilaria gracilis* occurs rarely on the lake floor (point 4). *Cystoseira foeniculaceus* and *Fucus vesiculosus* 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.*

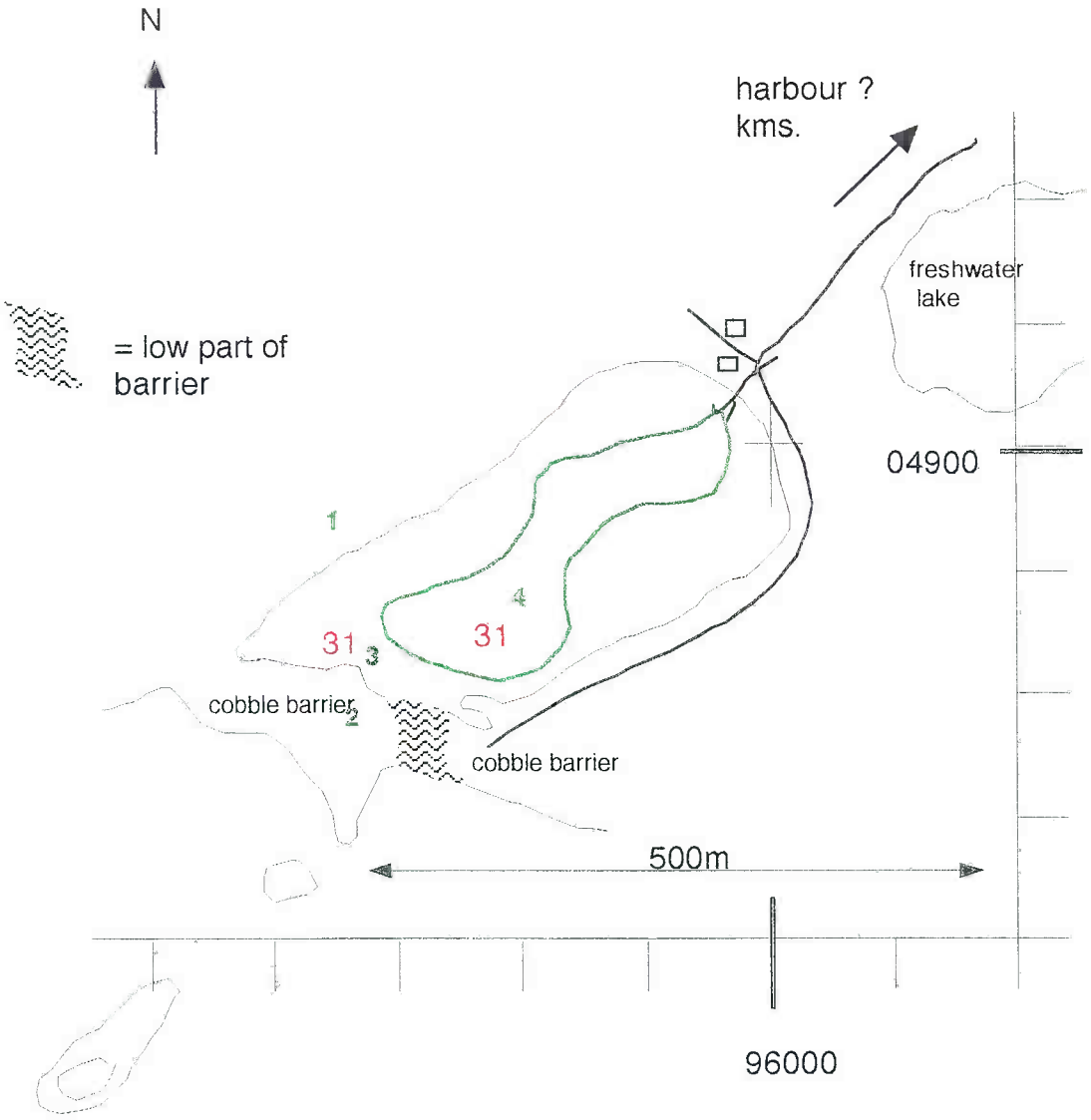
The flora of the barrier (point 2) included many of the above species and *Crithmum*

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, 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.



5.1 Sampling stations in Kilmore Lake, Whiddy Island, Co. Cork. June - October 1998.

Chapter 6

Loch Mór, Co. Galway. L989019

This site is a deep karstic lake. The lake floor consists of stepped limestone terraces which surround a central hollow 24m 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 palaeoecological 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 lakes sediments. He reports that a thermocline exists at about 6m depth with surface layer and deep layer temperatures of 16 and 9°C.

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. *Potamogeton pectinatus* forms very dense stands in this area, the plants rooting in the limestone grykes. 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 it's 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.

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

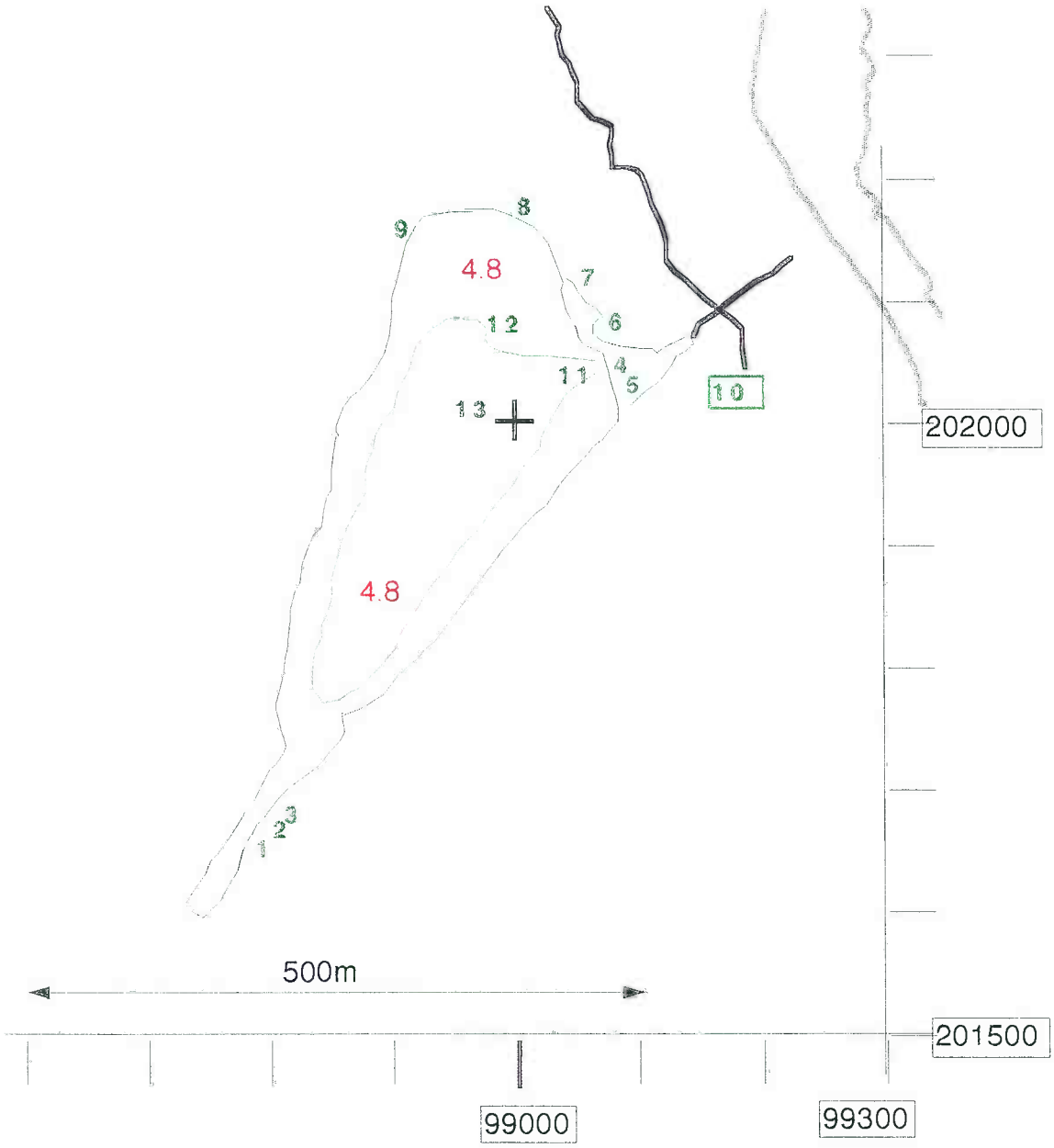
Results

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* community.
The plankton consists of blue green and other freshwater algae.

Notable plants. no unusual plants were noted.

Assessment. The most unusual feature of the lake was the calcareous algal nodules which occur at 4-5m depth. No comparable algae have been recorded at other sites. They may be 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 millenia ago (O'Connell *pers. com.*, 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 Loch Athola where submerged peat is found 4m below the present saline water surface.



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

25

Chapter 7
Loch an Chara, Co. Galway.
L887098

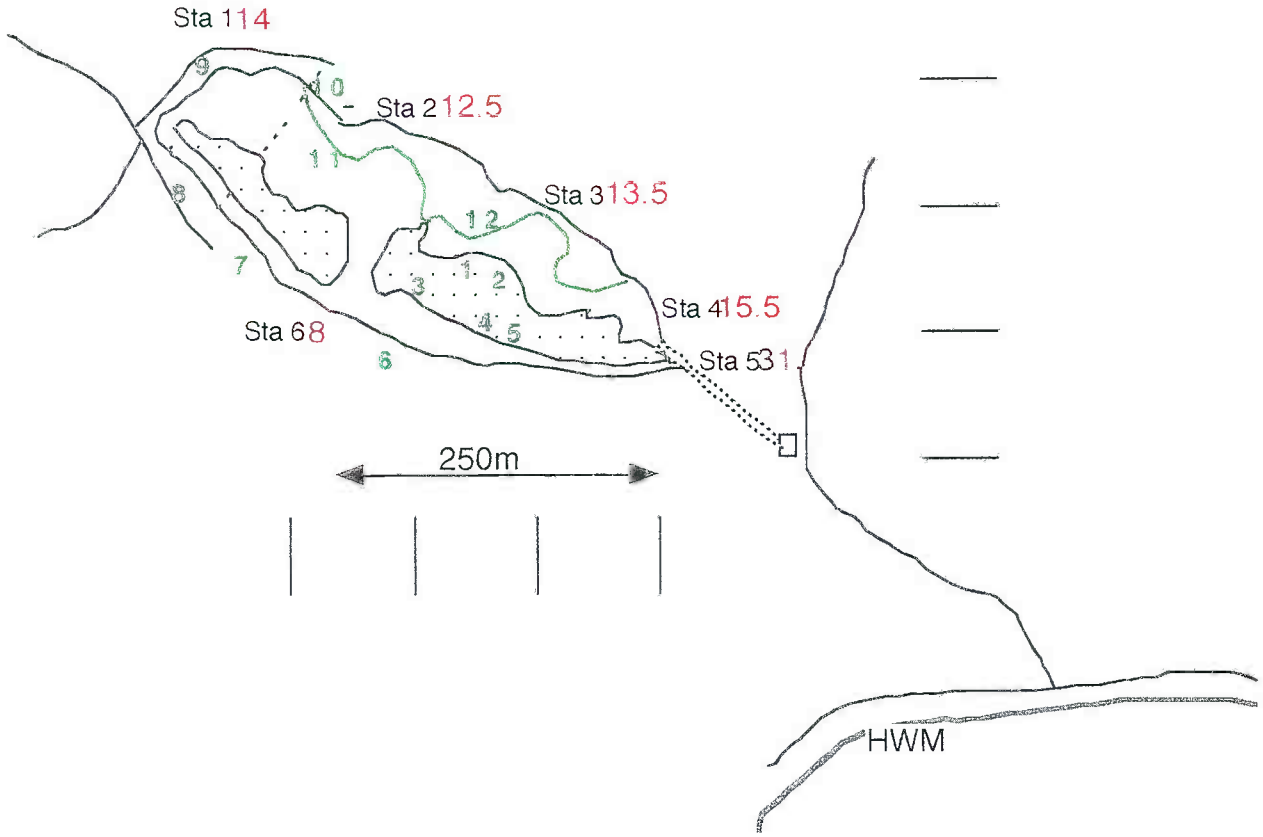
Site description. Loch an Chara is a shallow lake which is linked to the sea at each end. To the southeast a man made channel drains into Cuan Chill Éinne, while at the northwest end an underground channel percolates through the limestone bedrock and presumably reaches the sea some 200m distant. The 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.

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 (08872099) 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 (08872099) were made in the lake.Water depth is 0.5 to 1.0m with a substrate of sand and mud.

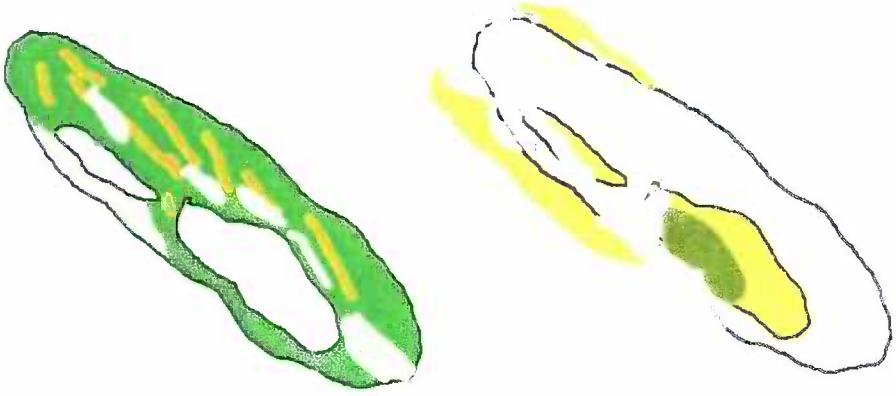
Results.
This shallow lagoon supports *Ruppia* sp. and *Potamogeton pectinatus* stands. Both species of *Ruppia* were recorded. *R. maritima* was commonest in water less than 50cm while *R. cirrhosa* occurred mainly in deeper water. *P. pectinatus* occurred occasionally in deeper water. Drift and attached *Enteromorpha intestinalis* and *Cladophora vagabunda* were very common.
The marginal vegetation consists of the *Potentilla anserina* community, as well as extensive stands of *Scirpus maritimus*.

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.



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



7.2 Benthic and marginal vegetation of Loch an Chara,

Chapter 8
Loch Phort Chorrúch, Co. Galway.
L857112

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. O Connail of Kilronan large quantities of drift seaweed are tossed over the barrier during winter storms. The weed's decay causes 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.

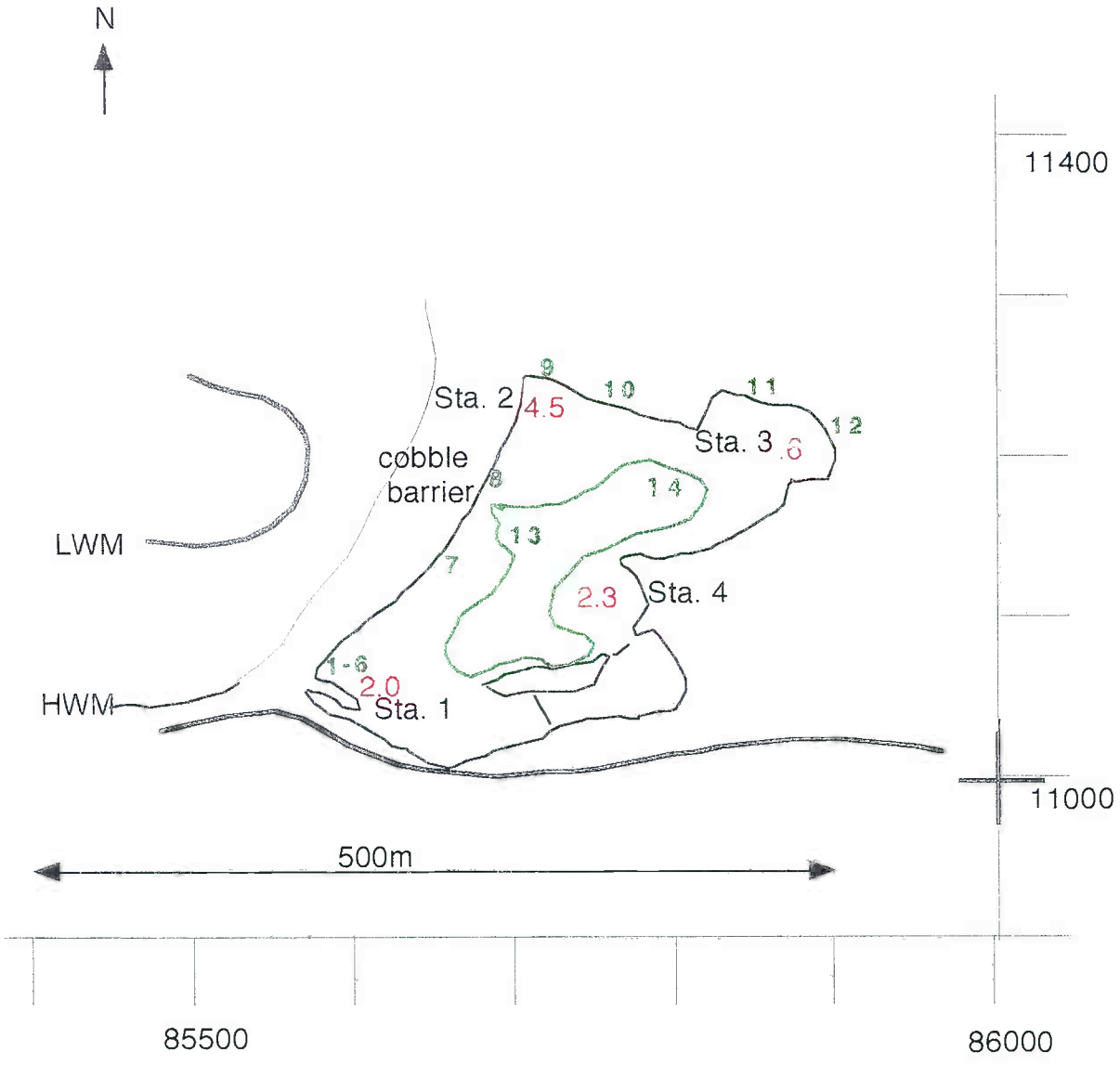
The site was surveyed on 22/6/1998 and 19/8/1998.
relevés 1-9 (08562111) were taken in the *Phragmites* scraw, 10 was taken in a S. tabernaemontanii stand , and 11-12 (08582112) were made in pasture.
The centre of the lake was explored by snorkelling. relevés 13 was taken in 1m depth on a sandy bottom while 14 was taken on a submerged karst/ sand bottom in 1m depth (08572111).
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. grow 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* community was well developed on the north and east side of the lake (11 and 12).

The plankton sample was almost exclusively comprised of zooplankton.

Notable plants
Both species of Ruppia occur.

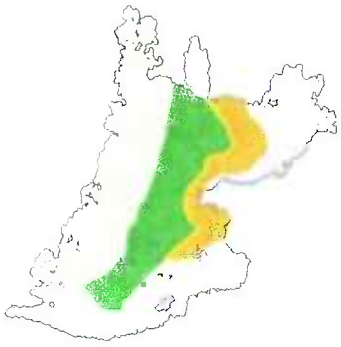
Assessment. The most interesting feature of the lagoon is the natural eutrophication caused by seaweed detritus which appears to provide nutrients for the malodorous Phragmites/Scirpus scraw.

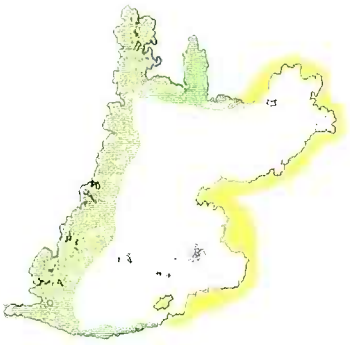


8.1 Sampling stations in Port Chorrúch, Inishmore, Co. Galway. July -September, 1998.

31

8.2 Benthic and marginal vegetation
of Loch Phoirt Chorruch





Chapter 9
Loch Cara Fionnla, Co Galway.
L963290

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.

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

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 bare peat, with dense stands of macrophytes in places.A salinity of 10 p.p.t. was measured here using a hand held refractometer..

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, (09602285) were taken in shallow 0.5m depth water with a peaty gravel bottom.
21 and 22 (09602290) were taken on the floor of the lake in the northern part.
23 and 24 (09602305)were taken in 1-2m depth in Cara na gCaorach.

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*. *Lamprothamnion* 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/ 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.

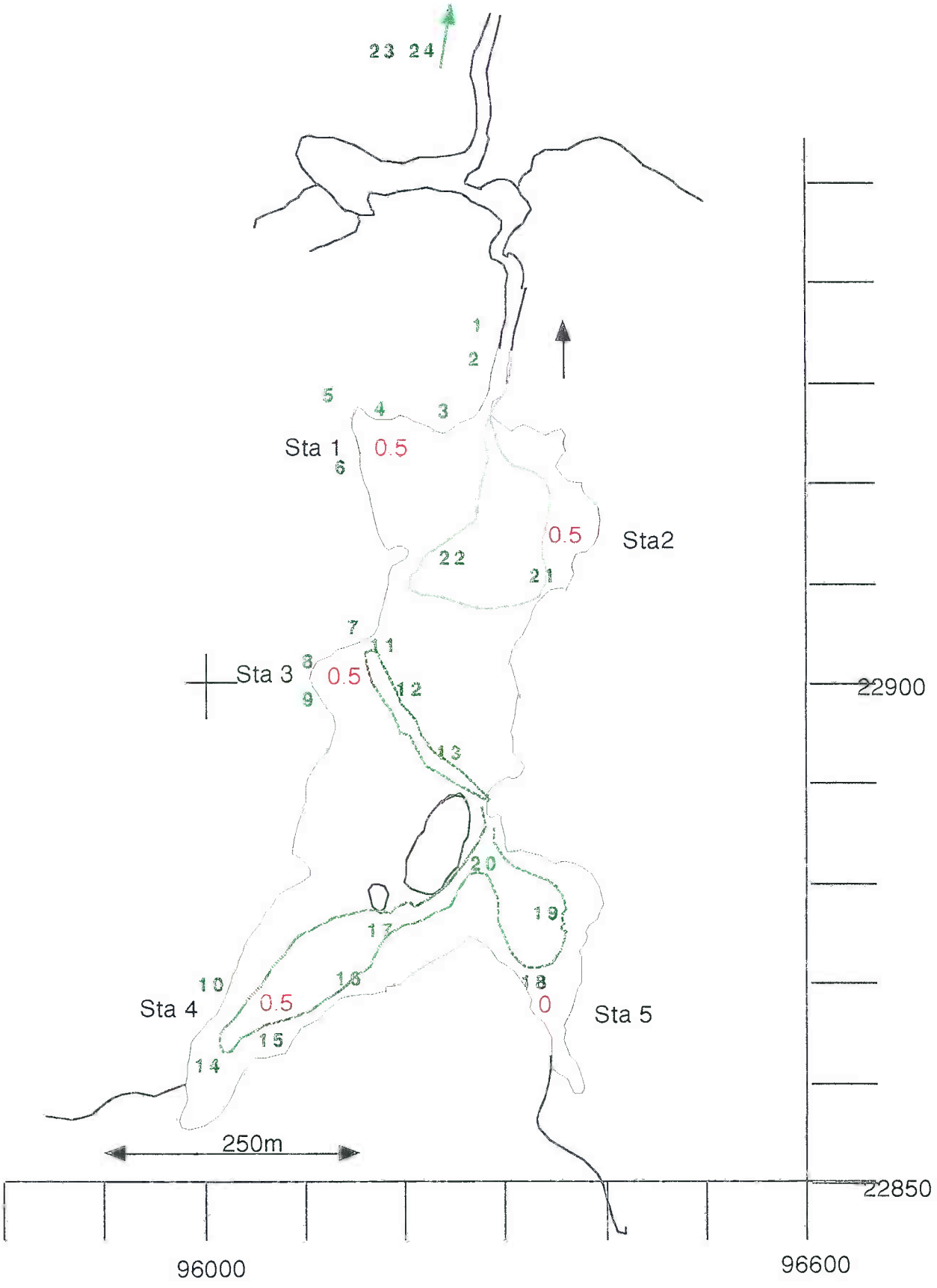
Marginal vegetation includes maritime lichens on bare rock, *Juncus maritimus* communities,

Eleocharis uniglumis communities, The *Samolus valerandii* variant of the *Juncus gerardii* association and stands of *Phragmites australis* and S*choenoplectus tabernaemontani* However, as the zone of marginal vegetation is extremely narrow, none of these communities are extensive. Springer (1999) gives a detailed account of the marginal vegetation along the Cara na gCaorach inlet.

The plankton community was very sparse in detritus rich water.

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

Assessment. Cara Fionla is a site for the rare charophyte *Lamprothamnion papulosum.* It is a good example of an intermediate salinity lagoon- to judge by flora and vegetation- the very low salinities measured in 1998 may be unusual, Oliver recorded 10 p.p.t. in 1996. Further exploration of the channel and inlets connecting the lake to Camus Bay may reveal new communities and species.



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

Chapter 10
Loch Fhada complex, Co. Galway. L9330

This group of four lagoons and interlinking channels lie on granite bedrock between Camus Bay and Greatmans Bay. While the lagoons are linked to Camus Bay via Loch an Aibhnín, 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) and Springer (1999) 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 *C. linum.*

(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;.

1-8 (09342298) were taken around the shore of Loch an Ghadaí. The marginal vegetation zone is narrow and interspersed with large slabs of granite bedrock.

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 occur in the splash zone of Loch Fhada. *Fucus vesiculosus* and *Enteromorpha* sp grow on rocks. *Chara* communities occur in the shallow sublittoral of both larger lakes. *Ruppia* and *Ruppia/Lamprothamnion* communities occur over the entire sublittoral of Loch an Ghadaí and around the circumference of Loch Fhada.

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.

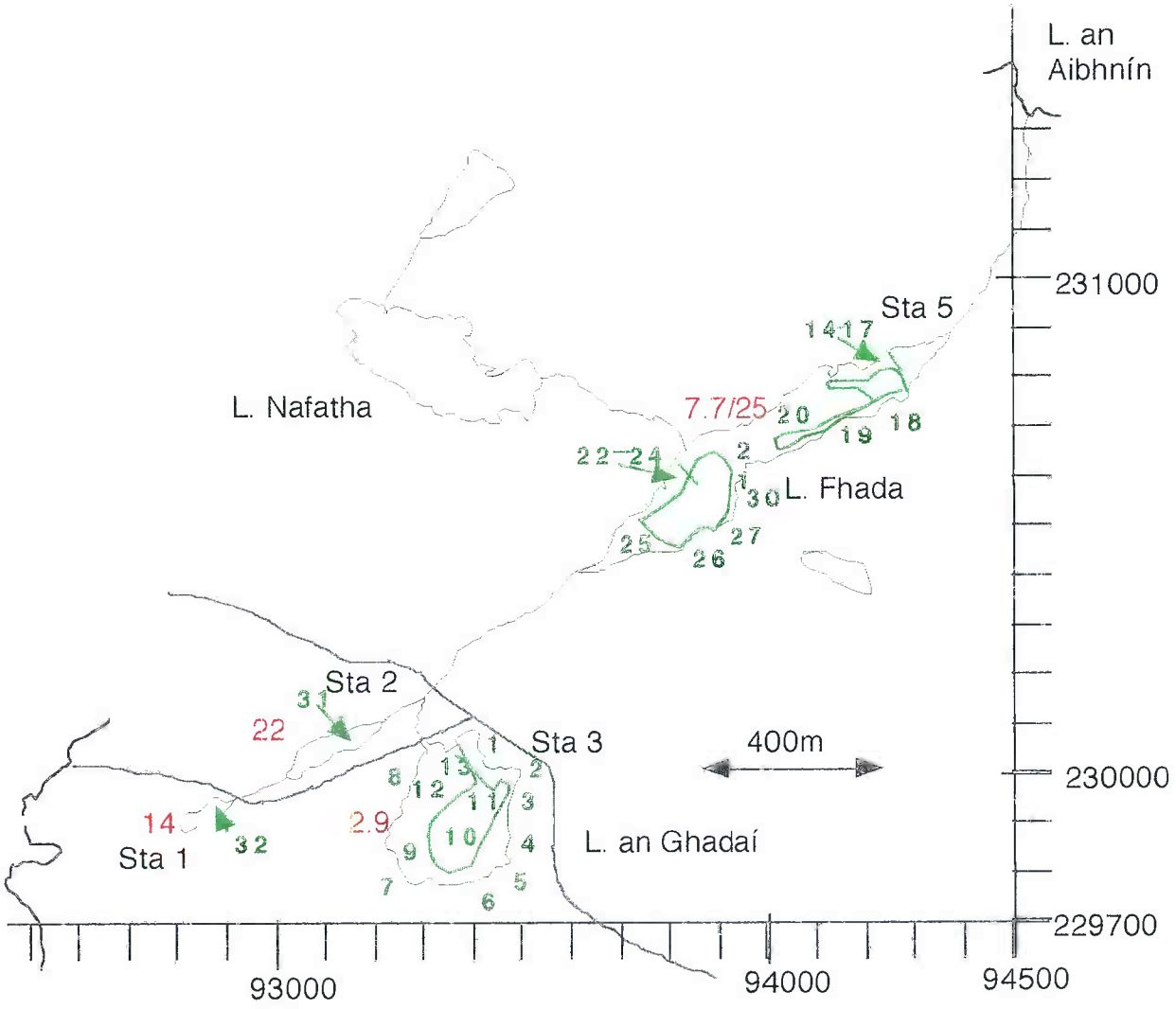
The floor of Loch Fhada is bare mud with occasional patches of *Beggiatoa.* *Cladophora rupestris* and a small number of Red Algae were recorded at the north east end of both Loch Fhada and one of the small lagoons (point 31).

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 an Ghadaí have diverse planktonic communities of brackish water dinoflagellates.

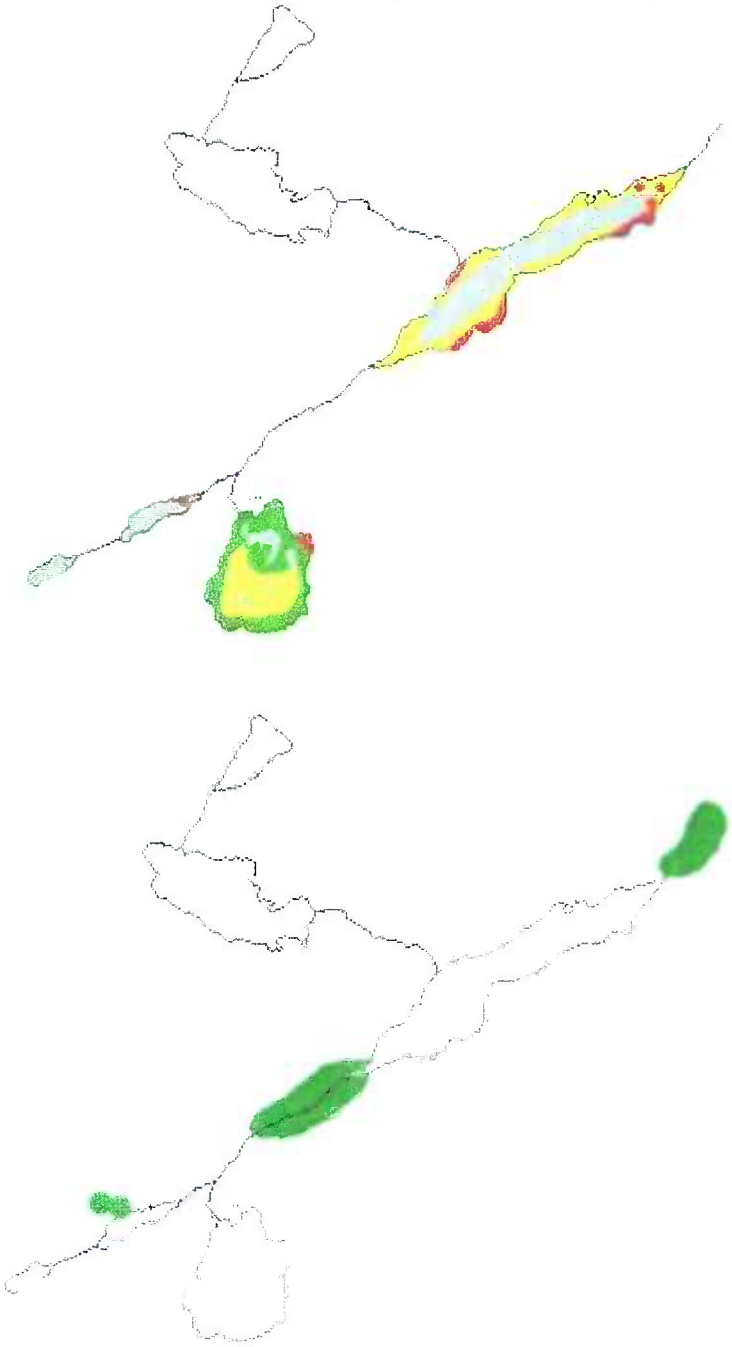
Notable plants. both species of *Ruppia* occur as well as large populations of *Lamprothamnion papulosum. Cladium mariscus* was only recorded from this site during the survey. *Cladophora vagabunda, C. liniformis* and *C. rupestris* were confirmed as occurring by Prof.. Van Den Hoek.

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 an Ghadaí has extensive *Ruppia/Lamprothamnion communities*. *Cladium* was not recorded from other lagoons in this survey. It appears that C. liniformis has not been recorded previously from Ireland, (Burrows 1991).



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

10.2 Benthic and marginal vegetation of Lough Fhada complex



Chapter 11
Loch an Aibhnín, Co. Galway.
L947315

Site description. Loch an Aibhnín is a large saline lake separated from Camus Bay by a shallow sill. There is no obvious intertidal zone, however salinity is comparatively high (25 p.p.t.).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 are found on the northern side. Local residents relate that 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 places large stands of *Juncus maritimus* occur.

Underwater observations. This 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 channel (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.

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.
1-4 (09432315)were made in the narrow shore zone on the northeast of the lake.
5-8 (09502308) were taken in a *Juncus maritimus* stand
9-11 (09502308) on a rocky shore.
12-17(09432316) were made on soft sediments in the western sublittoral, 18 (09482318) in the north and 19 (09503212) in the south.
20 (09502312) was made on flat rock, 21 (09502312) was made along a rocky submerged cliff, 22 (09432315) was made in the deep hole inside the sill.

Results.

This large high salinity lagoon contains several vegetation types, soft sediment communities include;
Peripheral vegetation in shallow water (<1m) includes *Ruppia* sp. along with a small form of *Z.marina, Fucus vesiculosus* and dense epiphytic ectocarpaceae. 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.*
The centre of the lagoon is occupied by a *Zostera marina* community with occasional *Spermathocnus paradoxus.*

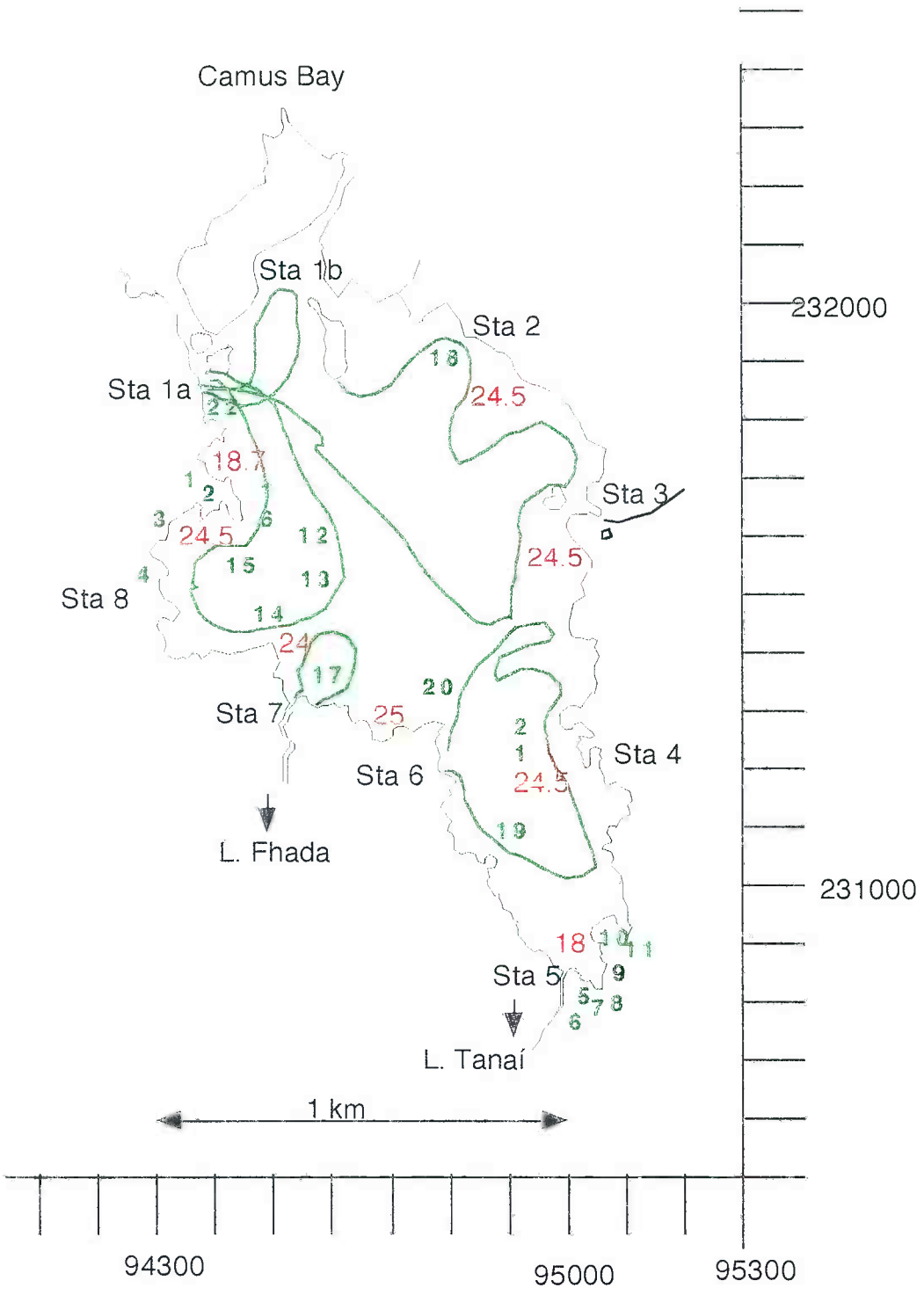
In slightly deeper water (3m) on the eastern side, a large area of bare mud occurs.

Exposed rocks support several algal communities. In shallower water *Furcellaria lumbricalis* and *Chyllocladia verticillata* occur on sloping rock. (TableVI). 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.*
At greater depths on mud loose lying *Gracilaria gracilis* and other species occur.
In a deep hole near the rock sill *Phyllophora crispa, Coccotylus truncata* and other species occur (tableVI).
The phytoplankton consists of brackish water dinoflagellates.

The marginal vegetation includes small areas of saltmarsh with the Puccinelletum and *Juncus gerardii* associations around the lake's 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.
Springer (1999) has compared the marginal vegetation of Loch an Aibhnín with that of the nearby Kinvara inlet.

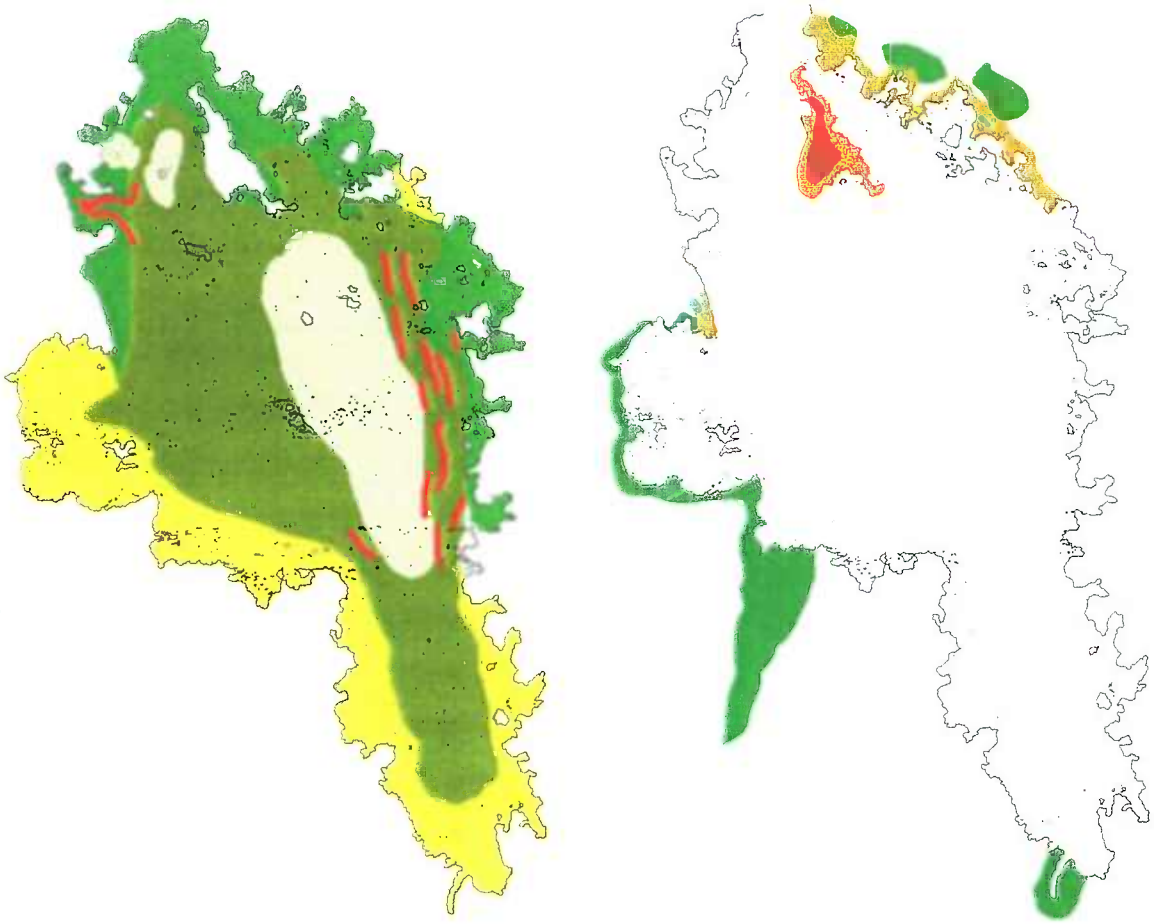
Notable plants; Both species of *Ruppia* occur as well as *Lamprothamnion papulosum.*The *Zostera marina* which grows close to the shore is very small and could be mistaken for *Z. angustifolia.*Several unusual or local algae are recorded.*Codium vermillaria* is known from Cork Clare and Antrim.. *Cladophora 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.



11.1 Sketch map of Loch an Aibhnín, Connemara, Co. Galway, showing sampling stations, 1998.

11.2 Benthic and marginal vegetation of Loch an Aibhnín



Chapter 12
Loch an tSáile, Screebe, Co. Galway. L9639

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 catchement of about 35 square kilometres enters the sea via the lagoon system. There are four loughs included under the name Loch an tSáile. Loch an 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 interlinking 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, 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 2-4m in depth but the dark colour of the water seems to inhibit plant growth. In the lower basin a sparse population of *Zostera marina* occurs with some *Chaetomorpha linum*, while *P. pectinatus* is common in the middle basin.

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 shell. 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.Much of the lagoon floor is mud with occasional small starfish (*Astropecten* sp.).

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 four 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 (09452383) 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 (>16m) and the strong salinity gradient result in a wide range of vegetation.
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 *Lamprothamnion 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.
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.
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*.
Mud and sand areas are covered by drifting balls of *Cladophora aegagropila* (28).
The small middle basin contains *Ruppia/Potamogeton pectinatus* communities with some *Chaetomorpha linum* (26).
The western arm of the lower basin is the most saline area. Rocky shores are covered by *Fucus ceranoides*, *Cladophora rupestris* and *Enteromorpha* sp.
At 1-2m depth, *F.serratus* and *F. vesiculosus* also occur . At greater depths dense mounds of *C. Linum* are found on rock (10).
Soft sediments support *Ruppia* sp. and at greater depths *Zostera marina* and *Ruppia* with some *C. linum*, (14-19).
The eastern arm (basin iv) is shallow with a dense growth of *P.pectinatus, Ruppia sp. L. papulosum* and *C. linum*. (20-23)
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).

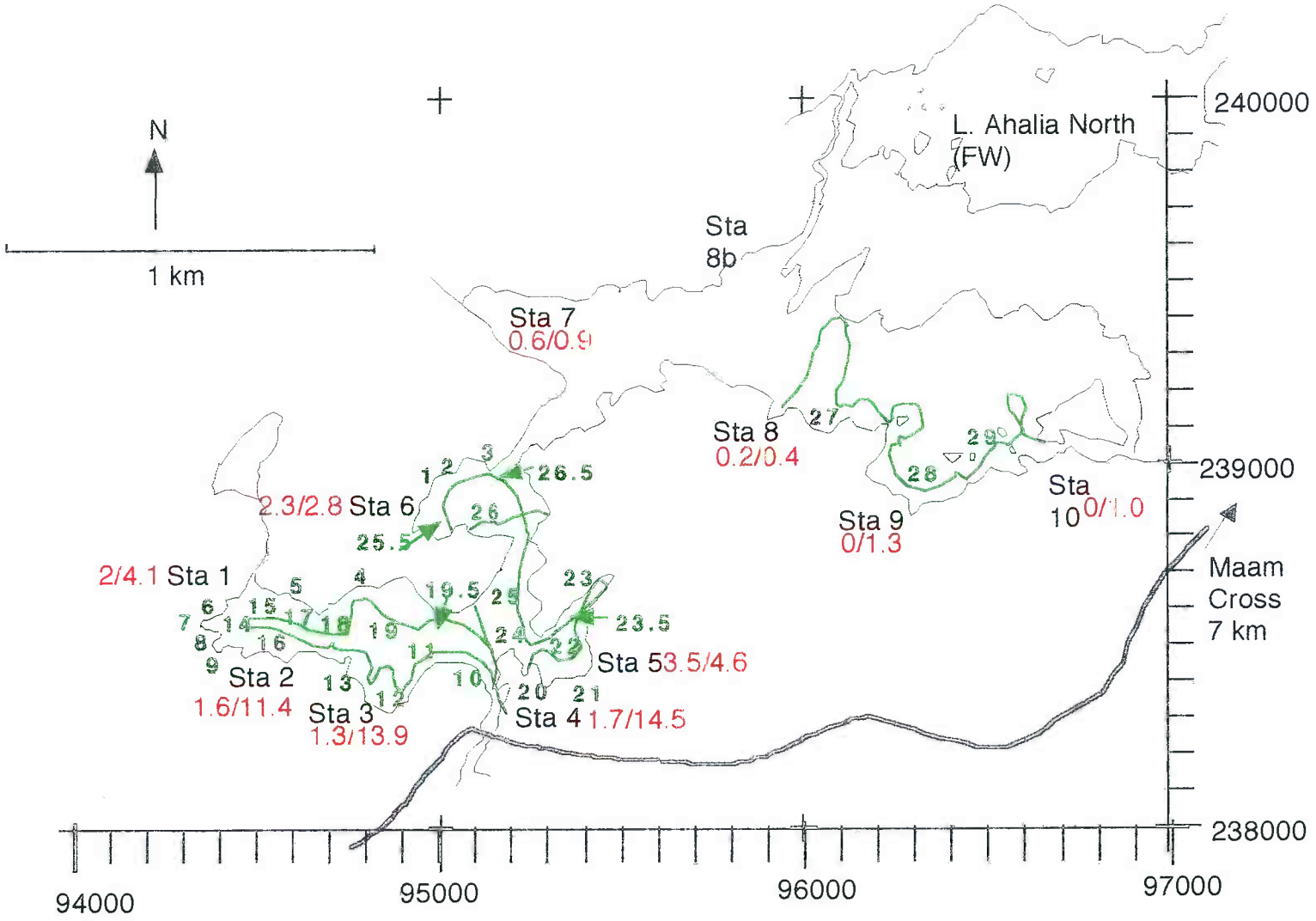
The lake basins are rocky so in general there is little marginal vegetation. The following communities were recognized ; *Juncus maritimus* stands, rocky shore communities with *Plantago* species and *Eleocharis uniglumis*, The *Samolus valerandii* variant of the *Juncus gerardii* association, emergent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

The phytoplankton is essentially that of a freshwater lake.

Notable plants. This lagoon has a rich charophyte flora with two red data book species, *Chara baltica* and *Lamprothamnion papulosum* . To date both species are known only from basin iv. An unusual form of *Potamogeton pectinatus* occurs in high salinity water where it

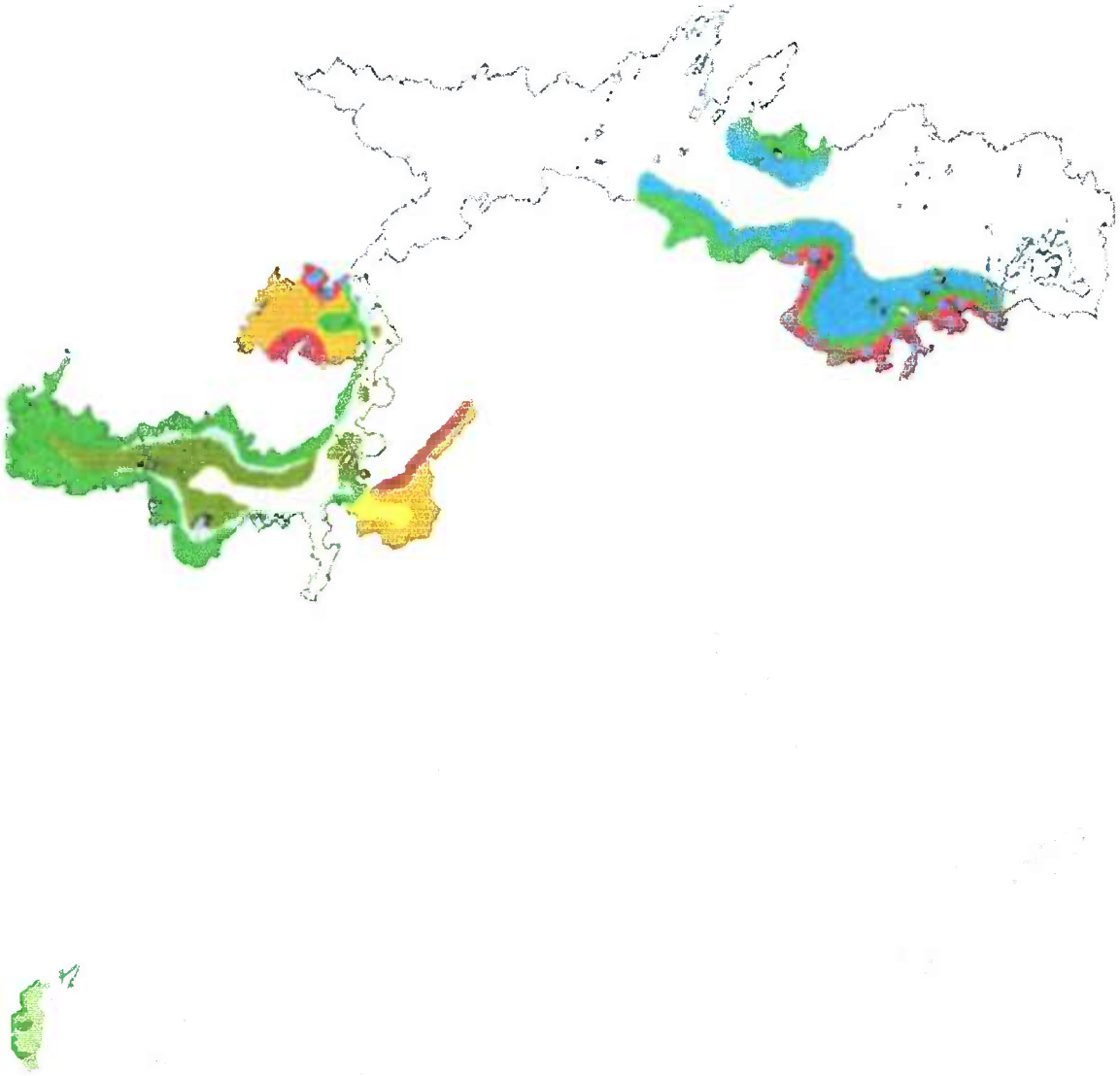
grows in association with *Zostera marina.* Its precise identity is not yet established. *Cladophora aegagropila* (identity confirmed by Prof.. Van Den Hoek). was only found in this lagoon, it also occurs in freshwater lakes but is not widely distributed in Ireland as far as is known.

Assessment.The Loch an tSáile 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. It's large size increases it's conservation value. A floating fish cage is kept in the upper basin. In places dense blankets of filamentuous green algae covered the lake bottom. However similar growths were seen in Cara Fionnla , so the algal growth may have no connection with fish culture.



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

12.2Benthic and marginal vegetation of Loch an tSáile



Chapter 13
Lough Athola, Co. Galway
L626484

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 4m. These channels terminate at a rock shelf which forms a very shallow sill separating the lake from the sea. The deepest point (5m) of the lake , like Loch nAibhnín 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.
Much of 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.

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 canaliculata* 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

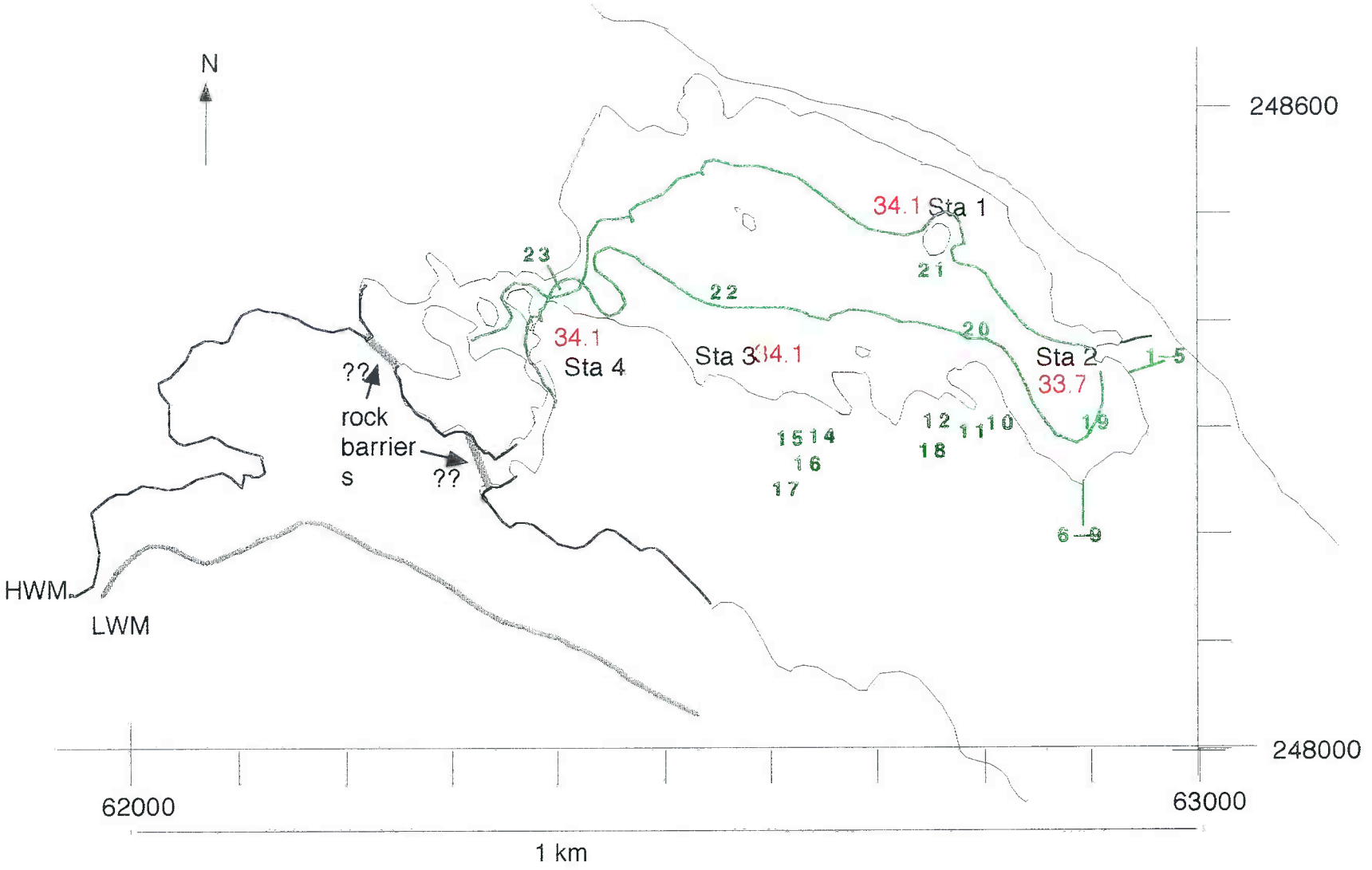
Phyllophora crispa, *P. pseudoceranoides*, *Gracilaria gracilis*, *Chondrus crispus*, *Plocamium cartilagneum*, *Rhodophyllis divaricata*, *Calliblepharis jubata*, *Furcellaria lumbricalis*, *Hypoglossum woodwardii*, *Polysiphonia elongata*, *Rhodomela confervoides.*
Some of these communities can be equated with the following communities of Covey and Thorpe, (1994).
OB5 Littoral fringe sheltered rock with *Pelvetia canalicuata,*
OB24 Hard substratum with *Phyllophora pseudoceranoide,s*
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 is 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 absent and is replaced by a very distinctive Red algal community. The *Cladophora battersii* community is shared only with Sallys Lough. It appears to be the best example of a high salinity lagoon seen during the survey.



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

Chapter 14
Lough Bofin, Co Galway
L525656

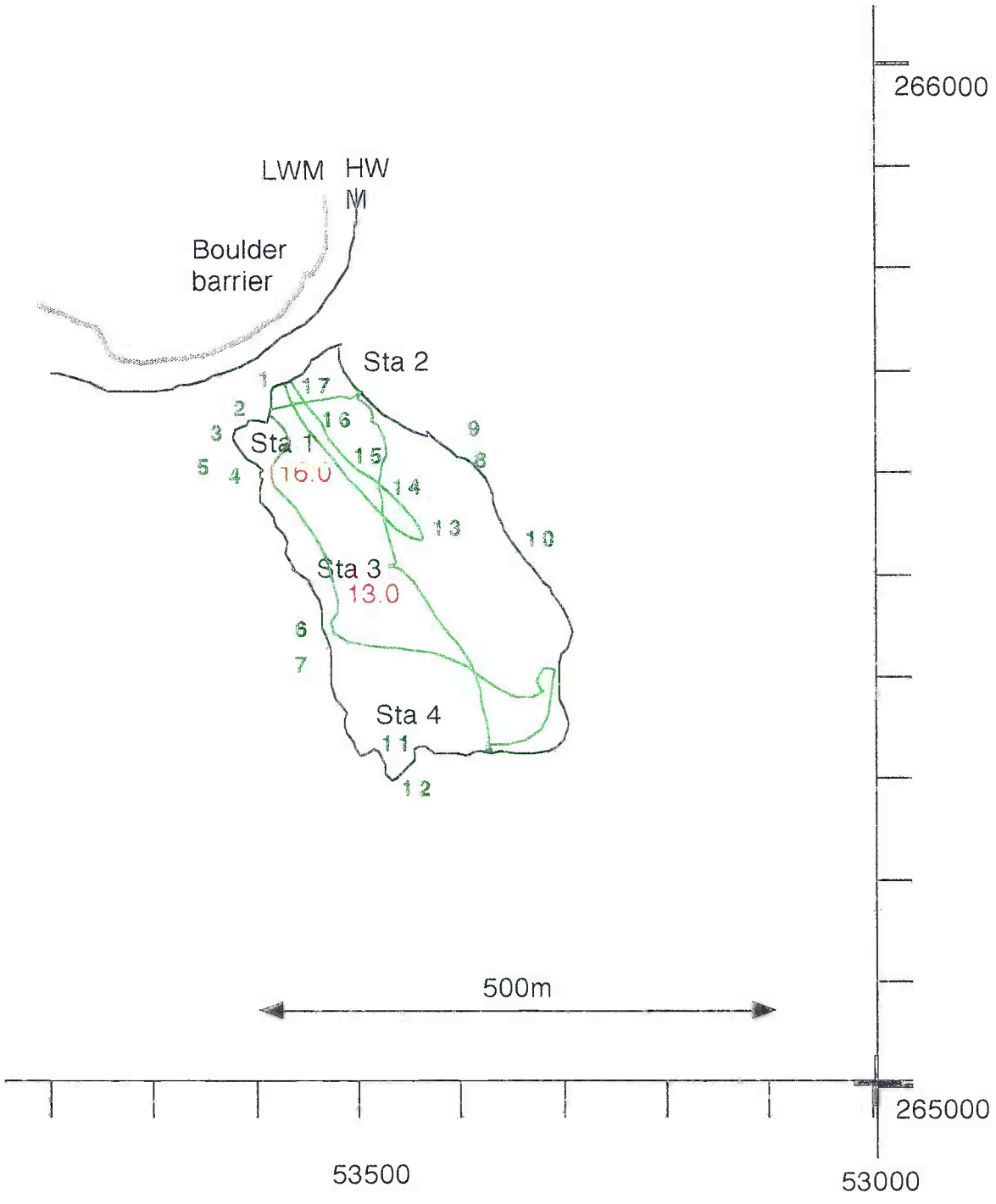
Lough Bofin is situated on the northwest coast of Inish Bofin. It is surrounded by low hills of metamorphic rock on three sides while a cobble barrier forms the shore on the northwest side. A small stream enters the lake on the eastern side. The shoreline includes areas of gravel and cobbles, small cliffs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

Underwater observations Lough Boffin 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. which is mixed through with a sparser population of *Lamprothamnion papulosum.*

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 *Lamprothamnion* 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 vagabunda* 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 *Lamprothamnion 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/Lamprothamnion* community. The plankton appears to contain unusual species.



14.1 Sketch map of Loch Bofin, Inis Bofin, Co. Galway, 1998.

Chapter 15
Maghery Lough, Co. Donegal.
G723094

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 very high 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 *Lamprothamnion 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* which protrude from the lake floor are very conspicuous.

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 *Lamprothamnion 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*, *Furcellaria lumbricalis*, *Coccotylus truncata*, *Chondrus crispus*, *Cladophora rupestris* and *Enteromorpha sp.* This community corresponds to the OB24 of Covey and Thorpe (1994).

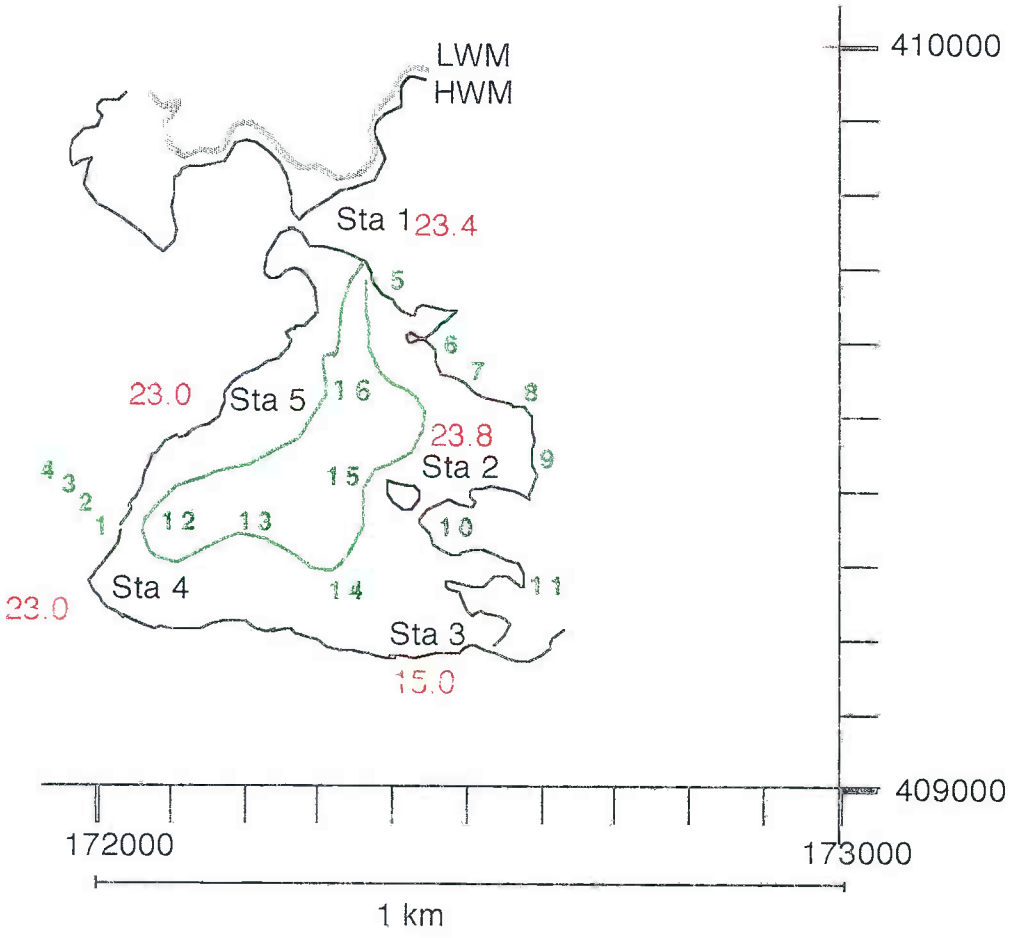
The phytoplankton contains several brackish water dinoflagellates.

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

Notable plants; The charophyte *Lamprothamnion*, 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. Both

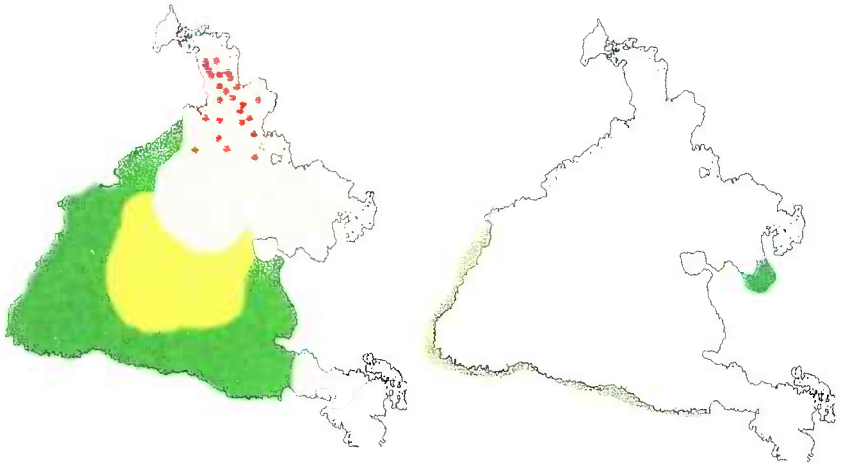
species of *Ruppia* occurred in the lake.

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



16.1 Maghery Lough, Co. Donegal, showing sampling stations, 1998.

15.2 Benthic and marginal vegetation of Maghery



Chapter 16
Sallys Lough, Co. Donegal.
B718168

Sallys 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 rises to within 1.5m of the surface. It's 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, *Ruppia* sp. were not found.

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
Sallys Lough is a 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 dicotoma, 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 (1994).

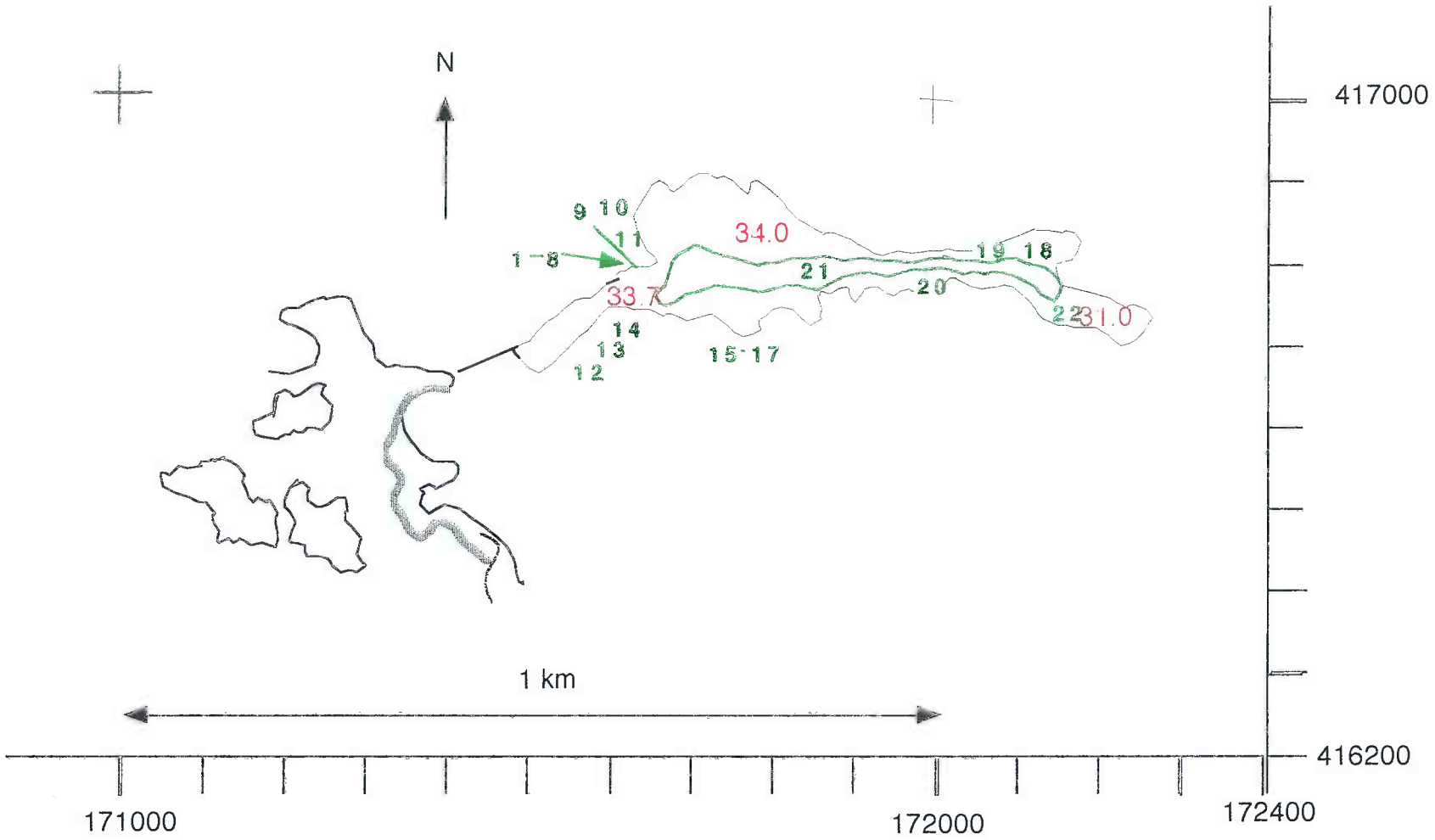
The phytoplankton of the lake was dominated by dinoflagellates, especially *Prorocentrum scutellatum* , a brackish water species. It occurred in huge quantities to judge from the density of the net haul.

Emergent vegetation includes a large stand of *Phragmites australis* and *Scirpus maritimus* (11).
The marginal vegetation includes a small area of salt marsh with Puccinelletum, *Juncus*

gerardii and *Scirpus maritimus* communities present ,The *Blysmus rufus* association was present in two places (1-10, 12-15). Much of the shore line consists of rocky cliffs with some patches of grassland or saltmarsh by the shore, (16-17).

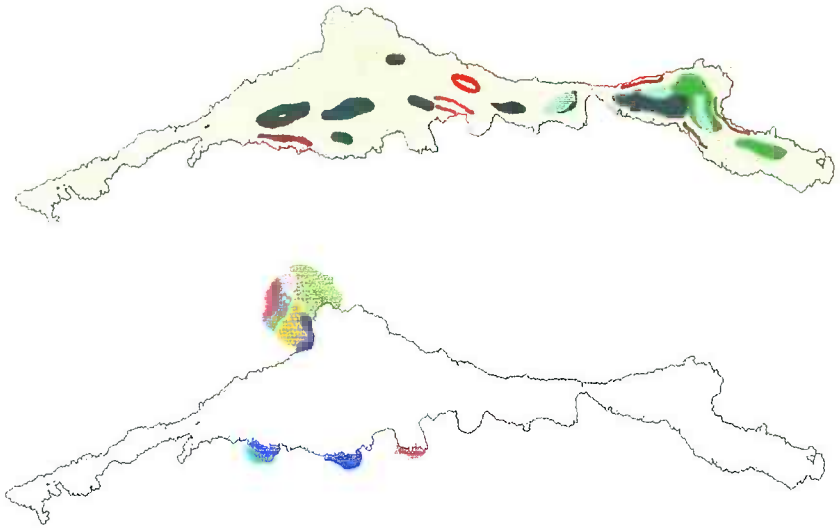
Notable plants *Cladophora battersii* is a very rare alga which grows unattached on the seabed. Its presence has been confirmed by Prof.Van Den Hoek, who also found *C. laetevirens* intermixed with it. *C. laetevirens* is common on Irish coasts .*Blysmus rufus* is common in two places. This plant however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

Assessment Sallys 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 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.



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

63



16.2 Benthic and marginal vegetation of Sallys Lough

Chapter 17
Kincas Lough, Co. Donegal.
B752197

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*.

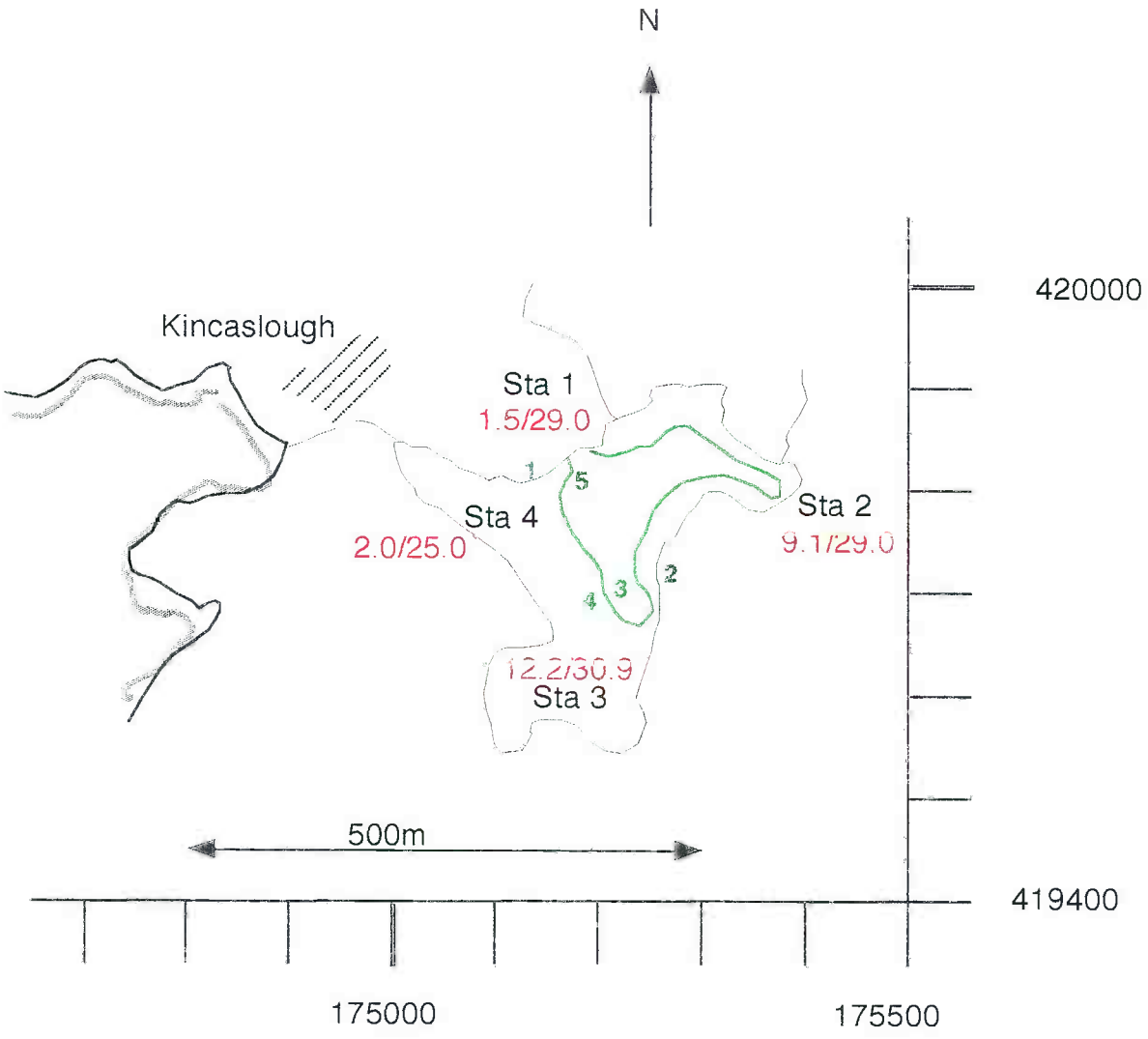
Underwater observations.This lake has extremely dark water , with little or no light penetrating below 3m. A surface stratified layer was evident. Because of bad light only a very imprecise idea of the sublittoral topography could be gained. Rocky slopes appear to descend to 2-4m. The bottom was muddy 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.
9/9/1998
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
5 (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 gavel. 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 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.

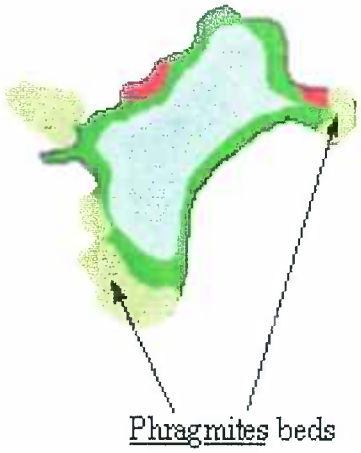
The phytoplankton of the lake was dominated by freshwater species and detritus probably washed into the lake from the adjoining Lough Mullaghderg.

Notable plants include *Ruppia cirrhosa*, *Blysmus rufus* and *Chara aspera*.

Assessment. Kincas is a good example of a deep saline lake with a diverse bentic 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.



17.1 Sketch map of Kincas Lough, Co. Donegal, 1998.



17.2 Benthic vegetation
of Kincas Lough

Chapter 18
Moorlagh, Co. Donegal.
B790187

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.

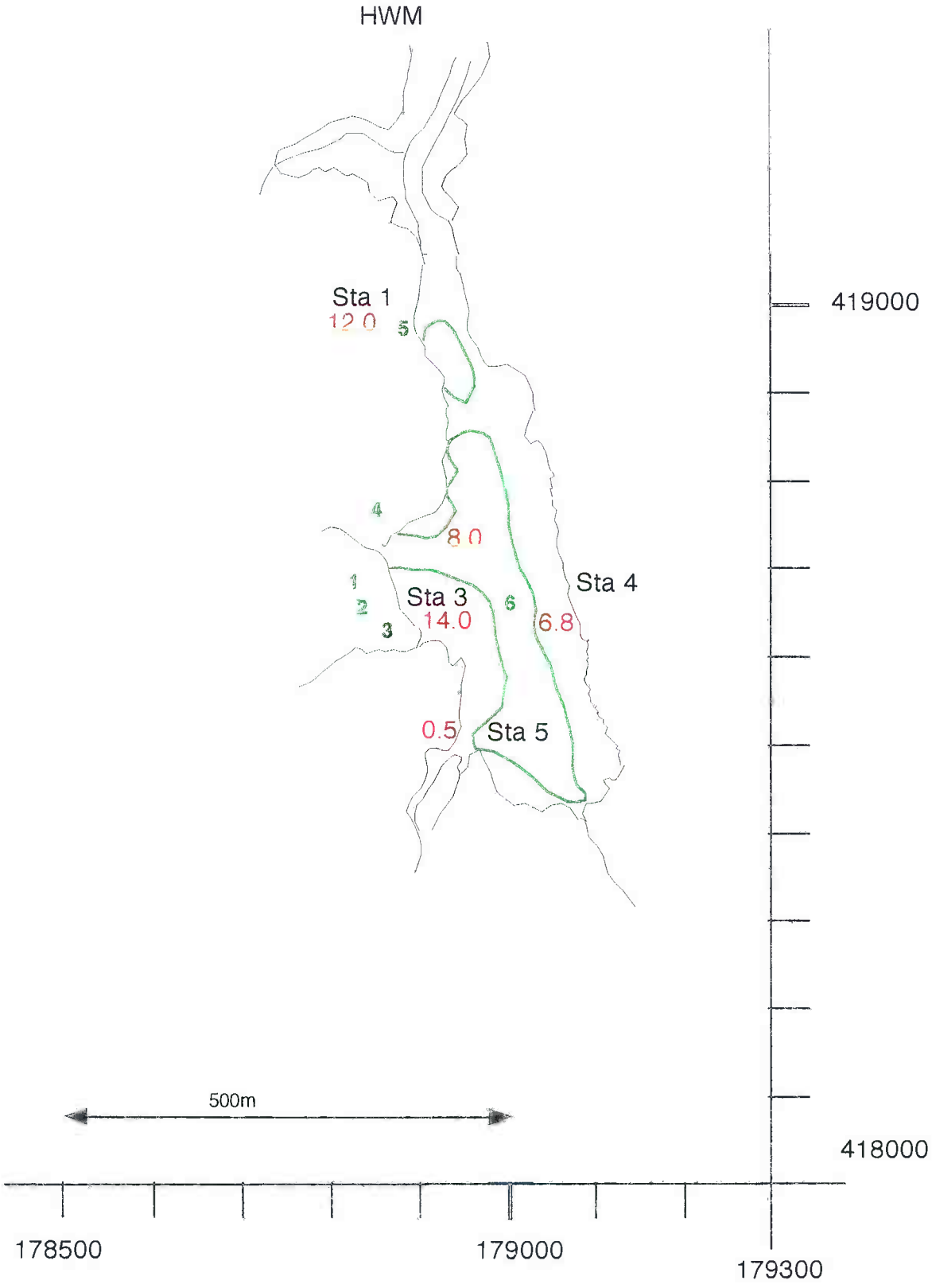
Underwater observations. Moorlagh is an extremely shallow sandy lake. Despite the size of the lake, depth rarely exceeded 1m. The bottom consisted mainly of sand with some areas of flooded peat. A ridge of rocks run north south in the centre of the lake. The bottom flora is a very uniform mixture of *Ruppia* sp. and drift *Cladophora.*

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.
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.

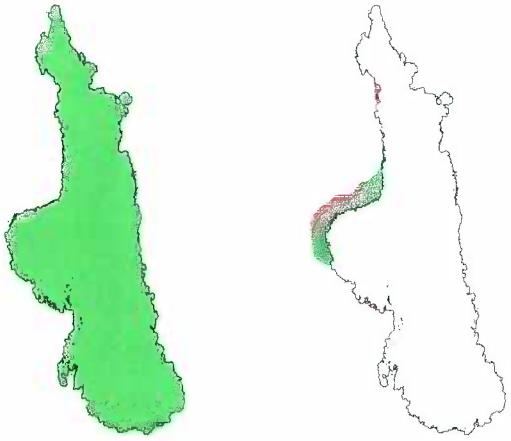
Marginal vegetation included stands of *Juncus maritimus* (1,2), *Festuca rubra* (3,4) and the *Juncus gerardii* association (5).

Notable plants None of the *Ruppia* could be identified to species as no fruiting plants were found.No other notable plants were found.
AssessmentMoorlagh appears to have no distinctive floristic or vegetational features of note.



18.1 Sketch map of Moorlagh, Co. Donegal, showing sampling stations, 1998

17.2Benthic and marginal vegetation of Moorlagh



Chapter 19
Inch, Co Donegal.
C352230

Inch lagoon lies between the mainland and Inch island in Lough Swilly. It is an artificial impoundment with dykes at the northern and southwest ends. The lake level is controlled by sluice gates and pumps on the southwest 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 southwest 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 southwest 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.

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 northeastern 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(2344238)-25 (23514235)were made in the northeastern part of the lagoon at depths of 1-1.5m.

Results

Benthic vegetation

Five types of vegetation were recorded, these are listed in order of areal extent;

Potamogeton pectinatus communities sometimes with *Myriophyllum spicatum*, mainly on mud (21,24,25).

Ruppia/P.pectinatus communities on sandy ground (18).

Charophyte communities with *C. aspera* and *C.canescens* (17,20,22).

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.

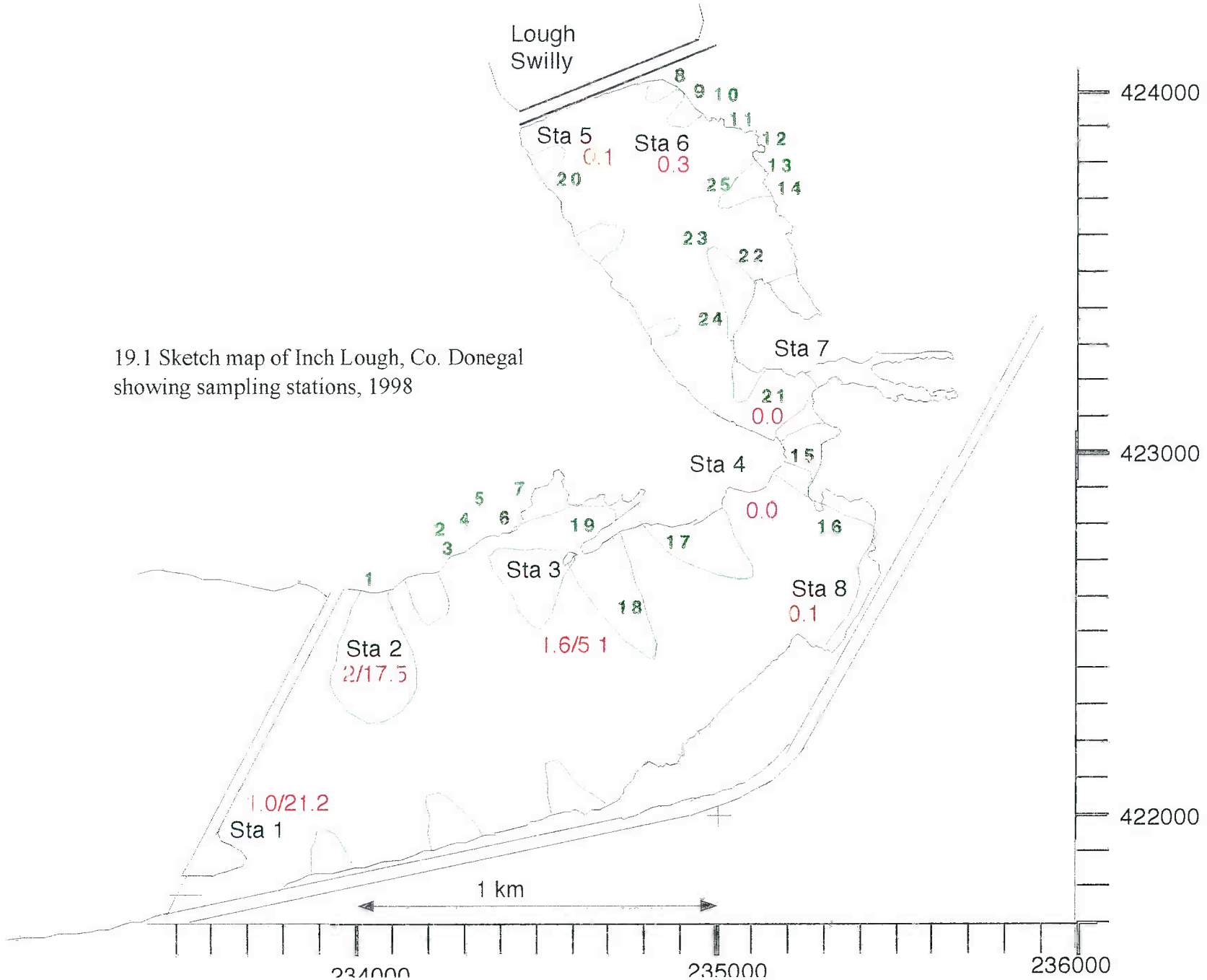
Zanichellia palustris community occurs on sand in one area in the centre of the lagoon (16).

Marginal vegetation consists of small areas of the *Potentilla anserina* variant of the *Juncus gerardii* association (2,8,10,11,).

Eleocharis communities (1,4,14),

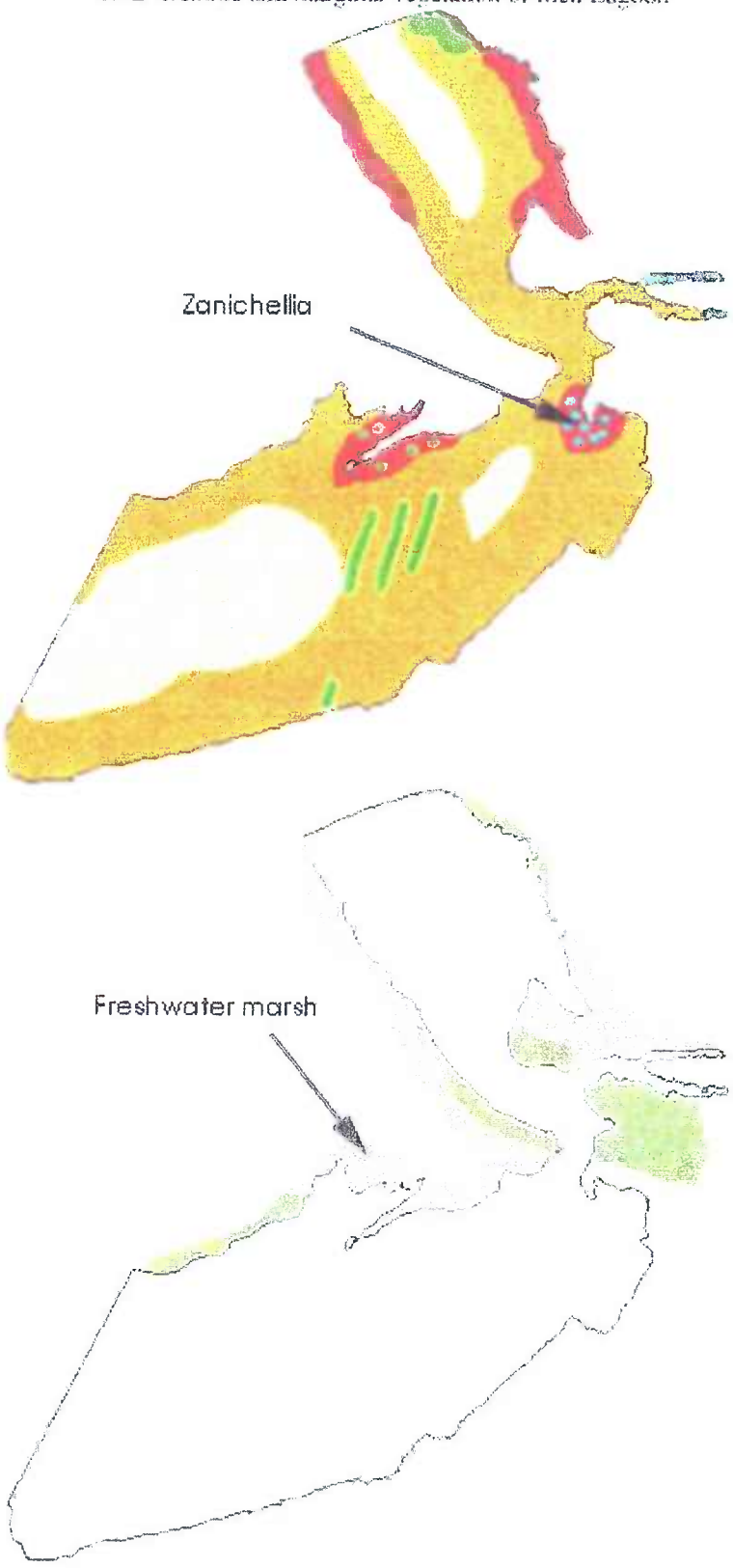
very extensive stands of *Schoenoplectus tabernaemontani* (3,5,6,7,9,12,13,).
In the eastern half a large area of freshwater swamp vegetation occurs, while this vegetation is outside the definition of lagoonal vegetation, as it lacks any maritime species it is of interest in its own right. Species include *Hippuris , Myosotis sp. Mentha aquatica, Baldellia ranunculoides, Caltha radicans, Galium palustre, Lythrum salicaria, Agrostis stolonifera.*

Phytoplankton was dominated by the brackish dinoflagelllate Glenodinium foliaceum along with 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 very short fruit stalks, thus resembling the variety *brevirostris* of *Ruppia maritima*. Verhoeven (1980) notes that this variety occurs with *Zanichellia palustris* in brackish water. Inch was the only lagoon surveyed with a *Zanichellia* 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 is perhaps the best example of a low salinity shallow lagoon in the survey. *Zannichellia palustris* and *Ruppia maritima* var *brevirostris* communities were not found in other lagoons although the *Ruppia* variety may occur in the channels at Ballyteige.



19.1 Sketch map of Inch Lough, Co. Donegal showing sampling stations, 1998

19.2 Benthic and marginal vegetation of Inch Lagoon



Chapter 20
Assessment of the sites

In the Natura 2000 project it is suggested that sites be assessed in terms of habitats and species present. Habitats are judged in terms of representivity, relative surface, and conservation potential, while species are judged in terms of population size and conservation potential. In this assessment I have adapted this scheme to the needs of the present survey.

Vegetation
Based on the analysis of the survey data the following communities are recognized;
Marginal vegetation
i) Puccinellietum
ii) *Juncus maritimus* communities
iii) Juncetum gerardii typicum
iv) *J.gerardii/ Potentilla/anserina* community*
v) *J.gerardii/Samolus valerandii* community*
vi) *Eleocharis* communities
vii) *Festuca rubra* communities
viii) *Blysmus rufus* communities

Emergent vegetation
Communities of;
i) *Phragmites australis*
ii) Schoenoplectus tabernaemontani
iii) *Scirpus maritimus*

Benthic vegetation; soft sediments
i)Charophyte communities*
ii) *Potamogeton pectinatus* communities
iii) Monogeneric *Ruppia sp.* communities*
iv) *Ruppia/Lamprothamnion* communities*
v) *Ruppia/Lamprothamnion/Zostera* community*
vi) *Ruppia/Zostera* communities*
vii) *Chaetomorpha linum* communities*
viii) *Cladophora aegagropila**
ix)*Cladophora battersii**

Benthic communities on rock
i) Red algal communities*?
ii) *Fucus sp. Enteromorpha* sp.
iii) *Cladophora Enteromorpha*
Plankton communities are not included in this analysis.

Some of these communities are best developed at lagoonal sites while others are closely related to more widespread communities in Ireland. The former are marked with an asterisk.
In this assessment vegetation is scored as follows;
Presence of a community =1
Presence of an * community=2

Total area of each * community ; <1 ha=1, <5ha =2, >5=3.
Rarity is scored for, in the following manner; community present at⩽2 sites=2, at⩽4 sites=1.
As the *communities showed little damage due to human interference, habitat condition or degradation is not scored.

Flora
Most of the species encountered are widespread and are known not to be rare. A number however are confined to brackish habitats . As their presence enhances the conservation value of the lagoon they are scored in the assessment. In addition a small number of algae are both confined to lagoons and thought to be very rare, either nationally or on a European basis.
Cladophora battersii has not been identified previously as a lagoon specialist but its two confirmed populations in the U.K. include the Loch Maddai lagoon in North Uist and the Fleet in Dorset, It has also been recorded in the past from the Vadills lagoon in the Shetlands.It is also recorded from a single French Lagoon. Prof.. C. Van Den Hoek states "I do think indeed that *C. battersii* deserves to be a protected species. It is quite rare, and it probably characterizes (but this should be investigated) an ecologically rather narrow (not very eutrophied and not extremely variable as to salinity)lagoonal habitat. I have seen myself 8 collections of the species from Eire, Britain, France and the Adriatic".
C.aegagropila has a somewhat more widespread distribution. Burrows reports that the plant has been found recently in brackish habitats in the Orkney Islands and South Uist. Prof.. Van Den Hoek states that it is common in the Gulf of Bothnia in the Baltic. However it also occurs in certain freshwater lakes.

Lagoonal species
Ruppia maritima var *brevirostris*
Ruppia maritima,
Ruppia cirrhosa,
Chara baltica
Chara canescens
Lamprothamnion papulosum
Cladophora aegagropila
Cladophora battersii
Chaetomorpha linum
An underlined species is scored 2 as these are believed to be rare, while a more widespread lagoonal species is scored 1. As most of these species form vegetational units, scoring for population size simply duplicates the vegetational score.

Table XII shows the results of this semi-quantitative ranking. The two largest and most diverse lagoons, Loch an tSáile and Loch an Aibhnín have the highest score, while the essentially marine Kilmore Lake has the lowest. Lough Athola is in my opinion under ranked because the scoring system takes no account of differences in red algal communities. The unique red algal vegetation in Lough Athola is possibly very unusual, while that of Maghery and Sallys Lough which rank higher than Lough Athola is poor. For this reason I would rank Lough Athola above these two sites. For similar reasons the difference in score between Loch an Aibhnín and Loch an tSáile probably overstates their difference in conservation value, but this does not affect their ranking.

Overall ranking of the 1996 and 1998 sites

The final part of this project is to combine the results of the present survey with those of the 1996 survey undertaken by Mr. Pat Hatch, in order to present an overall ranking of Irish lagoons for conservation purposes. Such a comparison is difficult as the 1996 survey was directed towards littoral and marginal vegetation, while the present survey laid most emphasis on the sublittoral vegetation. This problem is somewhat reduced as in 1998 it proved possible to visit some of the 1996 sites and to briefly examine the sublittoral vegetation. This additional data is now presented, before an attempt is made to produce a complete ranking.

Drongawn Lough. (2/10/1998)

Underwater observations. Only the area inside the entrance sill was examined. The lake water was reasonably clear without strong evidence of stratification. Inside the sill the sides of the lake consist of steeply shelving exposed rock. The rocky slope was followed down to at least 6m depth where a gently sloping bare muddy floor was encountered but there was no sign of *Beggiatoa* at this depth as in Loch Fhada.

Exposed rock near the surface was covered in red algal communities with *Polyides rotundus, Chondrus crispus, Codium fragile tomentosum, Phyllophora pseudoceranoides* and *Fucus serratus*. At 1m depth on sand or gravel a band of *Ruppia cirrhosa* was found. This band thinned with depth and at 3m gave way to dense stands of *Chaetomorpha linum* and *Cladophora sp.* (not *battersii*). This band in turn gave way to bare mud at about 6m.

Lough Gill (2/10/1998)

A small area in the north east of the lake was examined, including a dense stand of *Phragmites australis* and shallow open water. Two unusual plants were found in the reedswamp, *Ceratophyllum demersum* and *Aster lanceolatus*. The former is a uncommon native species while the latter is a scarce introduction from North America. The open water was extremely shallow with patches of *Ruppia cirrhosa* in an unusual small form but with the characteristic very long flower or fruit peduncules reaching the water surface. Two charophytes were found; abundant *Chara aspera* and occasional patches of *Chara canescens*. The latter species was not found in 1996 but had been recorded from Lough Gill at the start of the century. Both species, like *R.cirrhosa*, were dwarf forms about 2-4cm high.

Loch Aconeera (26/8/1998)

Underwater observations The water in this lake is visibly stratified at a depth of about 4m. Water clarity is moderate to good. The deepest point reached was about 6m. Here a muddy floor with outcropping rock had empty shells of *Mytilus edulis*, *Mya arenaria* and *Cerastoderma glaucum* on the surface. Rare plants of *Chondrus crispus* grew on rock. Along the thermocline occasional *Aurelia aurita* were seen, these specimens were larger than those found in Loch Fhada. At about the level of the thermocline dense stands of *Chaetomorpha linum* were found on rock and sand. The upper part of the lake floor consisted of very large glacial boulders (like Loch an tSáile) resting on bedrock, mud or sand. A band of *Ruppia (cirrhosa* ?) occurred above the *C. linum* at about 2-3m. Extremely dense stands of *Potamogeton pectinatus* were found near the shore. Above this zone at 1m *Chara baltica,Ruppia maritima* and *P.pectinatus* were seen.

Roonagh Lough (/10/1998)

This site was visited briefly but the lake appeared very different from the description of 1996.

The exit to the sea seemed very large and much of the lake floor was exposed, as the tide was out. It seems possible that the barrier has been breached or widened since the 1996 survey which reported that Roonagh was a low salinity lagoon.

Several other sites were briefly examined using chest waders but no new species or vegetation types were added to the 1996 descriptions. Sites include Tacumshin, Farranamanagh, Lough Muree, Mill lough, Lettermullen pool, Corragaun and Durnish. However one site which was not chosen to be surveyed in 1998 is of interest as its flora resembles that of Corragaun Lough as described in Verhoeven (1980). Ballyconneely Lough, Co. Galway which was briefly visited on 14/9/1998 had a flora which included *Ruppia maritima, Potamogeton pectinatus, Chara aspera, Chara vulgaris var longibractea, Chara hispida, Scirpus maritimus* and *Schoenoplectus tabernaemontani*. Like Corragaun Lough, Ballyconneely is a shallow lake on sand. It was the only site seen in 1998 with this particular flora.

A comparison method.

TableXI has shown that the different communities that combine to make up the total vegetation of each lagoon co vary, mainly in response to salinity changes. Using this table it is possible to sub divide the lagoons based on the presence of certain vegetation types in the littoral, sublittoral and lagoon margins. As already described four types of lagoon are recognized in terms of vegetation.
While little sublittoral data is available for the 1996 sites, the remaining data is sufficient to see if these sites can be included in this scheme.
The combined total of 36 lagoons are grouped as follows;

Group 1 lagoons includes Kilmore, Aughinish, Lough Athola and Sallys Lough.

Group 2 includes Drongawn, Lettermullen Pool, Loch Tanaí, Loch an Aibhnín, Maghery. The lower basin of Loch an tSáile is a possible inclusion on the basis that Zostera occurs.

Group 3 which is large is divided into two subgroups, i) very shallow and ii) >1m.
i) Lissagriffin, Cloonconeen, Lough Donnell, Bridge Lough, Corragaun, Roonagh, Moorlagh
ii) Farranamanagh, Cara Fionnla, Loch Fhada, Loch an Ghadaí, Mill Lough, Lough Bofin, Kincas. Only *R.maritima* has been recorded from group (i) while *R.cirrhosa* has been recorded from (ii).
Ladys Island can be included in this group but it is so large that several different communities may occur. Lough Murree and the east basin of Loch atSáile are transitional to group 4 as some *P.pectinatus* is abundant.

Group 4, Tacumshin, Kilkeran, Lough Gill, An Loch Mór, Loch an Chara, Loch Phort Chorrúch, Loch an tSáile, Lough Aconeera, Furnace, Durnish, Inch. This group can be sub divided with Inch, Tacumshin and Lough Gill having *Zanichellia*, and *Chara canescens*. All are large shallow lagoons. Loch an tSáile upper and middle basin, Lough Aconeera and Furnace Lough are all deep stratified lakes in rock basins with very diverse communities including *Chara baltica* in two of the three sites.

Ballyteige is not classified.

When the two data sets are combined , new insights into the distribution of species and vegetation types become obvious. For instance *Cystoseira foeniculaceus* is found in three of

the four group 1 lagoons, (it also occurs in an unsurveyed lagoon in inner Galway Bay). As Hatch and Healy (1998) have already noted the *Zostera / Lamprothamnion / Ruppia cirrhosa* community is only found in south Connemara, giving the lagoons in this area an exceptional importance.
The group 3 lagoons are sub divided into shallow and deep. The constant presence of *R.maritima* in the shallow group suggest that the benthic vegetation of these lagoons belong to Verhoeven's Ruppietum maritimae. In the deeper lagoon group, the supposedly rare *Lamprothamnion* occurs in seven of the ten sites, a search of Mill Lough and even Farranamanagh might reveal further populations. The common occurrence of *R.cirrhosa* suggests that a *R.cirrhosa/Lamprothamnion* community is widespread in suitable lagoons.
In group 4, the co-occurrence of *Zannichellia, Chara canescens* or *Ruppia maritima* in four large shallow lagoons suggests that a community including these species occurs in Irish lagoons. There was insufficient data from the Inch survey alone to define this association. *Chara baltica* was found in two of the three deep, stratified, low salinity lagoons, while *Cladophora aegagropila* occurred in one. These most unusual sites are unlikely to occur commonly in western Europe, their conservation value is great. As all three are large, further underwater exploration is desirable. The calcareous algal nodules in An Loch Mór are unique but further information is needed before their importance can be determined. The remaining small shallow low salinity lagoons seem of less value.
As similar data is not available from each lagoon, even a semi quantitative ranking system is impossible but in the following lists I attempt to rank in order of importance the sites included in the four major groups.

Group 1: Lough Athola, Sallys Lough, Aughinish, Kilmore Lake; includes examples of *Cladophora battersii*, Red algal communities and *Cystoseira foeniculaceus*.
Group 2: Lough Aibhnín and Lough Tanaí are linked and should be treated as one unit along with the linked Lough Fada complex, Lettermullen Pool, Drongawn, Maghery;
includes examples of *Zostera/Lamprothamnion/Ruppia cirrhosa* community and very diverse seaweed communities. If the Loch Fhada complex is added an even greater variety of communities is covered.
Group 3i: These lagoons are very poor botanically and it is impossible to suggest a rank order, they should be assessed solely on zoological or geological grounds, though some should be conserved. Ballyconneely Lough which has a flora which resembled that given by Verhoeven (1980) for Corragaun Lough would rank ahead of any of the listed sites as an example of a shallow lagoon with *Ruppia maritima.*
Group3ii: Ladys Island.(Given the huge area of the sublittoral in this site further survey is necessary to see if as yet undescribed vegetation also occurs). Lough Murree, Cara Fionnla (Further exploration of the channel and lakes leading to the sea may increase the value of this site), Lough Bofin, Kincas, Farranamanagh, Mill Lough.
Examples of Charophyte communities, *Ruppia cirrhosa/ Lamprothamnion papulosum* community and *Chaetomorpha linum* stands in deeper water.
Group 4: Lough Gill, Tacumshin, Inch, Durnish. All four sites are important for *Chara canescens* populations and *Zanichellia/Ruppia* communities.
Loch an tSáile, Furnace, Lough Aconeera, Important for *Chara baltica*, stratification and sub halocline brackish communities.
An Loch Mór, (important as palaeoecology site and possibly interesting calcareous algae) Kilkeran, Loch an Chara, Loch Phoirt Chorrúch.

Combining this data I would group the 36 sites in the following conservation categories

International Importance
Lough an Aibhnín, Lough Tanaí , Loch Fhada complex,
Ladys Island,
Loch an tSáile,
Tacumshin

National importance
Loch Athola
Lettermullen Pool
Lough Murree
Lough Gill
Inch
Furnace
Loch Aconeera
Sallys lough
Drongawn
Maghery
Ballyconneely?
Cara Fionnla
Lough Bofin
Kincas
Durnish

The vegetation of the remaining 16 sites does not appear to be of exceptional interest.

References

Burrows, E.M., (1991) *Seaweeds of the British Isles.* Vol. 2. Chlorophyta, Natural History Museum Publications, London.

Clapham, A.R., Tutin, T.G. & Moore, D., (1987) *Flora of the British Isles*, 3rd edition Cambridge University Press, Cambridge.

Corillion, R., (1957) *Les Charophyceés de France et d'Europe Occidentale.*Imprimerie Bretonne, Rennes:pp 499.

Covey, R. and Thorpe, K., (1994) *Classification of benthic marine biotopes for isolated saline waters in Scotland.* Joint Nature Conservation Committee report.

Curtis, T.G.F. and McGough, H.N., (1988) *The Irish red data book 1. Vascular plants.* Stationery Office, Dublin.

Curtis,T.G.F. and Sheehy Skeffington, M.J.,(1998) The Salt Marshes of Ireland: an inventory and account of their geographical variation. Biology and Environment. 98 B, 273-287.

Dixon, P.S. and Irvine, L.M., (1977) *Seaweeds of the British Isles. Vol. 1 . Rhodophyta part 1,Introduction, Nemaliales, Gigartinales.* Natural History Museum Publications London.

Dodge, J.D.(1982) *Marine Dinoflagellates of the British Isles*, HMSO London.

Dunn, M.D.,(1937)Notes on the flora of Loch Harray and Loch of Stenness and comparisons with the brackish water lochs of North Uist. Transactions and Proceedings of the Botanical Society of Edinburgh XXXIII 368-372.

Guiry, M.D., (1997) in Howson,C.M. and Picton, B.E., (eds)*The species directory of the marine flora and fauna of the British Isles and surrounding seas.* Ulster Museum and Marine Conservation Society, Belfast and Ross-on-Wye.

Hatch, P. and Healy, B., (1998) Aquatic vegetation of Irish coastal lagoons. Bull. Ir. biogeog. Soc. 21, 2-21.

Healy, B. and Oliver, G., (1998) Irish coastal lagoons ; summary of a survey, Bull. Ir. biogeog. Soc. 21, 116-151.

Healy, B. and Oliver, G. A., (1998) Coastal lagoons in the Republic of Ireland. Vol. 1 Outline and summary of a survey of Irish coastal lagoons,Report to the National Parks and Wildlife Service.

Healy, B., Oliver, G. A., Hatch, P. and Good, J. A., (1997b) Coastal lagoons in the Republic of Ireland. Vol. 2. Inventory of lagoons and saline lakes. Report to the National Parks and Wildlife Service.

Healy, B., Oliver, G. A., Hatch, P. and Good, J. A., (1997c) Coastal lagoons in the.Republic of lreland. Vol, 3, Parts 1-20. Reports to the National Parks and Wildlife Service.

Krause, W.,(1997) *Charales*, Süsswasserflora von Mitteleuropa; Bd 18, Gustav Fischer, Jena, Stuttgart, Lübeck, Ulm.

Maggs, C.A., and Hommersand, M.H.,(1993) *Seaweeds of the British Isles. Vol. 1 . Rhodophyta part 3A Ceramiales.* HMSO London.

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

Moore, J. A., (1986) *Charophytes of Great Britain and Ireland.* BSBI Handbook No 5. Botanical Society of the British Isles, London. 141 pp.

Nooren, M.J. and Schouten, M.G.C., (1976) Coastal vegetation types and soil features in south-east Ireland. Doctoraal Verslag. Catholic University of Nijimen.

O', Connell., Molloy, K. Usinger,H. and Dorfler, W., (1997) Coring deep calcareous lakes in south-east Clare and Inis Oírr (Inisheer), western Ireland, towards the reconstruction of Late-Glacial and Holcene environments. Wurzburger Geographische Manuskripte, 41,

151-152.
Preston, C.D., (1995) *Pondweeds of Great Britain and Ireland.* BSBI Handbook No 8. Botanical Society of the British Isles, London. 351 pp.
Robinson, T.,(1986) *Stones of Aran,* Lilliput Press , Mullingar 298 pp.
Robinson, T.,(1990) *Connemara, a map and guide,* Folding Landscapes, Roundstone
Scannell, M.J.P. and Synnott, D.M., (1987) *Census Catalogue of the Flora of Ireland* (2nd ed.) The Stationery Office, Dublin.
Sheehy Skeffington, M.J. and Wymer, E.D. (1991) *Irish salt marshes - an outline review.* In M.B. Quigley (ed) A Guide to the Sand Dunes of Ireland, 77-91, Dept. of Geography, Trinity College, Dublin.
Springer, S.S., (1999) *The vegetation and ecology of some lagoonal salt marshes in Connemara.* B.Sc Hons thesis, Botany Dept., N.U.I.G.
Stace, C., (1997) *New flora o fthe British Isles*. 2nd. ed. Cambridge University Press. 1130 pp.
Stewart, N. F. and Church, J. M., (1992) *Red Data Books of Britain and Ireland, Charophytes* Joint Nature Conservation Committee and Office of Public Works. 144 pp.
Tomas, C.R., (ed) (1996) *Identifying marine diatoms and dinoflagellates*. Academic Press, London. xiii+598.
Van Den Hoek, C. ,(1963) *Revision of the European species of Cladophora.* Leiden.
Verhoeven, J. T. A., (1979) The ecology of *Ruppia*-dominated communities in Western Europe I. Distribution of Ruppia representatives in relation to their autecology. Aquat. Bot. 6: 197-268.
Verhoeven, J. T, A., (1980) The ecology of *Ruppia*-dominated communities in Western Europe, II. Synecological classification. Structure and dynamics ofthe macroflora and macrofauna communities. Aquat. Bot. 8: 1-85.
Webb, D.A.and Scannell, M.J.P.,(1983) *Flora of Connemara and the Burren* , Royal Dublin Society and Cambridge University Press, Cambridge.
White, J. and Doyle,G., (1982) The vegetation of Ireland, a Catalogue raisonee, Journal of Life Science, Royal Dublin Society 3, 289-363
Wymer, E.D., (1984) The phytosociology of Irish saltmarsh vegetation.
Unpublished M.Sc.Thesis, National University of Ireland .

Vegetation tables

	Sallys	an Aibhnín	Athola	Bofin	Gadaí	Fhada	Maghery	Kincas	Cara Fionnla	an tSaile	Inch	An Loch Mór	Ballyteige
Dinoflagellates													
Alexandrium sp.	1	1				1	1						
Ceratium hirundinella								1					
Ceratium furca	1												
Ceratium fusus							1				1		
Ceratium lineatum			1										
Dinophysis acuminata	1	1				1		1					
Dinophysis acuta							1				1		
Glenodinium foliaceum					1						1		
Gonyaulax digitale	1												
Gymnodinium sanguineum		1					1						
Gyrodinium aureolum			1										
Polykrikos (beauchampia?)				1									
Polykrikos schwartzii			1										
Prorocentrum lima	1	1	1	1	1	1	1						
Prorocentrum minimum				1									
Prorocentrum sp.													
Prorocentrum micans		1	1			1							
Prorocentrum scutellatum	1	1	1	1	1	1	1	1	1				
Protoperidinium spp.	1	1	1	1									
Diatoms													
Asterionella formosa								1					
Asterionella japonica							1						
Cerataulina pelagica							1						
Chaetoceros spp.		1					1	1					
Ditylum brightwellii		1											
Eucampia zodiacus		1											
Leptocylindrus danicus		1	1				1						
Guinardia delicatula		1											
Rhizosolenia setigera		1	1				1						
Skeletonema costatum							1						1
Thalassiosira sp.							1						
Chlorophyceae													
Ankistrodesmus										1			
Cosmarium													
Eudorina elegans											1		
Pandorina sp.											1		
Pediastrum											1		
Scenedesmus sp.											1		
Stephanosphaera pluvialis													
Cyanophyceae													
Anabaena sp.			1							1		1	
Coelosphaerium										1			
Merismopedia													
Oscillatoria													
Other groups													
Dinobyon										1			
Eutreptia								1					

Table I; Phytoplankton recorded in the 1998 survey

lake	an tSaile	an tSaile	inch	inch	inch	gill	cara fionnla	fhada	kincas	inch	an tSaile	inch	inch	inch	inch	inch	loch mor	loch mor	inch	an tSaile	chorruch	inch	an tSaile	cara fionnla	chorruch	chara	an tSaile	carafinla	an tSaile	an tSaile	cara fionnla	cara fionnla	maghery	cara fionnla	an tSaile	gadaí	bofin	bofin	fhada	fhada	gadaí	fhada	fhada	fhada	an tSaile	kincas
depth	0.5	0.5	1	1	1	0.5	0.8	0.5	0.5	1	0.5	1	1	1	1	1	1	1	1	2	1	1	2	2	1	1	1	1.5	0.5	2	2.5	2	1.5	2	1	1	1	1	1.5	2	0.5	1	2	.5	2	1
salinity	0.5	4	1	1	1		3	8	9	1	5	1	1	1	1	1	4	4	1	10	3	1	10	1	3	13	5	3	4	8	1	1	23	1	4	3	15	15	15	20	3	10	10	7	10	29
releve	26.5	23.5	17	16	20		14	30	5	22	25.5	25	24	21	19	15	12	11	23	22	14	18	24	11	13	11	14	20	21	23	13	12	14	16	20	10	13	14	29	28	9	17	14	18	18	2
Littorella uniflora	1																																												
Zannichellia palustris				1																																									
Chara virgata	1																																												
C.baltica		1																																											
C.cannescens			2	1	2	1									1																															
Chara aspera		1		1	1	2	3	2	2	2	1	2	1																														0			
Myriophyllum spicatum												1	1	1																																
Potamogeton.berchtoldii															1	1																														
P.pectinatus												2	2	2	1	4	4	4	3	3	3	3	2	2	1	1	0	1	1	3	0															
Lamprothamnion papulosum		1						0																				1	1	2	0	1	1	0	1	1	4	4	1	0	3	1				
Ruppia sp.			2			2	0													1	1	2	2	1	3	3	3	1	1	2	1	2	2	3	3	5	1	1	1	1	0	0	0	1	1	2
Chaetomorpha linum																				3			2								0					1	1	1	2	5	0	5	3	0	4	0
Zostera marina																							1																							
Spermathocnus paradoxus																																													
Cladophora aegagropila																																													
C.battersii																																													
Beggiatoa																																													
Gracilaria gracilis																																													
Zostera angustifolia																																													
Fucus ceranoides																								2										0												
F.vesiculosus																																										2	1			
Cladophora vagabunda			1	1	2		1		1	1		2	1	1	0	0			0			1				3			0			1		2	1	1	1			1				1
Enteromorpha sp.			1	1	2			3		1		2	1	2	0	1	2	1	1			1			1	2	2			0			1			1			3	0			3	4		

Table II:Benthic vegetation of soft sediments.

lake	bofin	kinvarra	an tSaile	gadaí	bofin	maghery	cara fionnla	moorlagh	an Aibinn	cara	cara fionnla	A tSaile	fhada	maghery	ballyteige	ballyteige	cara fionnla	fhada	athola	maghery	cara fionnla	an Aibinn	an Aibinn	an Aibinn	an Aibinn	an Aibinn	an Aibinn	an tSaile	an tSaile	an tSaile	fhada	fhada	an tSaile	kincas	gadaí	fhada	fhada	fhada	sally's	sally's	athola	sally's	an tSaile	an tSaile	kincas	loch fada
depth	1	1	1.5	1	1	1.5	1.5	0.6	1	1	2.5	0.8	0.5	1.5	1	1	2	0.5	0.5	1.5	1	1	2	1.5	1.5	2	2	2	2	2.5	2.5	1.5	3	3	2	1	3	3	3	4	1	2	4	4	3	3	5
salinity	15	10	10	3	15	23	3	10	25	13	3	8	7	23	28	28	3	7	28	23	3	25	25	25	25	25	25	25	12	14	14	25	25	10	29	3	15	25	25	33	33	28	33	12	10	29	30
releve	15		17	11	16	13	15	6	15	12	17	15	22	15	4	4	18	20	19	16	19	17	18	14	16	13	12	19	19	25	19.5	27	16	10	3	12	15	21	23	19	22	20	20	28	27	4	24.5
Littorella uniflora																																														
Zannichellia palustris																																														
Chara virgata																																														
C.baltica																																														
C.cannescens																																														
Chara aspera				1			0											0																												
Myriophyllum spicatum																																														
Potamogeton.berchtoldii																																														
P.pectinatus																																														
Lamprothamnion papulosum																						1	1									1															
Ruppia sp.	3	3	3	4	5	5	4	4	4	4	4	3	3	3	2	2	2	1	1	1	0	3	1	2	2	1	0		0												1			1			
Chaetomorpha linum	0	2	2	0	1																		2						2	1	3	3	1	3	4	5	5	5	5	1	1					
Zostera marina																						2	0	0	1	3	3	3	2	1	1														
Spermathocnus paradoxus																							2	0	0	0	1	1																	
Cladophora aegagropila																																										3	5			
C.battersii																																								3	1	5	4				
Beggiatoa																																												1	1
Gracilaria gracilis		0																																											
Zostera angustifolia		1																																											
Fucus ceranoides							1																																						
F.vesiculosus													1					0																												
Cladophora sp.			1					1		2																			3		3	1														
Enteromorpha sp.			0		1					1			1	2															0			3					1								
Table II continued																																														

	var brevirostris	*maritima*	*cirrhosa*
Ballyteige	1		
Kilmore			
Loch Mór			
Loch an Chara		1	1
Loch Phort Chorruch		1	1
Cara Fionnla		1	1
Loch Fhada		1	1
Loch an Aibhnín		1	1
Loch an tSáile		1	1
Lough Athola			
Lough Bofin		1	1
Maghery		1	1
Sallys Lough			
Kincas			1
Moorlagh			
Inch	1		
TABLE III; Ruppia species in the lagoons			

Verhoeven		This study.	
Association	Character species		
Rupietum brevirostris	*R.maritima brevirostris*		
Cladophoro-Ruppietum cirrhosae	*R. cirrhosa*	*R.cirrhosa/C,vagabunda?*	
Ruppietum maritimae	*R.maritima*	*R.maritima brevirostris /charophytes, Ruppia/charophytes*	
Ruppietum cirrhosae	*R.cirrhosa*	*Ruppia stands, Zostera/Ruppia, P.pectinatus/ Ruppia, C.linum/Ruppia*	TABLE IV:Ruppia associations of Verhoeven compared to communities found in this study.
No equivalent		*Ruppia/Lamprothamnion*	
		Zostera/Ruppia/Lamproth amnion	

	Sallys	Athola	Kilmore	an Abhuin	Maghery	Fhada	Kincas	Moorlagh	an tSaile	Cara Fionnla	Loch Mór
salinity	34	34	31	25	23	20	19	9	7	5	4
Rhodophyceae											
Anfeltia plicata	+	+									
Audouinella floridula		+									
Bonnemaisonia asparagoides				+							
Calliblepharis jubata		+									
Chondria dasyphylla		+		+							
Chondria capillaris?				+							
Chondrus crispus	+	+		+	+	+					
Chylocladia verticillata		+		+							
Corallina officinalis	+	+		+							
Cystoclonium purpureum				+							
Furcellaria lumbricalis	+	+		+	+						
Gelidium pulchellum		+									
Chondracanthus acicullaris		+									
Gracilaria gracilis	+	+	+	+	+						
Griffithsia coralinoides				+							
Heterosiphonia plumosa				+							
Hildenbrandia sp.				+		+					
Hypoglossum woodwardii		+									
Jania rubens		+		+							
Laurencia obtusa				+							
Laurencia pinnatifida		+									
Lomentaria clavellosa				+							
phyllophora crispa	+	+		+							
Phyllophora pseudoceranoides	+	+		+	+	+					
Coccotylus truncata	+			+							
Plocamium cartilagneum		+		+							
Polyides rotundus				+							
Polysiphonia elongata		+									
Polysiphonia macrocarpa						+					
Polysiphonia nigra				+							
Polysiphonia nigrescens		+				+					
Pterocladia capillacea		+									
Rhodomela confervoides		+									
Rhodophyllis divaricata		+									
Sphaerococcus coronopifolius				+							
Table V; Seaweeds recorded in the 1998 survey											

	Sallys	Athola	Kilmore	an Abhainn	Maghery	Fhada	Kincas	Moorlagh	an tSaile	Cara Fionnla	Loch Mór
salinity	34	34	31	25	23	20	19	9	7	5	4
Phaeophyceae											
Ascophyllum nodosum	+										
Cystosira foeniculaceus		+	+								
C. baccata			+	+							
C.tamariscifolia		+									
Chorda filum		+		+							
Cutleria multifida			+								
Dictyota dicotoma	+	+		+							
Fucus ceranoides								+	+	+	
Fucus serratus	+					+	+		+		
Fucus vesiculosus	+	+		+		+			+	+	
Halidrys siliquosa		+		+							
Laminaria sacharina				+							
Pelvetia caniculata											
Spermatochnus paradoxus				+							
Chlorophyceae											
Codium vermilaria				+							
Codium fragile sp tomentosoides	+	+	+	+					+		
Enteromorpha intestinalis											
Cladophora rupestris	+			+	+						
Cladophora sp.			+								
Caladophora laetevirens	+								+		
Cladophora pellucida				+							
Cladophora coelothrix				+							
Cladophora vagabunda											
Calcareous crust											+
Table V continued											

	Athola	an Aibhnin	an Aibhnin	Athola	Sally's	Maghery	Sally's	Fhada	an Aibhnin
substrate	rock slope	rock slope	4m hole	4m hole	rock slope	large stone	steep rock	steep rock	flat rock
sampling point no.		21	22		21		22		19
Chondracanthus acicullaris	1								
Laurencia pinnatifida	1								
Pterocladia capillacea	1								
Chylocladia verticillata	1	1							
Gelidium pulchellum	1	1							
Laurencia obtusa	1	1							
Chondria capillaris?		1							
Griffithsia coralinoides		1							
lithothamnion		1							
Cladophora pellucida		1							
Polyides rotundus		1	1						
Bonnemaisonia asparagoides			1						
Cystoclonium purpureum			1						
Heterosiphonia plumosa			1						
Polysiphonia nigra			1						
Sphaerococcus coronopifolius			1						
C. baccata			1						
Laminaria sacharina			1						
Codium vermilaria			1						
Halidrys siliquosa			1	1					
Chorda filum			1	1					
Plocamium cartilagneum			1	1					
Lomentaria clavellosa			1	1					
Calliblepharis jubata				1					
Hypoglossum woodwardii				1					
Rhodomela confervoides				1					
Jania rubens	1		1						
Rhodophyllis divaricata	1			1					
Codium fragile sp tomentosoides	1		1	1	1				
Corallina officinalis	1		1		1				
Chondria dasyphylla	1	1	1						
Dictyota dicotoma		1	1	1					
Coccotylus truncata		1			1				
Phyllophora crispa		1	1	1	1				
Furcellaria lumbricalis		1	1	1	1	1			
Gracilaria gracilis		1		1		1	1		
Anfeltia plicata				1	1		1		
Cladophora rupestris		1	1		1	1	1	1	
Chondrus crispus				1	1	1	1	1	1
Phyllophora pseudoceranoides		1	1	1	1	1	1	1	1
Chaetomorpha linum	1	1					1	1	1
Hildenbrandia sp.		1	1		1	1		1	1
Polysiphonia macrocarpa								1	
Polysiphonia nigrescens								1	

Table VI; seaweed vegetation in the most saline lagoons.

Lake	an tSaile	Athola	an Aibhnín	Maghery	Athola	Moorlagh	Moorlagh	Athola	Athola	an Aibhnín	an Aibhnín	Cara Fionnla	Cara Fionnla	an Aibhnín	an Aibhnín	Athola	Athola	Maghery	an Aibhnín	Athola	Sallys	Maghery	an Aibhnín	Sallys	Sallys	Athola	Sallys	Sallys	Sallys	Sallys	Athola	Athola	Sallys
	6	7	6	9	12	2	1	10	6	7	5	4	10	8	3	13	11	10	4	8	13	6	2	16		3	4	1	3	2	9	4	12
Astet tripolium															1					1									1	1	1	2	0
Juncus gerardi																	1	0	0	1	1	2	3		2	0							
Puccinellia maritima																1					1	0	1	4	0		2	4	1	2	2	1	4
Triglochin maritima														1	0	0		0	0	1	0	1		1	1	1	1	2	1	2	1	2	1
Armeria maritima											0	0	1	1	1	1	1	1	1		2	1	1		1	1	2		1	0	1	2	0
Carex extensa		1									1		1	0	1		1								2								
Agrostis stolonifera	2	2	0	1	2	1	1	2	2	1	2	2	2		1		1	1	2			2	0	0								
Juncus maritmus	3	3	5	4	3	3	2	3	3	2	2	3	2	4	3	3	3	3	3	2	2											
Festuca rubra						3	3	2	1	4	1	2	2				1	2		0												
Leontodon autumnalis	1	0	0		1					1	0	1																				
Samolus valerandi	1	1							0		0	1	1																			
Carex distans														0																		
Glaux maritima	0	1	1		0			0		0	0	1	2	1	1	0	1		2	2	0	2	0	0	2	2	0	1	2	1	1	1	
Plantago maritima		1			2		1			1	0	0	1	1	0		1	1	1	2	2	1	0	1	1	3	2		3	1		2	0
Isolepis cernua	1																															
Phragmites australis		0						0																								
Carex viridula									0																							
Juncus articulatus									0																							
Schoenus nigricans											1																					
Triglochin palustre												1																				
Limonium humile																							1									
Spergularia marina																							0				0					1
Cochlearia officinalis														1									0	0								
Saliconia europea																															0	
Table VII; salt marsh communities																																

Lake	Bofin	inch	Chorruch	Bofin	Chorruch	Loch Mór	Chara	inch	inch	Bofin	Chara	Chara	Cara Fionnla	Chara	an tSaile	an tSaile	Cara Fionnla	Bofin	an tSaile	Maghery	Maghery	Athola	Maghery	Sallys	an Aibhnín
Relevé no.	1	10	12	4	12	5	2	11	8	2	6	7	8	1	9	8	6	6	2	7	4	14	5	7	1
Festuca rubra																									
Blysmus rufus																								1	2
Triglochin maritima																				1	1	1	2	2	1
Plantago maritima										1					1	0	0	1	1	1	0	1	1	0	1
Samolus valerandi											2	0	2	1	1	2	1		1		0	0			
Potentilla anserina			4	2	4	2	2	1	1	1	3	3		0											
Leontodon autumnalis				1				0	0	1	0		1				0					1			
Agrostis stolonifera			1		0	1	3	3	1	0	3	3	3	3	2	2	2	1	1	2	2	2	3		2
Glaux maritima	2	2	0					2	1	2	1	1	1	1	1	1	1	3	1	2	1		1		2
Juncus gerardi	3	2	0	3	1	2	1	1	4	3	1	1	1		2	3	3	1		1	2	1	1	1	1
Eleocharis uniglumis		2	1	1	1																				
Trifolium pratense											0														
Trifolium repens				2			1																		
Plantago lanceolata																									
Agropyron repens																									
Lotus corniculatus																									
Sagina sp																									
Cochlearia officinalis																									
Carex distans																									1
Sagina nodosa																				1			0		
Plantago cornopus																		1	1						
Armeria maritima															1		1								
Triglochin palustre																	0					1			0
S. tabernaemontani															1									2	
carex extensa												1												2	0
Juncus articulatus							0	0			0									1	2				
Scirpus maritimus							1				0	0		0								1		2	
Hydrocotyle vulgaris							2				2	0													
Phragmites australis				0	0																				
Puccinellia maritima																									
Astet tripolium																									
Rumex crispus						0																			
Carex obtrubae												0													
Juncus bufonius														2							0				
Carex viridula																			1						
Carex nigra				1						2															
Ranunculus acris																							1		
Galium palustre											0														
Isolepis cernua																0									
Oenanthe lachenalii																						1			

Table VII; Communities with Juncus gerardi and Festuca rubra

Sallys	Sallys	Sallys	Kincas	Athola	Sallys	Athola	Athola	Athola	Moorlagh	Athola	an Aibhnín	Cara Fionnla	Sallys	Cara Fionnla	an Aibhnín	Athola	Moorlagh	Gadaí	Moorlagh	an tSaile	Sallys	Sallys	Lake
14	8	9	1	15	6	17	2	16	5	5	9	3	10	1	11	1	4	1	3	5	16	17	Relevé no.
						0	1	2	3	1	3	1	4	3	5	4	1	3	3	1	3	5	*Festuca rubra*
2	3	0	2	2	2	3																	*Blysmus rufus*
	1				2	2	1	1		1							0	1	1				*Triglochin maritima*
	0	1	1	2	0		2	1	1	2	1	2				0			1				*Plantago maritima*
	1																	0					*Samolus valerandii*
																1							*Potentilla anserina*
			1					0		1		1	1	0				1	1				*Leontodon autumnalis*
3	1	2	2	1			1	1	3	1	2	2	1	4	1	1	3	2	2	2			*Agrostis stolonifera*
1	2	0					1	1	0	1	1	2	0	0	0								*Glaux maritima*
1				3		2	2	3	0	3													*Juncus gerardii*
			1																				*Eleocharis uniglumis*
												2	1	1	0		1						*Trifolium pratense*
							1									0							*Trifolium repens*
																0					0		*Plantago lanceolata*
																					3		*Agropyron repens*
															1	1							*Lotus corniculatus*
																	1			0			*Sagina sp*
1		0								1													*Cochlearia officinalis*
		0						1		0													*Carex distans*
		0																					*Sagina nodosa*
				1							1	0		1				1					*Plantago cornopus*
	0				0				1					0									*Armeria maritima*
	0	0											1										*Triglochin palustre*
																							S.tabermontanii
	1										1	1											*carex extensa*
		0	1						1			1			2			1					*Juncus articulatus*
					3																		*Scirpus maritimus*
																		0					*Hydrocotyle vulgaris*
																							Phragmites australis
1																							*Puccinellia maritima*
				0																			*Astet tripolium*
																							Rumex crispus
																							Carex obtrubae
																	0						*Juncus bufonius*
															1								*Carex viridula*
																							Carex nigra
																							Ranunculus acris
																							Galium palustre
		0																2					*Isolepis cernua*
																							Oenanthe lachenalii

Table VII continued

Lake	Gadaí	Inch	Gadaí	Gadaí	Gadaí	Bofin	Inch	Gadaí	Chara	Cara Fionnla	Bofin	Cara Fionnla	Athola	Gadaí	an tSaile	an tSaile	Bofin	Bofin	Loch Mór	an tSaile	an Aibhnín	Bofin	Loch Mór	Loch Mór	Loch Mór
	4	14	2	8	5	5	1	7	4	2	3	9	18	3	3	4	8	10	4	1	10	9	11	6	7
Eleocharis palustris				1	1			1																	
Schoenoplectus tabernaemontani	0	1	2	0																					
Eleocharis uniglumis	4	4	4	4	1	0	1	3	2	2	4	4	3		2	3	1	2							
Agrostis stolonifera		2		2	2	1	3	1	3	3	2	1	1	3	2	2								2	2
Samolus valerandi			1		1							1								1	1				
Triglochin maritima			1	1			1	1						1											
Juncus articulatus					2	2		1		1							1								
Triglochin palustre					0	1			1	1															
Hydrocotyle vulgaris					1	2											2	0							
Lythrum salicaria					0	1																			
Carex nigra					1	0					1						1								
Potentilla anserina						1	1		3															0	3
Isolepis cernua								1						2								0			
Atriplex hastata									0										1						
Glaux maritima										1		1									1				
Leontodon autumnalis							0				1	2	1	1		1	1							0	1
Plantago maritima												1	1	2	1		1	3	0	1	1	2	4		
Plantago cornopus														1			3	3	1	1		4			
Carex viridula															2	2	1	1							
Anagallis tenella															2	1		2							
Rumex crispus																			0					0	0
Carex obtrubae																								3	1
Juncus bufonius																						1		1	
Trifolium pratense																								0	0
Cochlearia officinalis																							1		
Armeria maritima																					1				
Scirpus maritimus									1																
Ranunculus acris						0																			
Sagina sp																		1							
Juncus gerardi						0																			
Agropyron repens																							2		
Salix repens																		0							

Table IX Eleocharis and rocky shore communities

Lake	Corruch	Corruch	Corruch	Corruch	Corruch	Chara	Chara	Bofin	Loch Mór	Corruch	Corruch	Loch Mór	Loch Mór	Maghery	Maghery	Loch Mór	Corruch	Ilnch	Ilnch	Ilnch	Ilnch	Ilnch	Maghery	Maghery	an tSaile	Cara Fionnla	Ilnch	Ilnch
	8	1	2	5	4	8	3	7	9	6	9	2	3	1	2	1	7	5	6	7	12	13	4	3	7	5	3	9
Scirpus maritimus	5	3	0	3	2	4	3	3	3	1	1	2	1			0												
Phragmites australis			5					3	4	5	5	3	2	1	1	5	4						1	0				
Schoenoplectus tabernaemontani						0					1	1	1	2	3	0		1	2	3	2	1	0	3	3	2	3	3
Eleocharis palustris																					1						1	
Matricaria maritima		0	0																									
Atriplex hastata		0	0																									
Astet tripolium		3	1	1																								
Potentilla anserina				2	2																							
Agrostis stolonifera			0	2	3	1	1									2	3	5	4	3	2							
Samolus valerandi						2	2														1	2	1	1	1	2		
Juncus articulatus																				1	0	2	2	1				
Hydrocotyle vulgaris																							1	0				
Anagallis tenella																							1	0		0		
Triglochin palustre																							1	0				
Ranunculus flamula																				1			2	1				
Lythrum salicaria																0						0						
Triglochin maritima																							1					
Isolepis cernua																									1			
Juncus gerardi																									1			
Plantago maritima																										0		
Glaux maritima																									0			
Ranunculus acris																								0				
Galium palustre																							1					
Sagina sp																							0					
Schoenus nigricans																										1		
Spergularia marina		2																										
Cardamine pratense														1														
Saliconia europea		1																										
Lemna minor														0														
Polygonum hydropiper																						1						
R.scleratus														0														
Salix cinnerea																0												
Senecio aquatica																							1					

Table X; emergent vegetation

COMMUNITY	*Zostera*	*C.battersii*	*Red algae*	*Puccinellia*	*Blysmus*	*J.gerardii*	*Fucoids*	*Juncus maritimus*	*Festuca*	*Marine plankton*	*Chaetomorpha*	*Lamprothammion*	*Ruppia*	*Potamogeton*	*Phragmites*	*Chara aspera*	*Eleocharis*	*S.tabernaemontani*	*Freshwater Plankton*	*P.anserina*	*S.valerandi*	*Scirpus maritimus*	*C.aegagropila*	*Enteromorpha*
GROUP IV	SALINITY 0-20																							
Loch an tSaile upper													1	1				1	1				1	1
Phort Chorruch													1	1	1			1		1		1		1
Loch an tSaile middle									1				1	1		1	1		1		1			1
An Loch Mór														1	1			1	1	1		1		1
Loch an Chara													1	1			1			1	1	1		1
Inch										1	1		1	1	1	1	1	1	1	1				1
GROUP III	SALINITY 2-30																							
Loch an tSaile east												1	1	1		1								1
Lough Bofin						1				1	1	1	1	+	1		1			1		1		1
Loch an Ghadaí									1		1	1	1			1	1	1						1
Cara Fionnla							1	1	1	1		1	1	1	1	1	1	1			1			1
Loch an tSaile lower	1						1	1			1		1	+			1	1	1					1
Kincas					+		1			1	1		1		1	1								1
Loch Fhada			+				1	1		1	1	1	1			1								1
Moorlagh						1	1	1	1				1											
GROUP II	SALINITY 15-26																							
Maghery	+		1	1		1		1		1		1	1		1						1			1
Loch an Aibhnín	1		1	1	1	1	1	1	1	1	1	1	1											1
GROUP I	SALINITY 27-34																							
Lough Athola		1	1	1	1	1	1	1	1	1			+				1				1	1		1
Sallys Lough		1	1	1	1	1	1	1	1	1	1		+					1				1		1
Kilmore							1																	1
NOT CLASSIFIED																								
Ballyteige										1			1											1

TABLE XI; The distribution of the main vegetation types. 1=common, += very rare.

TABLE XII; SITE ASSESSMENT

	number of communities	number of* communities	area< 1ha	area< 5ha	area>5ha	number ol lagoonal species	number of * species	rarity	VALUE
Loch an tSáile	12	6	2	2	2	5	3	3	50
Loch an Aibhnín	9	4		1	3	4	1	3	37
Inch	10	4	2		2	2	2		32
Loch Fhada	11	4	2	2		3	1		30
Cara Fionnla	9	4	2	2		3	1		28
Sallys Lough	10	4	3	1		3	1	4	32
Maghery	6	3	1	2		3	1	1	23
Lough Athola	7	3	2	1		2	1	4	25
Lough Bofin	6	2	1	1		3	1		18
Kincas	7	3	3			2			18
Loch Phort Chorruch	7	2	1	1		2			16
Loch an Chara	5	2	2			2			13
Ballyteige	1	1		1		3	2		12
Loch Mór	7	1	1						10
Moorlagh	5	1		1		1			10
Kilmore	0	0	0			0			0

COLOUR CODE FOR BENTHIC VEGETATION

- ***Beggiatoa***
- ***Cladophora battersii***
- ***C. aegagropila***
- ***Chaetomorpha linum***
- ***Zostera marina***
- ***Ruppia/L.papulosum***
- ***Ruppia sp.***
- ***Potamogeton pectinatus***
- ***Chara species***
- ***No vegetation***
- ***Red Algae***

COLOUR CODE FOR MARGINAL VEGETATION

Puccinellietum

Juncus maritimus community

Juncus gerardii typicum community

Juncus gerardii community Potentilla variant

Blysmus association

Festuca rubra community

Eleocharis community

Scirpus maritimus

S. tabernaemontani

Phragmites australis

Ballyteige Channel, An Loch Mór and
Loch Pho rt Chorruch.

PLATE I

Loch an Aibhnín; (top) Sill, note high tide level shown by lichen band. (middle) Open water. (bottom) Narrow marginal vegetation zone.

PLATE II

Loch an tSáile; upper, middle and lower basins. Note the steep cliff like shores and large granite boulders forming small islands.

PLATE III

Lough Athola, the barrier at Lough Bofin and high spring tide flooding over the brid ge at Maghery Lough.

PLATE IV

Sally's Lough, Kincas Lough and Moorlagh, Co. Donegal

PLATE V

Inch Lagoon; panorama from Inch Island and looking west over S.tabernaemontani beds at the narrow waist.

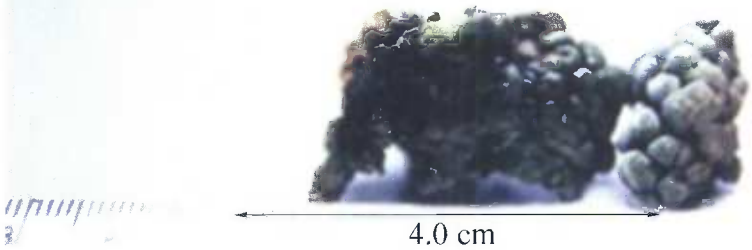
PLATE VI

Schoenoplectus tabernaemontani at Loch Pho rt Cho rruch
Scirpus maritimus at the same site
Enteromorpha intestinalis at an Loch Mór.

PLATE VII

Juncus maritimus at the edge of Loch an tSáile.
Maritime lichens at the edge of Cara Fionnla.
Ruppia sp., Fucus vesiculosus and Zostera at
the edge of Loch an Aibhnín.

PLATE VIII



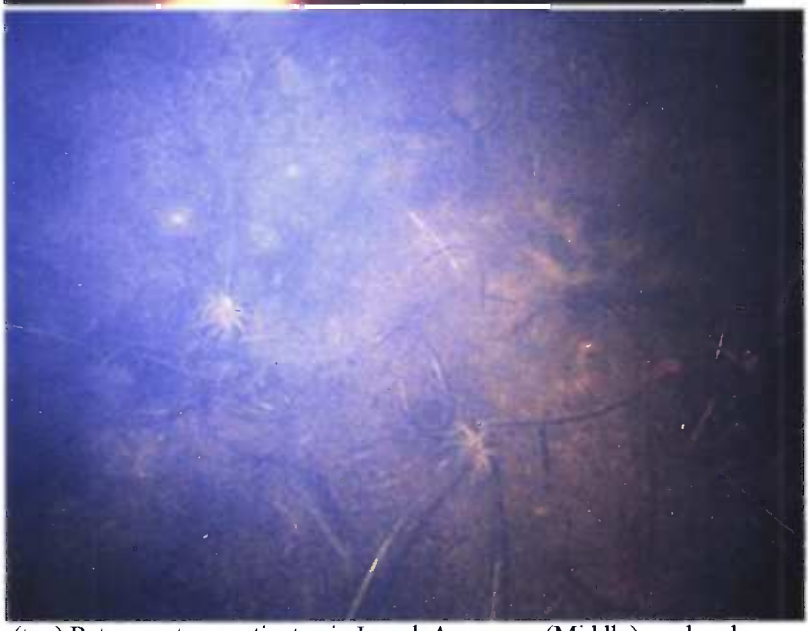
4.0 cm

Ruppia maritima.
Calcareous algae from an Loch Mór.
Chaetomorpha linum from Loch Fhada.

PLATE IX

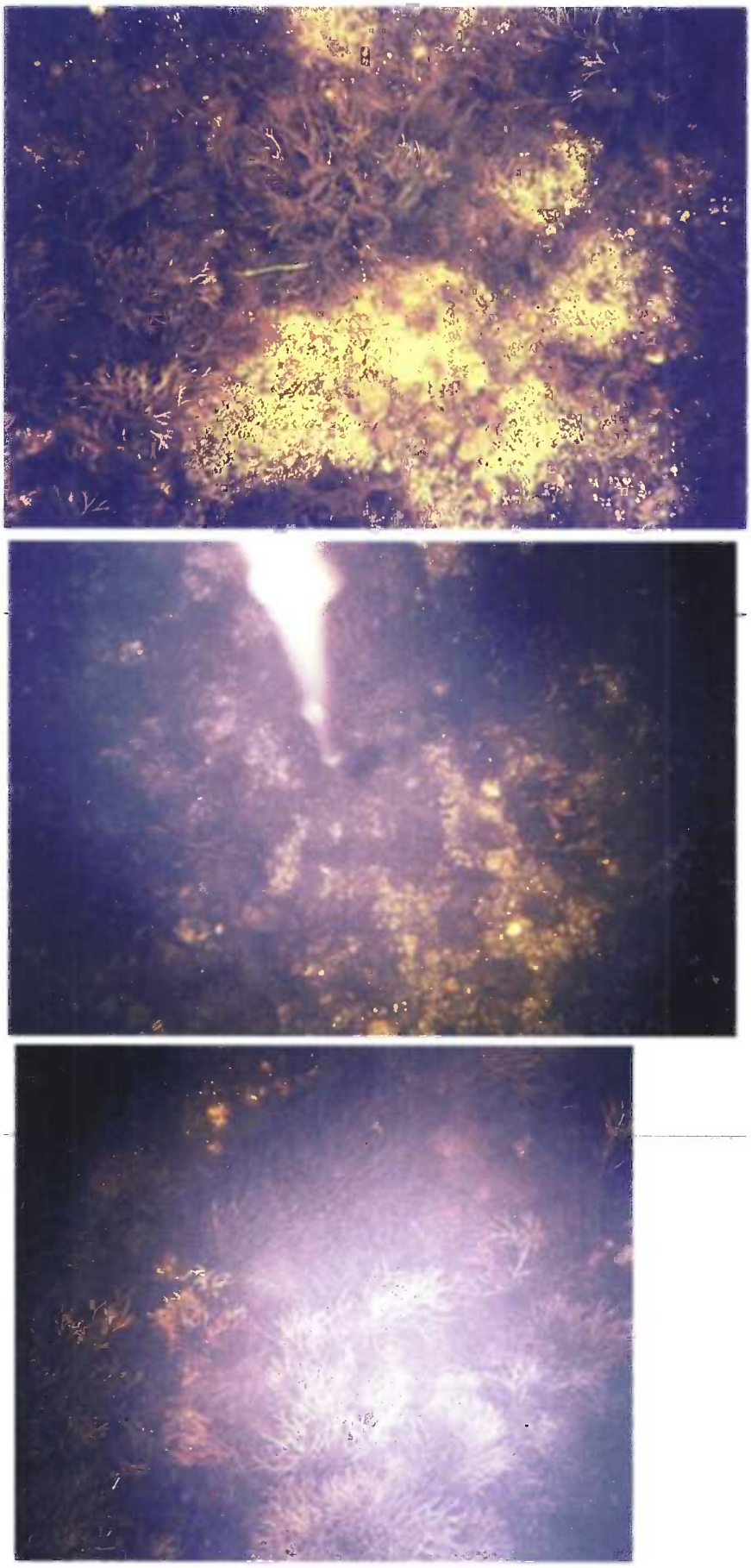
Loch an Aibhnín sub littoral communities. (Top) Ruppia cirrhosa/ Lamprothamnion, (middle) Ruppia/ Lamprothamnion/ Zostera. (bottom) Zostera /Ciona intestinalis

PLATE X



(top) Potamogeton pectinatus in Lough Aconeera. (Middle) mud and Chaetomorpha in Loch an tSáile lower. (Bottom) mud and Zostera in Loch an Aibhnín.

PLATE XI



Seaweeds in Loch an Aibhnín; Furcellaria/Polyides community in shallow water. (middle) Phyllophora crispa in the 4m hole. Furcellaria/polyides community at 2m.

PLATE XII