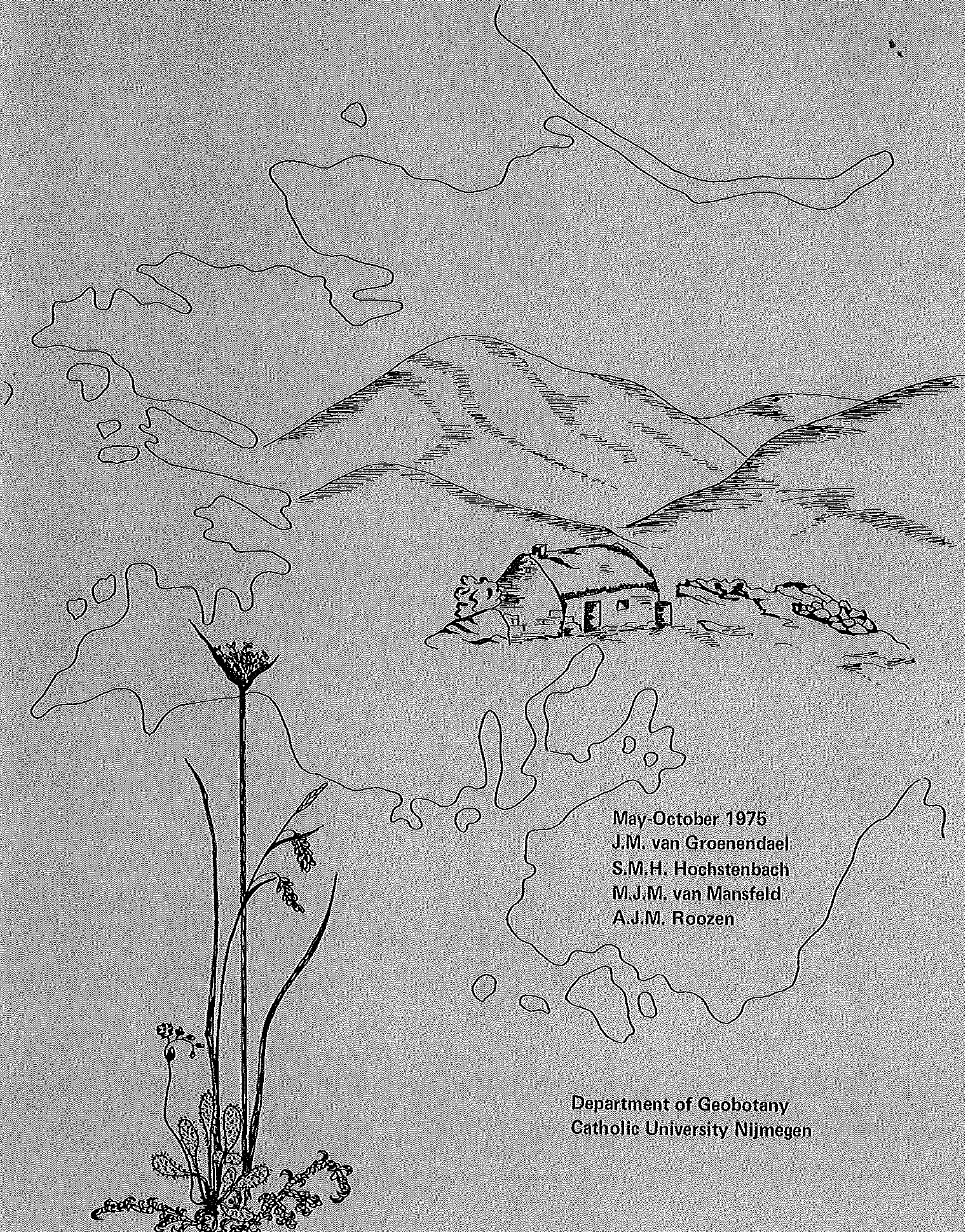
THE INFLUENCE OF THE SEA AND OF PARENT MATERIAL ON WETLANDS AND BLANKET BOG IN WEST-CONNEMARA, IRELAND



May-October 1975

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S.M.H. Hochstenbach
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Connemara....

"a land of whitewashed cottages set against
a background of mountain, bog and ocean,
a land of muted colours, in which the ochres,
violets, pearly greys and misty blues mix
together in countless combinations".

(Whittow, 1974)

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I. INTRODUCTION.

1.1. The motive of the investigation

It occurred already to Praeger(Praeger 1934), that the vegetation of the coastal strip of Connemara in western Ireland, differed completely from the vegetation of the lakes and blanket bog inland.

To quote this outstanding Irish naturalist:
"Along the shore, limy sands, formed mainly of foraminifera and nullipores, have been widely scattered by westerly gales; and the coastal region harbours in consequence a calcicole vegetation very different from the bog and lake flora of the hinterland".
Apart from this eyecatching difference, it was noted by Prof. V. Westhoff, Nijmegen (oral communication) during his many visits in the area, that there were vegetation differences in the area of Errisbeg, near Roundstone, (see fig. 1), probably due to different type of country rock. These two observations, in addition to our own curiosity, aroused during a previous visit and stimulated by Prof. V. Westhoff, formed the motive of our investigations.

We hope that our results will help the understanding of the different vegetation types in their relation with the environment and will contribute to the conservation of this beautiful area.

1.2. Period of the investigation; supervision; grants

The fieldwork for our investigations was done in West Connemara during part of the spring, the summer and part of the autumn 1975, starting on the 20th of May and ending on 10th of October. The raw data were processed in the laboratories of the Catholic University of Nijmegen in several sessions in 1976 and 1977. Supervisors of our work were Prof. V. Westhoff, Dept. of Geobotany of the Catholic University of Nijmegen, in cooperation with Prof. J.J. Moore, Dept. of Botany, University College of Dublin, who both assisted us in the field, as well as in the synthetic phase.

The fieldwork was made possible by grants of the "Beyerinck-Popping Fonds" (Royal Netherlands Academy of Arts and Sciences) and of the "Stichting Nijmeegs Universitair Fonds".

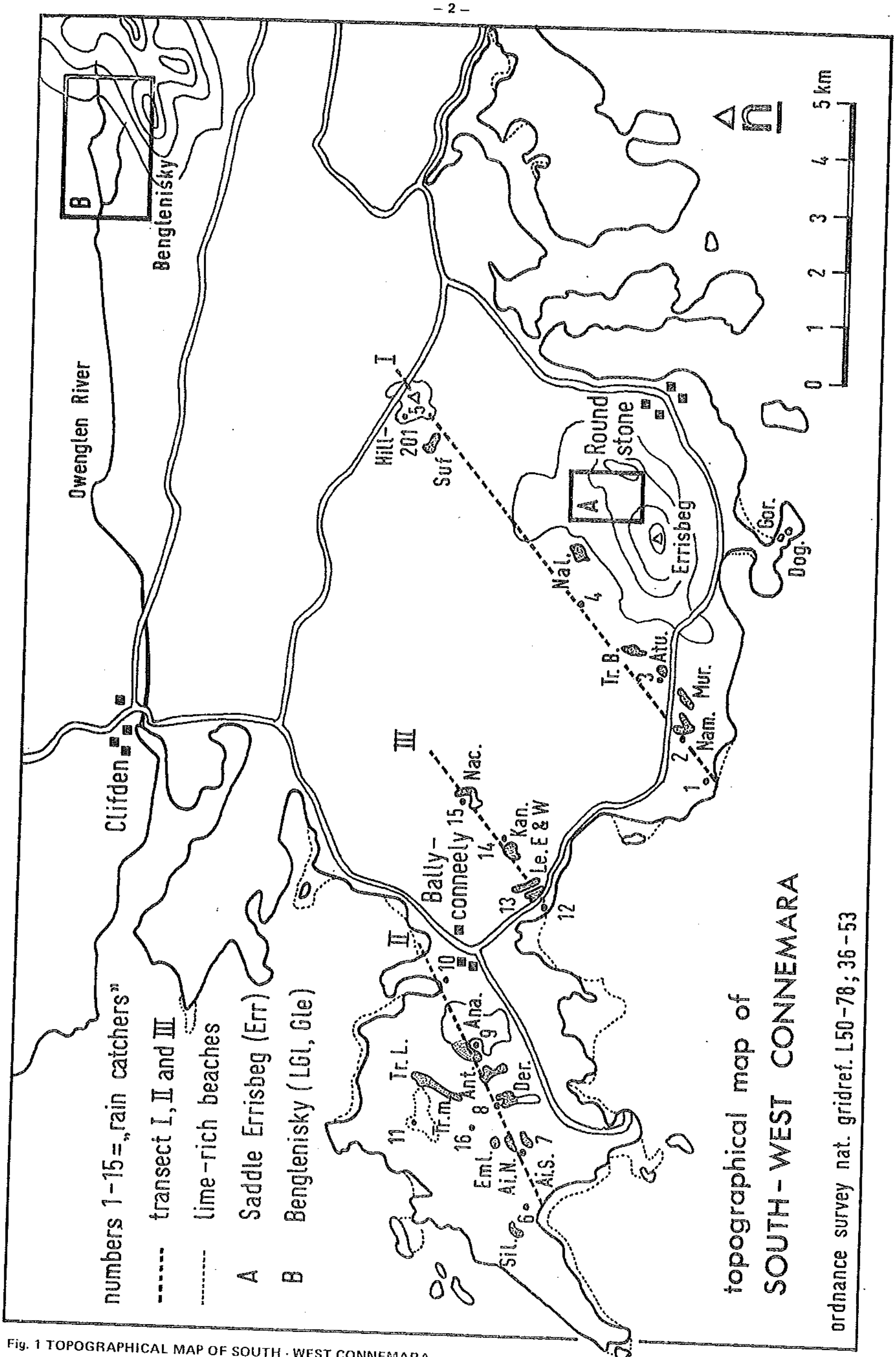


Fig. 1 TOPOGRAPHICAL MAP OF SOUTH - WEST CONNEMARA

1.3. Pollenanalytical data

The first two weeks of August 1975 were spent on a geobotanical excursion in Ireland, with assistance of Prof. V. Westhoff and Dr. D. Teunissen, geologist both of the same university.

During this excursion, a core sample of the blanket bog near Errisbeg within the area of our investigation was taken by Dr. D. Teunissen and Drs. H. Teunissen-van Oorschot, who subsequently analysed this sample pollen-analytically. Their results will accompany this MSc-thesis as an independant second part.

The reason for including this investigation is, that apart from its own merits, Dr. D. Teunissen, Drs. H. Teunissen-van Oorschot and ourselves thought it an excellent opportunity to combine from the same area the zonation in space from the coast inland with the zonation in time, as found in the pollen diagram.

1.4. The scope of the investigation

The scope of the investigation, based upon the observations of Praeger (l.c.) and Westhoff (l.c.), falls into two main parts: 1. Description, 2. Causal analysis.

As to our descriptive task, we tried to establish the differences between the vegetation types and the nature of those differences. Secondly we tried to explain the observed differences. As already mentioned in 1.1, there are two main categories: the difference in vegetation between coastal strip and inland areas, and the differences between the vegetation of the slopes of Errisbeg and the surrounding blanket bog.

This division into two main parts will be evident throughout our thesis, because each part generates its own set of possible causes for the observed variation.

When thinking of the coastal area, the following explanations may be valid:

- The main cause for the sharp discontinuity in the vegetation is the influence of the sea, exerting this influence by means of sea-spray, blowing in of (calcareous) beach material etc. The type of coast (rock, sand, mud, peat) and the prevailing wind direction will then be important factors.

- The main cause is the influence of man, whose settlements occur in this narrow strip and made it fertile by use of manure such as seaweed and calcareous beach sand (2.6).

- There is a combination of these two. Man as been attracted to the more fertile coastal strip and has consequently enlarged this area by his activities.

With regard to Errisbeg, the following may apply:

- Errisbeg is built from a different type of rock, causing the observed changes, in yielding a richer substratum and/or a richer input of nutrients from the rock by water movements (see flow and see page 2.4).

- The water movement itself, as a result of the slopes has an influence on the vegetation, by enhancing the dynamics of the ecosystem and/or by concentrating nutrients from rain water in certain areas.

- The two effects cooperate and may or may not be inseparable.

Chapter IV will summarise in more detail all the possible influences in our area of investigation and will give more details how we set about to solve the problems mentioned above.

II. DESCRIPTION OF THE INVESTIGATION AREA

2.1. The area of investigation

The area of investigation is situated along the west coast of Ireland in County Galway, in that part that is called Connemara, bordered in the east by the Maumturk mountains and Cashla Bay, in the west by the Atlantic Ocean.
The survey area consisted of the south-western part of Connemara (see fig. 1) stretching from Cloch na Rón (Roundstone) to An Clochán (Clifden). Ordnance survey map, national grid reference: L50-78; 36-53. (½ inch to 1 mile = 1:126,72).
This stretch is about 25 km long, when measured by the road, but the coastline, comprising peninsulas and inlets, is more than 100 km long.

A more distant part of the survey area is Ben Glenisky, (1710ft), one of the Twelve Bens, situated north of Ballynahinch lake. Errisbeg near Roundstone is, with its 987 feet, the other high point in the area of investigation.

2.2. Geology, Geomorphology and Pedology

The geology of Connemara is reasonably complex. The four main geological structures are: (see fig. 2)

A. Precambrian schist and quarzites.

B. Cambrian basic and ultrabasic intrusions.

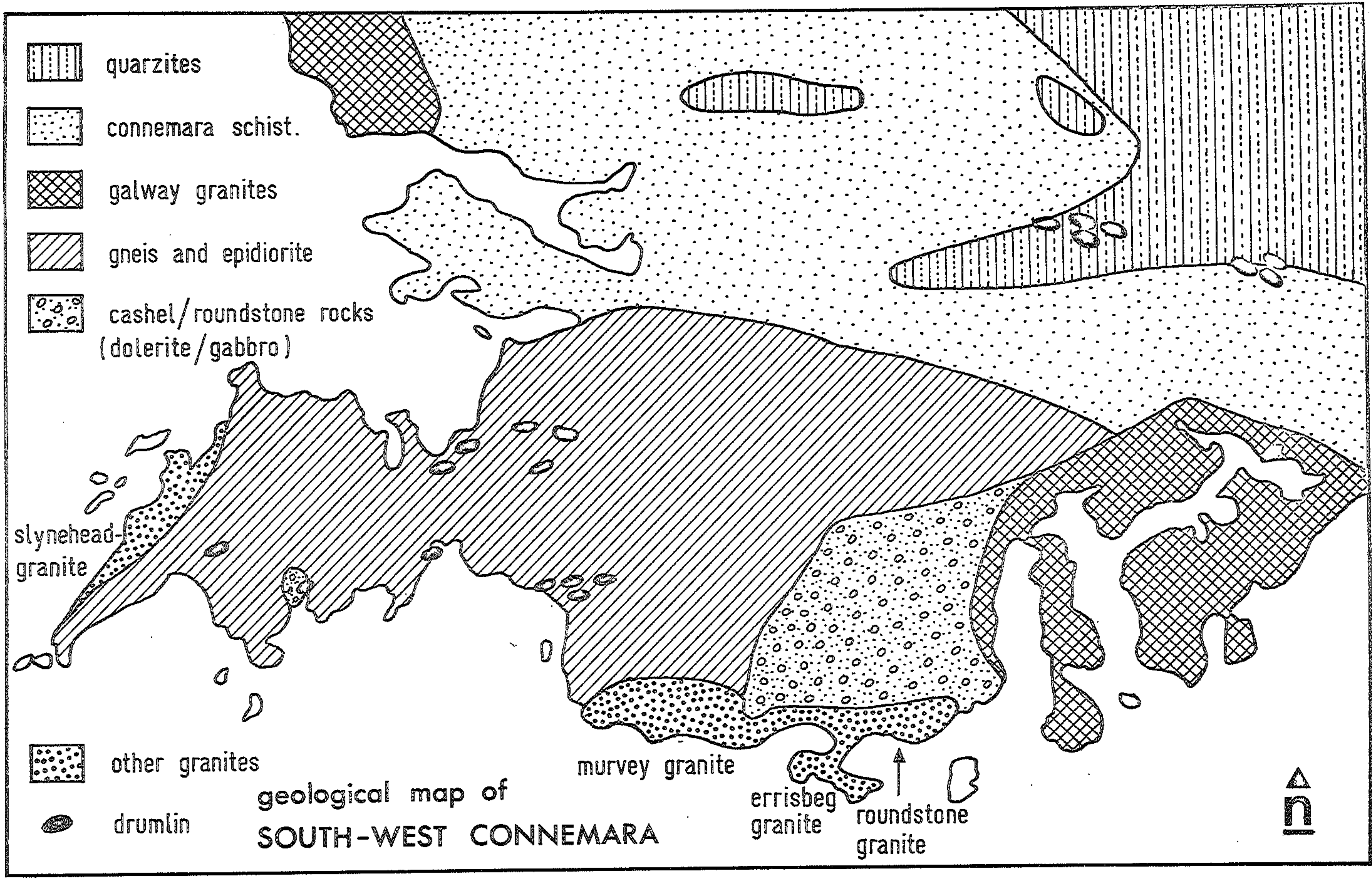
C. Late-cambrian gneis and migmatite injections.

D. Ordovician granite intrusions.

The precambrian schists are quarzites of the so-called Connemara Dalradian series, are formed by folding and regional metamorphism of a series of sediments. This schist series strikes along an east-west line and in the middle of Connemara rises a hard quarzite core forming the Twelve Bens (about 2000ft). (These are sometimes flanked by rocks which are poor in silicia but rich in aluminium and iron: Leake, 1970).

A period of basic and ultrabasic intrusions came after the formation of the quarzites and schists, in Cambrian times, in which black gabbro-diorites were intruded. Errisbeg near Roundstone and Doonhill on Bunowen peninsula consist of these complex basic rocks, mainly epidiorites, dolerites and gabbros.

FIG. 2 GEOLOGICAL MAP OF SOUTH - WEST CONNEMARA



Between a west-east line, running just south of Clifden, and the Galway granites, occur coarsely crystalline gneisses and migmatites; they appear from Slyne Head to Galway city. These quartz-diorite gneisses metamorphosed the Dalradian schists.

In the south of Connemara along the coast some forms of Ordovician Galway granite intrude into these Connemara Dalradian series. This Galway granite is a course granite, consisting of pinkish potash felspar, hornblende and biotite. Several varieties of this granite occur in Connemara: viz. the Roundstone granite, which is mineralogically the same as the Galway granite; the Errisbeg granite, the Murvey granite, south-west of Roundstone, which is the most acid differentiation; and the Slyne Head granite (Charlesworth, 1963).

quarzite ↓ schist ↓ gneiss ↓ epidiorite +gabbro	Nutrient poor, acid ↓ nutrient rich, basic

As a result of glacial erosion during the ice ages in the Pleistocene, the softer rocks, such as granites, schists and gneisses were denuded, but harder rocks, such as quarzites (Twelve Bens) and gabbro-diorites (Errisbeg) became isolated in the landscape.
The remarkable stoniness of of Connemara is largely the result of glacial action during the ice ages.

Another result of this glacial action are the so-called drumlins, boulderclay hills, moulded by the ice in an ovoid form, which at the present day can be seen in the brownish bog landscape of Connemara as fertile green hills (see fig. 1). Sometimes however they are hidden under the blanket bog as is probably the case on the slopes of the Twelve Bens (viz. Ben Glenisky).

The most important legacy from glacial times and at the same time the most striking feature of Connemara are "the thousand lakes", formed by glacial action on the outcrops of the schists and gneisses and migmatites north of Roundstone. During the wetter conditions of the present subatlantic period (which started 2500 years ago), the formation took place of the water-logged landscape between Roundstone and Clifden, with hardly any drainage to the sea. The result is, as Whittow (1974) states: "40 square miles of the most desolate lake-riddled bogland to be found anywhere in Ireland".

The blanket bog that has developed as a patchwork between the lakes is only extensively grazed by sheep and Connemara ponies. This blanket bog extends from these lowlands over the lower slopes of the surrounding hills such as Errisbeg and the twelve Bens north-east of Clifden.

A sharp contrast with the desolate inland is formed by the coastal area about 1 mile wide, where human occupation occurs and the soils are drained and enriched.

The coastline itself consists mainly of rocky shores with numerous bays, alternating with small stretches of limy sands, formed mainly of foraminifera and nullipores. These lime-rich beaches are indicated on fig. 1 and played an important role in our investigations.
At Mannin Bay, between Ballyconneely and Clifden, the beach material consists partly of tiny broken fragments of the thallus of a calcareous seaweed, Lithothamnion calcareum.

Except for the sandy calcareous soils near the coast, not many other different soil types can be found in the survey area.
The grasslands and heathlands in the coastal zone have extremely shallow humus-rich soils of only a few centimeters depth.

Within the coastal strip a gradient can be found from sandy to more humus-rich peaty soils under the pastures and arable land.

The wetlands, marshes and fens (sensu Wheeler 1975) of the coastal area often have a soil of thin or compact organic mud (sapropel) or humic earth, which contains some mineral fractions. Dependent on exposition and distance to the shore-sands, these soils are mixed with the in-blown calcareous shelly sands.
The names given to different strata in the wetlands profiles vary considerably; McVean and Ratcliffe (1962) use terms such as humified peat, peaty gleys, calcareous or base-rich peats.

The lakes in the blanket bog area mostly have a peaty bottom but the shores often consist of course or fine gravel.

The different strata in the blanket bog profiles are subjectively named by Walsh and Barry (1958) and vary from blanketpeat bog to mud peat, podzolised peat, fine silty loam to grey boulderclay.

Terms used in this survey as soil indications, are combinations of these literature data and terms used during the fieldwork (see 3.3. for the listing of these terms).

2.3. Climate

The climate in Ireland, especially on the west coast, is an extreme atlantic one, determined by the dominant westerly winds, by Ireland's situation on the extreme west border of the Eurasian continent and the presence of the Gulf-Stream along this west coast.

In winter, during 72% of the time the wind has a direction between north-west and south (Klein 1975). The combined action of these westerly winds and the relativly warm water of the Gulf-Stream causes a rather mild winter season, with a mean temperature above 0^{o} C.

The mean temperature throughout the year is about 9^{o} C in the extreme north-east and $10,5^{o}$ C in the extreme south-west. The mean temperature of the coldest month(January), being from 5^{o}-7^{o} C and for the warmest month(July) from 14^{o}-16^{o} C. (Webb 1952). The range of seasonal variation from this mean is rather restricted.

Not many reliable temperature records of the Connemara district are available. Only Connolly (1930) records a mean temperature in this district of 10^{o} C and the fact that both the January isotherm of $5,5^{o}$ C and the July isotherm of 15^{o} C pass through Galway.

In the months from November to April temperatures of below 0^{o} C are recorded, but they never seem to persist for more than two or three successive nights. In the west it can snow for three or four days, but it melts quickly and even on the highest mountains it is exceptional for it to lie for more than two weeks (Webb 1952).

Another important climatic factor, especially on the north and west coasts, is the great frequency of moderate westerly winds, which in winter season alternate with westerly gales. The influence on plant growth and vegetation is rather strong, showing itself especially in dwarf growth and wind-pruning. Also afforestation in some extensive tree-free regions on the west coast seems to be hampered by the wind (Freeman, 1972).

The most striking feature of the rainfall in Ireland is its even distribution throughout the year. Even in the driest months, April and May, the rate of precipitation in less than two third of the annual average.
On the driest parts of the east coast the rainfall is as low as 750 mm per annum and in the western counties the annual average exceeds 1500 mm. The rainfall records available for south Connemara are those taken at Ballynahinch and Kylemore. The average rainfall in Ballynahinch over four years (1921-24) was 1862 mm (Connolly 1930). In Kylemore the average over 16 years was 2077 mm (Praeger 1932).

In the wettest spots in the western mountains (e.g.Co.Galway) precipitation as high as 2500 mm may occur.

The frequent occurrence of rain, together with the constant seawinds causes a constant high humidity of the air. The relative humidity in Connemara in June, July and August has average values of 66, 75 and 80% (Connolly 1930).

On many parts of the west coast there are more than 240 rain days per annum. This is naturally associated with a low average of daily insolation of the sun. The annuel average is only 3¾ hour a day.

Ombrotrophic vegetation is largely dependant on the rainfall for its supply of electrolytes. It is obvious that the concentration of electrolytes in rainwater can be of major importance for the vegetation.

Concentrations of salts in rainwater vary with the distance from the sea. Data given by Sparling (1967) show that the extreme west coast of Ireland is receiving appreciable concentrations of ions and therefore large amounts of salts (especially sodium, magnesium, calcium and potassium). The amounts of phosphorus and nitrogen which fall on the blanket bogs of western Ireland generally appear to be lower than those which fall on more easterly situated bogs. This may be attributed to the association of phosphorus and nitrogen with dust particles, which are less frequent in regions with high humidity. Firbas (1952) gives data that show very clearly the decreasing concentrations of Cl^- in rainwater, with increasing distance from the coast.

It is obvious that the amount of electrolytes in rain-water is of importance for vegetation in areas bordering on or nearly completely enclosed by the sea, such as south-west Connemara.

2.4. Water regime

Because of the high amount of rainfall the blanket bogs are oversaturated with water. In the survey area, the only clear drainage system of the blanket bog to the sea, is a tiny river near Callow bridge, between Ballyconneely and Roundstone. The bulk of the water however probably drains to the sea in other ways or perhaps evaporates in dry seasons.
The main drainage of the Ben Glenisky area is the Owenglen river. The lakes within the blanket bog as well as in the coast zone are often interconnected by means of little streams or flowditches. The water of the coastal wetlands often flows directly to the sea.

Rainwater flows during heavy showers over and through the rocks and vegetation instead of percolating into the soil. Percolation of water in peat is 1 cm per day, compared with a soil with good drainage, that drains 25 cm per day (Blom 1969). Especially on slopes regular surface movement of water is an important environmental factor.
This flow of water brings in extra minerals from rocks and soils that are situated higher on the slopes and it furthermore affects the dynamics of the system.

Another form of water transport, especially in the blanket bog and the sapropel layer of the wetlands is the so-called seepage or groundflow. Water within the peat or sapropel moves upwards and transports minerals or nutrients from lower layers of the subsoil or underlying rocks. Seepage can occur more frequently when a slope "induces" this groundflow.

2.5. The vegetation of south-west Connemara -in general-

- The greater part of the investigated area is covered with blanket bog, due to the high amount of rainfall and its even distribution throughout the year (Tansley, 1949). This type of bog is spread down over the land surface like a blanket, following all its contours. This is in contrast with the raised bogs in central Ireland (deep bogs with a domed surface) usually developed in former fens. Both types are considered to be ombrotrophic (Ratcliffe, 1964).

Blanket bog has been found to develop equally well on base-rich as on base-poor rock (with exception of limestone), (Ratcliffe l.c.). Blanket bog is not so clearly delimited as raised bog is. It can merge gradually into a third type of bog, called intermediate bog (Ratcliffe, 1964). This type is usually found on the bottom of valleys and is under comparatively strong influences of seepage from surrounding slopes. It is never seen to develop into true raised bog.
However, very often it forms the more minerotrophic element in the blanket bog area and some authors (Moore, 1964) restrict intermediate bogs to these areas. In this opinion, intermediate bog is the more minerotrophic end point of a line between valley bog and true ombrotrophic blanket bog. The differences between the two are gradual and completely dependent on local topography (see also 3.1.2).
Further differences between the oceanic blanket bogs and the raised bogs from central Ireland and the continent are:
The alternation of hummocks and hollows is less distinct in the blanket bog, also the species composition of the plant communities of these bogs is different. The blanket bogs distinguish themselves by the presence of some eu-atlantic species such as Schoenus nigricans, Pleurozia purpurea, Campylopus atrovirens and a dominance of Molinia caerulea. Absent in the blanket bogs are Andromeda polyfolia and Oxycoccus palustris. The blanket bogs distinguish themselves from continental raised bogs by species that indicate the high concentrations of minerals in the rain, like Myrica gale (Bog Myrtle), Narthecium ossifragum (Bog Asphodel) and Erica tetralix (Cross-leaved Heath), (Moore, 1964; Westhoff, 1969).
In raised bog areas on the continent these species only occur in the lagg-zone of the bogs and therefore are considered to be indicators of mineral nutrients in the soil water ("Mineralbodenwasserzeiger" after Du Rietz, 1954).

The exact species combinations will be discussed later on.
At places where the peat is shallow and dry, one may find a heathy vegetation mainly dominated by the strikingly deep yellow Dwarf Furze (Ulex gallii) and the purple Bell Heather (Erica cinerea).

Glacial drift appears at many points, indicated by the several low hills (whaleback-shaped drumlins) in this region (see 2.2). Those hills are clearly visible in contrast with the brown surrounding moorland, as fertile green hills. The vegetation is a grassy one, sometimes rich in bracken (Pteridium aquilinum).

A very striking feature of Connemara is the nearly complete absence of trees and woods in this district; human activities were of major importance for this phenomenon. The remains of Pinus sylvestris under the blanket bog indicate the existence of pine woods in Neolithic times. The destruction of woods by man has lead to a changed balance between precipitation and evaporation and a more suitable situation was created for bog formation (Westhoff, 1976).

Regeneration of woods in this area does not occur nowadays. There are three possible reasons for this:

1. The absence of trees on the exposed western coasts of Ireland is usually regarded as a direct result of the exposure to westerly winds (Freeman, 1972). This might be shown by the presence of a well developed woodland in the wind shade of the Errisbeg near Roundstone (Letterdife House).
2. Extensive sheepgrazing could also prevent regeneration. But Westhoff (1976) refers to investigations on blanket bog protected from grazing near Glenamoy Co. Mayo. After several years still no regeneration of forest occurs.
3. Perhaps the most important reason is an inhibition of seed-germination of woody species in the acid environment of the blanket bogs.

The lowland between Clifden and Roundstone is strewn with numerous lakes (see 2.2), which provide an excellent habitat for oligotrophic vegetation of the Class Littorelletea.
Mire and reedswamps are nearly completely absent in this bog area.

Most of the land along the seabord is cultivated and human habitation is confined to this strip. Tilled fields, pastures, hay meadows and calcareous grasslands are situated up to one or two miles inland.

A number of vegetation types relevant to this survey are those of lake bottoms and lake shores. In this coastal area, extensive marshes can be seen, such as reedswamps and fen vegetation (dominated by different sedges), around these lakes.
These vegetation types are often stages in the process of autogenic succession ("Verlandung"), a phenomenon often to be observed in coastal lakes. In the bog lakes, these processes are almost absent, or else different vegetation types are involved.

The vegetation of saltmarshes and dunes, high-tide marshes and rocky shores do occur in Connemara, but have a rather restricted occurrence. Since such vegetation is not included in our investigations (see 3.1), they are left out of consideration.

2.6. Population and employment

The coastal fringe of western Connemara is closely occupied by houses and fields, but only for a distance of one mile or so from the shore (see fig. 3). Inland, the limit of settlement generally is a line of demarcation set by the farmers themselves, between their fields and their rough pastures. These rough pastures generally consist of bog-covered lowland.

Freeman (1972), gives a population density for West-Connacht in 1971 of 44 to the square mile. Restricted to the inhabited coastal area; this means a population of 200-300 per square mile (in 1961). During the last hundred years there has been a decline of the population of 43%, mainly caused by emigration.
Also the balance between country and town inhabitants has been considerably altered; the town and village population has increased.
In the survey area, Clifden has the biggest concentration of people and is the most important market centre with some tweed- and knitting industry.

Agriculture still remains a major source of employment in the area. After the Land Acts of 1909, large estates were divided up to satisfy local needs (Inglis 1970).
However, the poverty of the land, the small farm units and the high density of the population, made an intensive agricultural development impossible.

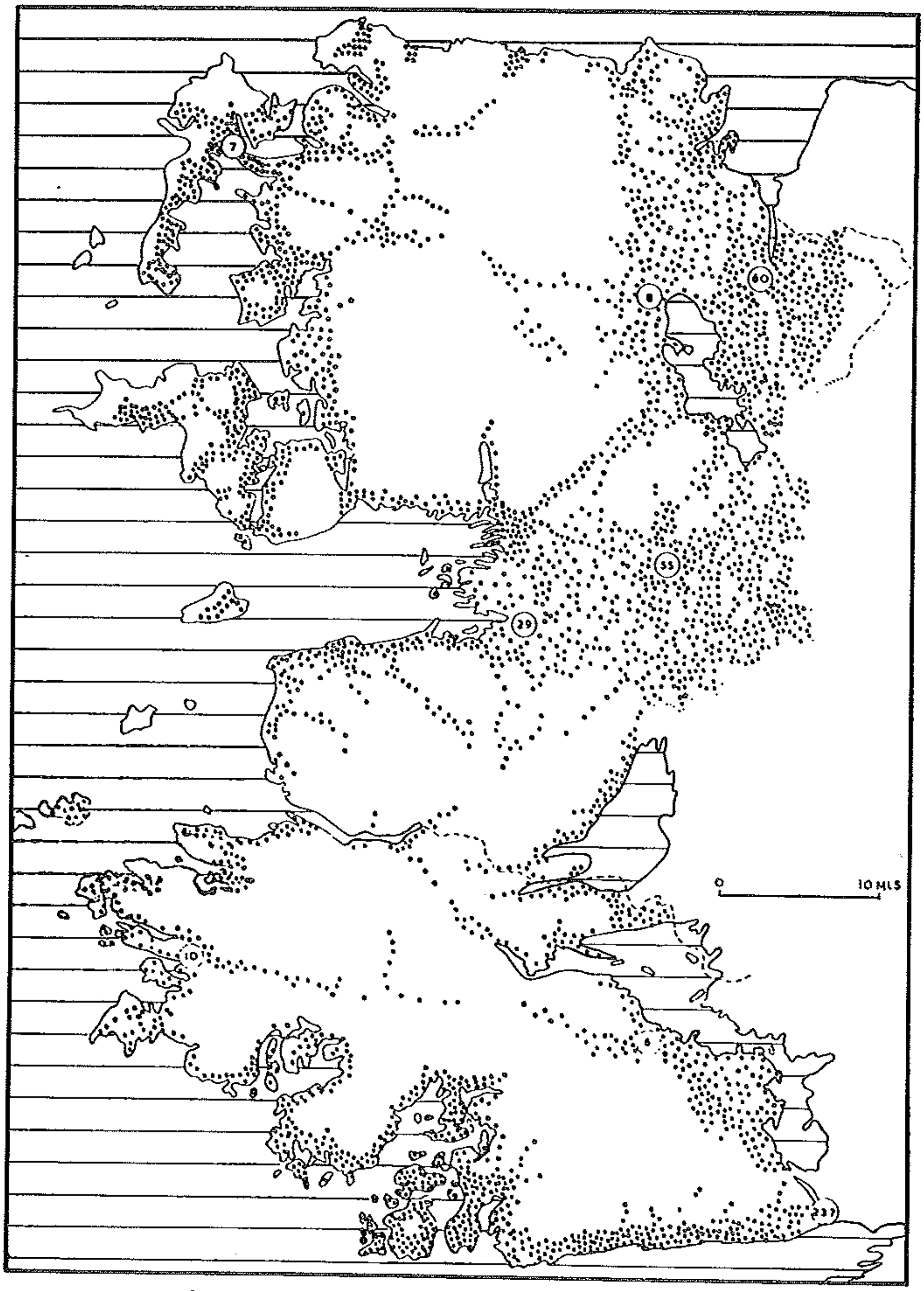


FIG. 3 POPULATION DISTRIBUTION, WEST CONNACHT (from Freeman, 1972)

ONE DOT TO 25 PERSONS

EXCEPT IN THE CLEW BAY LOWLAND, THE BALLINA LOWLAND AND AROUND LOUGH CORRIB AND LOUGH MASK, MOST OF THE POPULATION LIVE NEAR THE COAST.

In coastal districts, since at least the twelfth century, man has been drawing shell sand and seaweed from the shore and spreading it on his fields, to improve both the fertility and the drainage of the soils (Mitchell 1976). The harvest of seaweeds is still in use, as manure, but also for industrial working up in the local seaweed factory.
According to Prof. J.J. Moore (University College, Dublin), fertilization with ammonium nitrate lime is only in very recent use here, at the most since 1970.

Freeman (1972), suggests the term "cottage farming" for the type of farming that provides the people of this area with food, fuel and clothing. In the small fields potatoes, carrots, onions, turnips, patches of corn and meadow hay are grown for home use. Cows, horses (Connemara ponies) and sheep form the main stock and are reared on the enclosed farm pastures, the heathlands and on the dune grasslands of the coastal zone usually held in commonage. The rugged inland and hillsides are more suitable for flocks of sheep. On the whole the quantity of arable land is limited and the "cottage farmers" remain chiefly dependent on some form of livestock.

Other sources of income from the land are provided by peat cutting and fishing.
In the survey area, peat is cut by hand, for personal use, as fuel in the houses. The winning of turf with machines is almost impossible, because of the unevenness of the land with its many lakes and rock outcrops.
Every family holds a piece of bogland in lease for life.
The cutting causes a pattern of channels and walls that penetrates further into the bogland every year. Sometimes those bogholes and boglakes are used as rubbish dump.

Since the founding of the Irish Forestry Commission in 1908, there have been plans for afforestation of the boglands. Drainage, fertilization and afforestation with conifers has already taken place in the environment of the Twelve Bens and Ballynahinch castle. One experiment near Roundstone appeared to be a failure because of the atlantic winds (Freeman, 1972).
In 1975, a project of the Forestry Division, to start along the Toombeola-Clifden road, was abandoned, thus preserving this vulnerable and interesting area of blanket bog for man and nature preservation interests.

Fishing is also a supplementary resource of many people on or near the coast. Efforts to make it commercially succesfull failed. An important reason for this is the structure of the coast, with no ports of significance.

Inshore fishing and long-line fishing from small boats is profitable, as is lobster fishing.

The lakes and rivers are famous for salmon and trout fishing. This is a main tourist attraction in the area.

Most of the game fishing waters are privately owned and are under control of the local Anglers Association. Pressure from this group resulted in the management and protection against water pollution, becoming a matter for concern by the Government. For the local inhabitants this is of special importance, because it still uses surfacewater as source of water supply.

The low level of income is supplemented to a viable level by seasonal migration to various parts of England, by local public works, by remittances from emigrants or from Government aid. A rural electrification programme is going on and electricity is generated in peat-fired power-stations. The Government encourages tourism and promotes the district abroad.

Recreation pressure, peat digging on a large scale and intensive afforestation however, will have repercussions on the landscape and will alter its scenery drastically; it will also change the local way of life.

III. METHODS OF INVESTIGATION

3.1. Choice of localities and communities to be investigated

The two parts of our investigation (see 1.4) demanded a different approach. We thought it best to investigate the gradually decreasing influence of the sea by means of transects lying in the main direction of the wind (see 3.1.1), and to investigate the influence of the parent material by comparing the Errisbeg plant communities with similar communities on the slopes of Ben Glenisky (see 3.1.2.), a mountain of different rock type.

In the field we confined our study to those communities that are under direct or indirect influence of water, that is: growing in open water, or under more or less permanent influence of the water table.

The reason for these restrictions are threefold:

1) It was impossible for us to cover all types of vegetation in the time given;
2) The communities of the wet areas are probably less influenced by man than those of the drier parts, which are more readily accessible and used by man and animals.
3) It is possible to compare the communities of the lakes and the waterlogged places in the blanket bog, with those of lakes and wetlands from the coastal area.

We used the techniques of the Zürich-Montpellier school (see 3.6.) and in terms of this school, the investigated plant communities belong to the following syntaxonomical classes:

Potametea, Phragmitetea, Parvocaricetea, Littorelletea, Scheuchzerietea and Oxycocco-Sphagnetea, sometimes also transitions to the classes Molinio-Arrhenatheretea and Nardo-Callunetea.

3.1.1. Choice of transects

In order to find out what the influence of the sea was, we placed three transects, orientated in a north-east, south-west direction, corresponding to the prevailing winds. The latter was indicated by the direction of the windpruning of trees and shrubs (see 5.3). For the locations of these transects see fig. 1. A limited number of lakes was chosen along the transects, using the following criteria:
firstly, we only took lakes and their associated wetlands, no isolated wetlands. The reason for this was, to have as many as possible of the seven investigated vegetation classes represented on each side.
Secondly the lakes should be readily accessible, for obvious reasons of efficiency; and thirdly, within each transect the lakes should be close together near the coast, with a gradually increasing distance between them, going inland, according to a hypothetical(exponential) decrease of the influence from the sea (see 2.3.). The three transects will now be discussed in more detail.

The first transect starts (see fig. 1) near Lough Namanawaun on a coast with foraminiferous sands, runs alongside the foothills of Errisbeg and ends in the neighbourhood of "hill 201" west of Toombeola (Praeger 1934, p. 130, calls this place Craigga-more lough). Ideally it should show the influence of the coastal sands; further on the influence of the run-off water of Errisbeg; and in order to have observations from a lake far from sea or Errisbeg, the transect ends near "hill 201" in the middle of the blanket bog area.

This transect contains the following lakes:
Namanawaun(Nam), Murvey(Mur), Aturtaun(Atu), Truska near Errisbeg, (Tr.B.), Nalawney(Nal), and Suffrauncam(Suf). For more details of these and the following lakes see 5.5.

The second transect lies entirely on Bunowen peninsula: starting in a vast area of sand dunes, built up from calcareous materials and ending on the opposite rocky shore of the peninsula. This transect should show the greatest influence from the sea, being surrounded by it and by several large beach-sand dune complexes.
This transect consists of: Silverhill lake(Sil), Aillebrack South(Ai.S), Aillebrack North(Ai.N.), Emlagharan (Eml), Derreen(Der), Antony(Ant) and Anaserd(Ana).

The third transect is rather a short one, starting on a rocky shore with pieces of bog in between the rocks and ending in the middle of the blanket bog. The intention with this transect was to show the effect of sea-spray alone without the influence of calcium-rich coastal material. This transect contains Lettershask West(Le.W), Lettershask East(Le.E), Kankoge(Kan) and Nacorrussaunbeg(Nac).

In addition to these three transects, we chose one more lake with a wetland associated with it on Bunowen peninsula, namely Truska lough (Tr.L) and Truska mire(Tr.M).
This was chosen in order to have a reference point for north-westerly influences, the other important wind direction (see 5.3.).

These transects of lakes were accompanied with "rain-catchers" (see 3.2), in order to collect comparable weather data along these transects; again they were arranged to each other near the coast and gradually further apart going inland.

3.1.2. Choice of locations on Errisbeg and on Ben Glenisky

The second objective of the investigation was to detect the influence of the parent material on the vegetation; i.c. the influence of the basic-rich gabbro-diorite rock of Errisbeg.

For that purpose two comparable situations were chosen; in the case of Errisbeg the parent material was primarily nutrient-rich and in the other case primarily nutrient poor. The comparable nutrient-poor situation was found on one of the Twelve Bens, Ben Glenisky.
The areas for investigation had to be on slopes, to be sure that the influence of the parent material was evident and under influence of the water regime (see 2.5).

The transect on Errisbeg was chosen in a saddle, halfway up the north-west slope of the mountain (see fig. 1 and fig. 14a).
The saddle is a depression between two edges of rocks in which water of the surrounding slopes flows together and a thick bog-layer of bog was formed (Valley bog in the sense of Tansley, 1949). The depression is drained by means of rivulets, that tumble down in a north-west direction to Lough Nalawney.

If one were to expect a difference in the vegetation, caused by seepage from the basic intrusion, it should be here, where the water flows into the saddle from the sides and concentration of both flow and seepage water occurs.

On indication of Prof. J.J. Moore and Prof. V. Westhoff, we found a somewhat similar place halfway up Ben Glenisky at more or less the same height above sea level(500 ft).
Here a big lens-shaped blanket bog is situated at the base of the steep north-west facing slope of the Ben Glenisky - cone, consisting mainly of quarzite (see fig. 1,2 and 14b).
This lens was drained by means of rivulets which rise on the lower western slopes of the lens.

Down slope on this lens, some glacial deposits(drumlins) were hidden beneath the blanket bog and probably influence the vegetation by means of seepage.

The influence of the sea on this lens as well as on the Errisbeg saddle is negligible, because of the north-west direction of the main axis of the saddle and the lens, which is perpendicular to the main direction of the wind.

In order to be able to make a comparison with uninfluenced blanket bog (so-calles zero-bog), we chose the middle of a big lens-shaped blanket bog area called Dolan (see fig. 14c), far from mountains, drumlins, or glacial drift deposits, with no influence of flow and/or seepage. The lens is well-developed, several meters thick, with no visible traces of peat cutting. In this area we made several relevés and it was also the location from which Dr. D. Teunissen took a sample from the profile for subsequent pollen analysis.

Finally, to complete the picture, we explored two lakes in which the water from Errisbeg accumulates, because we supposed that the influence from seepage from the gabbro-diorite should reach its maximum here. The first lake was Lough Nalawney, already used in the first transect (see fig. 1) and the second a small lake/wetland at the base of the Errisbeg without a name (see fig. 14c), where most of the Errisbeg flow was accumulated.

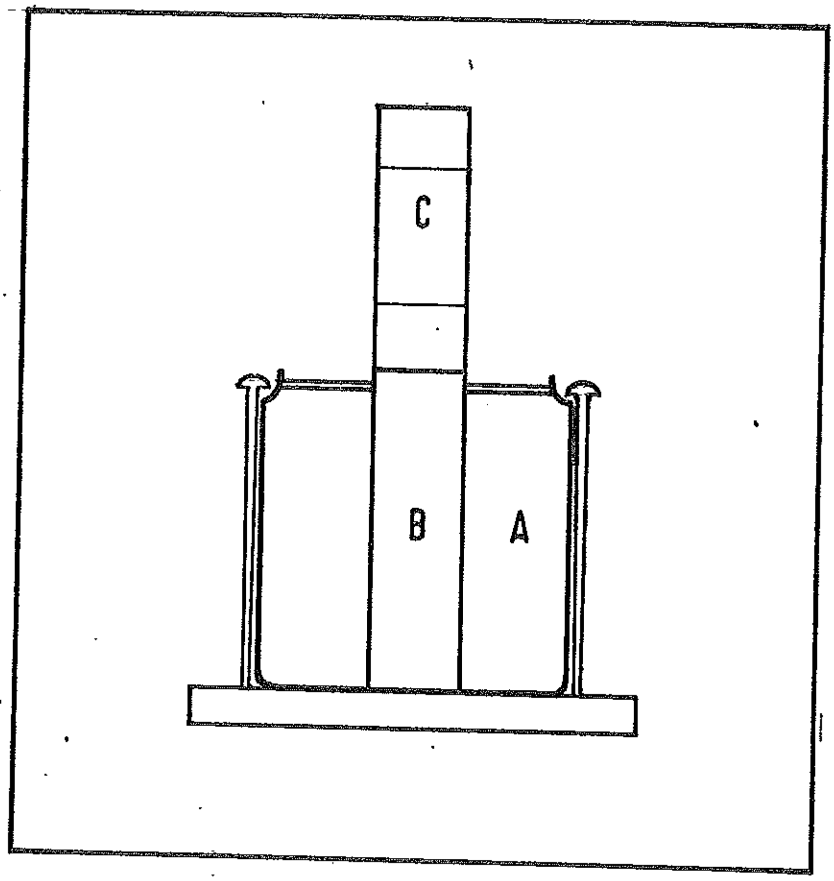


FIG. 4 A " RAIN CATCHER " FOR EXPLANATION SEE TEXT

3.2. "Rain catchers" and weather station

In order to measure the influence of the sea we used "rain catchers" similar to those used by Sloet van Oldruitenborgh (1969). The idea behind these "rain catchers" is, that a piece of filter paper will catch parts of the material blown in by the wind, mainly miniscule droplets of sea-water. When it rains, the rain water, which also contains dissolved salts, will wash down the salts caught on the paper.

Influence of wind velocity, wind direction, distance from the sea and shelter caused by topographic and vegetational features, have been shown to be important, for the pattern of distribution of airborne salts. (Edwards & Claxton, 1964; Sloet van Oldruitenborgh & Heeres, 1969).

The device used is constructed as follows (see fig. 4):

A. An open jamjar with diameter of 7.3 cm.

B. A plastic tube with lenght of 20 cm and diameter of 2.7 cm, which is anchored by a galvanized crosswire support.

C. Filter paper wrapped around the tube with a length of 10 cm. The paper was attached to the tube by two elastic bands.

The whole apparatus was secured between three long nails on a pole about 1.70 meter above ground level. This was done to prevent destruction by cattle and exclude the influence of shelter by vegetation or rocks or direct blowing in of soil material.

Sixteen " rain catchers" were put out in the three transects, approximately parallel to the prevailing wind direction and perpendicular to the coastline. The further from the sea, the greater the distance between the rain catchers (see fig. 3.1 and fig. 1).

Every two weeks during the period from 9-7-1975 to 1-10-1975 we collected the contents of the jars with the filter papers and renewed these papers. The jars were rinsed with distilled water .

The contents were chemically analysed on the same day for Ca^{++} and Mg^{++} with Na_2EDTA and for Cl^- with $Hg(NO_3)_2$, (see 3.5). The first samples (9-7-1975) were filled up to 100 ml with distilled water before measuring, later on we only used the measured volume from the jar (for explanation see 5.2.1). We then also changed over to "Rotbandfilter" paper because the filter paper appeared not to be chemically pure and was not very weather-proof.

Weather data

Because there is no meteorological station in the neighbourhood of the investigated area, we built our own "weather station" to collect data of rainfall, wind direction and wind velocity, together with maximum and minimum temperature.

The weather station was built into a wall on a low hill, so that it stood free in the environment. It consisted of:

- a precipitation meter: a jar with a funnel. The diameter of the funnel was 9,3 cm and the receiving surface 68 cm^2. The volume of rainfall was measured in cm^3 with a cylinder and converted to mm precipitation.
- a wind direction meter: an iron peg with a handkerchief, attached into a hallow stick by way of a fishing lead.
- wind velocity was estimated approximately as calm, gentle moderate, strong or stormy.
- a maximum-minimum thermometer.
- a reference "rain catcher", S 16

The observations were done every day during the period 26-6-1975 to 1-10-1975.

3.3. The taking of soil samples.

Whenever there was a soil present in the sites from which we described the vegetation (3.6), the thickness of these soils was measured and their composition described.
We used for this purpose a hollow peat sampler of about 1,5 meter, which we could lenghten, if necessary, up to 4,5 meter. We described the following types of soil:

1. bog: all peat or peat-like material, in which the plantparts are easily recognisable.
2. half decayed organic mud: in between first and following category.
3. sapropel: finely divided, decaded organic substance.
4. humic earth: decayed organic substances mixed with considerable amount of mineral particles.
5. calcareous sands.
6. gravel: course sand and small stones.
7. stones.
8. gyttja: a blue puttylike substance, a layer of 1-10 cm just above the mineralisation layer of the rock, found under blanket bog as well as under thick wetland or fen substrata.

For use in our tables, we took into account the uppermost 20 cm of the soil, being the substratum that contains the bulk of plant roots; we used the following abbreviations (see also 2.2).

Bog= as in 1.
TOM= thin organic mud; like 2, but very loose, mainly under quaking mire.
COM= compact organic mud; like 2 but more compact than TOM.

OMB= organic mud bare; like 3, forming a thin layer on the bottom of lakes, mostly under water not or only scarcely covered with plants.
HE = humic earth; like 4.
CSa= calcareous sands; like 5.
Sto= stony substratum; like 7.

The presence of gyttja in the subsoil has been indicated in our tables (see 3.6 and 3.8).

3.4 The taking of water samples

From most stands we took a water sample for subsequent chemical analysis of some ions (only in those cases where similar results could be expected, for instance neighbouring stands in open water, only one sample was taken). This sampling was done in order to give us an idea of the direct availability of these ions for the plant.
In some cases, those samples were taken from the open water as close to the roots as possible, mainly in communities from the classes of the Phragmitetea, Potametea and Littorelletea.

From the blanket bog and wetland communities when there was no open water, a soil water sample was taken. This was in most cases not too difficult, because of a groundwater table at or close to the surface level. The water was taken home in plastic jars of 250 ml and analysed chemically the day after they were collected, in order to prevent changes due to micro-biological activities. The plastic jars were treated beforehand with a concentrated iodine solution. This was done to make sure that all the positivity charged positions in the plastic were saturated with iodine, because it has been shown that otherwise phosphorous ions in the solution will "stick" to the surface of the plastic (Heron, 1962).

Samples were collected and analysed in three periods:

9 September 1975:	Dogs Bay, Gorteen Bay, Aturtaun, Murvey, Namanawaun, Silverhill, Emlagharan and Aillebrack-north.
10 September 1975:	Truska mire, Derreen and Anthony.
1 October 1975:	Nalawney.
2 October 1975:	Aillebrack-south.
6 October 1975:	Truska lake, Aillebrack-south, Anaserd, Lettershask-west, Lettershask-east, Nalawney, Kankoge, Naccorrussaunbeg, Suffrauncam, Aturtaun, Aillebrack-north, Truska in the bog, Emlagharan.

We interrupted the collecting of water samples on the second of October, because of heavy rainfall during that two days. New samples were collected on the 6th of October, after 3 days of relative calm weather, without rain. Duplicate samples were collected from Aturtaun and Aillebrack-north, to be able to compare both main collecting periods.

In the samples we measured the pH and the amounts of Cl^-, Ca^{++}+Mg^{++}together and PO_4^{---}.

3.5. Chemical analyses

We used several chemical techniques to analyse our water-samples coming from "rain catchers", as well as from the stands. The ions measured were H^+(pH), PO_4^{3-}, Ca^{++}+$Mg^{++}$and Cl^-.
The reasons for this selection were mainly practical: The analysis should be possible with relative simple methods, for which we could bring apparatus and chemicals with us to Connemara, because there were no laboratories in the neighbourhood and preservation of so many water samples for several months and their subsequent transport to Nijmegen was not feasible within these limitations.

The elements chosen possibly indicate the following:

- -pH , overall characteristic of soil and/or lakes.
- -PO_4 , when in excess, it possibly indicates human activities (sewage-output).
- -Ca^{++}+Mg^{++}, can give information about presence of calcareous beach materials.
- -Cl^- , will indicate possible sea-spray.

The first two items therefore, were not analysed in the water samples of the "rain catchers".

The pH was measured directly on the water samples with a Metrohm E488 pH-meter. If any mud or sapropel was present, care was taken not to insert the electrode into the precipitated mud, because the pH in the mud generally was about 0.3 pH units lower than the pH in the solution above the mud. The meter was calibrated with the aid of buffer solutions of pH 3.95 and 7.05, after every tenth measurement.

Before we continued with the other three analyses, the water samples from the vegetation were filtered in order to remove mud, sapropel etc. and to obtain a clear solution. This filtration had a slight effect on the calcium content of the solution, because small amounts of calcium appeared to remain attached to the sapropel on the filter. For this reason, measurement of calcium in the clear solution was always slightly lower than direct measurement in a sample from the unfiltered solution (see also results).

The measurements carried out on the clear solution were:

1. The phosphate was determined colorimetrically as the blue antimony-phospho-molybdenum complex, that was concentrated in isobutanol (Kempers, 1975). By this method, using the higher solubility of the complex isobutanol, quantities of phosphate of about 0.001 mg/l still can be detected. This method concentrates all the colour out of a large quantity of water into a small volume of isobutanol, obtaining in this way a greater sensitivity. We used 10 ml of the sample, cooled in rain-water, 1 ml complex solutions, and 2 ml of isobutanol, warmed near the fire. This difference in temperature is necessary to obtain full separation of both liquids. The colour in the sample was then compared visually with a series of standards treated the same way, containing 0.002; 0.005; 0.01; 0.02; 0.04; 0.08; 0.16; 0.2 mg PO_4^{3-}/l.
2. Calcium was determined, along with magnesium, because we used a titration with Na_2EDTA, without special masking-techniques for magensium, therefore both ions are measured (Heald, 1965). Hydroxylamine hydrochloride was added to reduce ferric ions into ferrous ions. Furthermore diethyldithiocarbamate was added to complex heavy metal ions; and eriochrome black-T was used as an indicator. The results of this titration for Ca^{++} and Mg^{++} are expressed as mg Ca^{++}/l (ppm) or mg Ca^{++}/pot ("rain catchers").

   The calculations used were:

$$\frac{\text{ml EDTA. titre}}{\text{ml sample}} .40.10^3 = \text{mg} \quad (Ca^{++})/1.$$

40 = atomic weight of calcium

10^3 = (volume "rain catchers" in ml), to express the values per litre or per pot.

By expressing the results as mg Ca^{++}, we ignored the fact that a mixture of calcium and magnesium is determined.
For information on the relative content of these ions in our relevés, this does not matter, but care has to be taken when comparing with data from other authors (see results).

3. The chloride ion was titrated with mercury-nitrate solution with diphenylcarbazon-bromophenolblue as an indicator, according to the standard procedures used at the soil department of the Catholic University at Nijmegen (Kempers, 1974). The results of this titration are expressed as mg Cl^-/l, or as mg Cl^-/pot, when working with "rain catchers".

The calculations used were:

$$\frac{\text{ml } Hg(NO_3)_2 \text{ .titre}}{\text{ml sample}} .35,5 .10^3 = \text{mg } Cl^-/l$$

35,5= atomic weight of the chloride ion.
10^3 = (volume of "rain catcher" in ml), to express the values per litre or per pot.

3.6. The analysis of the vegetation

The techniques we used to investigate the plant communities are the techniques of the Zürich-Montpellier school. For a description of these techniques see Westhoff & van der Maarel (1973), Shimwell (1971) and Müller-Dombois & Ellenberg (1974).

The reason why we used these techniques was, that in a broad survey like ours, aiming at the description and the establishment of basic vegetational units, it was the most efficient (Moor, 1962). Moreover it is the only system providing a broad hierarchical framework, into which new units can be fitted and compared (Poore, 1956).

In this system relativily homogeneous stands of vegetation are selected and described by means of a relevé, the size of which we roughly estimated.

We divided the vegetation in the relevé, when necessary, in two and sometimes into three layers. Most of the time we described a layer of cormophytes and a layer of bryophytes. The cormophytes include Pteridophyta and Spermatophyta, that is, all vascular plants but not the mosses. This use of the term cormophytes is according to Nultsch, 1968, who regards bryophytes as a group in between thallophytes and true cormophytes. The bryophytes include the occasional occurrence of the lichen Peltigera canina. Whenever the lichens formed a substantial part of the cover, as is the case in many relevés made in the blanket bog, then the terms phanerogams and cryptogams are used for these two layers.

Where erect plants were found in open water, the need often arose for a division into three layers, above water, a floating and an under-water layer. The first one is named layer of helophytes, according to Raunkiaer, 1934, (see also e.g. Cain & Castro, 1959), marsh-plants in which the perennating bud is in soil under the water.

We estimated the total cover percentage as well as the cover percentage of each layer. Moreover we noted the height of the vegetation in each layer, its upper and lower limits, as well as the height limits of the bulk of the vegetation, if applicable. This was noted as shown in the following example:

Cormophytic cover % 70% (5) 10-30 (50)

That is to say: the cormophytes cover 70% of the area; the bulk lies between 10 and 30 cm above groundlevel; their maximum upper and lower limits lie at 50 and 5 cm, respectively.

In our tables we only used an average height, in the above case 20 cm.

Following this, we noted several ecological features of the site: type of soil (see 3.3), depth of soil, depth of groudwater table, slope, occurrence of flow and seepage, the dominant species and several other data that are coded with letters under the heading "remarks" in our tables.

These codes are:

-a. extensively pastured and manured
-b. trodden down by cattle
-c. gyttja in the subsoil
-d. calcareous dune sand in the subsoil
-e. mineral particles in the subsoil
-f. quaking mire
-g. iron bacteria present
-h. open water, cover% estimated for whole lake
-i. western lake shore
-j. eastern lake shore
-k. shrub layer present

The next point was to note down all the species present, to give them a value for their combined cover-abundance and for their sociability. For cover-abundance we used the scale of Braun-Blanquet (1964), with some slight alterations according to Barkman et al. (1964).

This scale reads:

r = one or only a few individuals in the whole vegetation.

\+ = only a few individuals in the plot area, covering less then 5%.

1 = abundant in the plot area, but covering less then 5%.

2m = very abundant in the plot area, again covering less then 5%.

2a = covering 5-12,5% of the plot area, regardless of the number of individuals.

2b = covering 12,5-25% of the plot area, regardless of the number of individuals.

3 = covering 25-50% regardless of number of individuals.

4 = " 50-75% " " " " "

5 = " 75-100% " " " " "

The symbols used for the sociability were:

1 = growing solitairy

2 = growing in small tussocks

3 = growing in large tussocks or cushions

4 = growing in extensive patches or forming carpets

5 = covering nearly the whole plot area.

Sometimes these symbols are underlined, indicating that the appropriate sociability was rather loose, allowing other species to grow in between to a certain extend.

The last thing noted, was an indication for the vitality of the species, a value not further used in the tables:

v = vegetative

fl = flowering

fr = fruiting

\+ = dead.

During our work, a herbarium was made of several phanerogams and of all the mosses and lichens, because a sample of mosses and lichens was taken from each relevé containing them, for further determination and/or verification.

The names used for the species are according to the following lists:

All vascular plants	: Clapham, Tutin and Warburg (1962).
All mosses, Sphagna not included:	van der Wijk et al. (1959-69).
Sphagna	: Isoviĭta (1966).
Hepaticae	: Müller (1971), Müller and Herzog (1971).
Lichens	: Poelt (1969).

3.7. Vegetation maps

3.7.1. Mapping and relevé planning

To elucidate the field situation in the wetlands and lakes, reasonably simple maps were drawn of these lakes and their plant communities. Originally it was intented to map only the seven main classes (see 3.1.) to be investigated, but in most cases the vegetation was mapped in more detail in order to see the relative proportion of the recognized vegetation units. These vegetation units were based upon physiognomic, structural and floristic characteristics.

The mapping itself was a subjective method, without help of special technical instruments. The outline of a lake was copied from the Ornance Survey Maps (see 2.1.) and drawn to scale of about quarto-size. The scale lines are indicated on the maps themselves (fig. 13.1-13.20).

Looking from high points in the surrounding, vegetation units were mapped into these outlines, making use of a kind of pacing technique and of reference points within the survey area.

The position of the relevés was planned within each mapped vegetation unit. At least one, sometimes more relevés were made to represent each of these vegetation units in each lake.

One must recognize however, that the mapped vegetation units in the field are not entirely equivalent to the vegetation units later derived from the tables. This feature is inherent to the methods used: the sampling technique according to the school of Zürich-Montpellier (see 3.6.), being a method of "successive approximation" (see Poore 1956, Moore 1962, Shimwell 1971, Westhoff & van der Maarel 1973, Müller-Dombois & Ellenberg 1974).

This means that the so-called B-maps of the lakes (fig. 13.1-13.20) largely show the vegetation units as they were mapped in the field, but that they have been modified according to the results of the synthesis of the data, the vegetation units from the tables. Explanation on the design of the final vegetation maps (fig. 13.1-13.20) is given in 5.5.2. .

After the classification analysis, relevés 54, 65, 79, 98, 100, 114, 118, 119, 124, 132, 136, 166, 241, 246, 252, 304, 320 and 361 were found to be anomalous showing little similarity with any of the clusters recognized (rest group). This was partly because these relevés represented disturbed conditions or because they were the only examples of a particular vegetation unit. These relevés have been assigned to those vegetation units to which, to our best knowledge, they had the greatest affinity and they have been shaded accordingly in the maps.

The two mountain transetcs on Ben Glenisky and on Errisbeg have not been mapped, because of the extensiveness of the area. The same applies to the "zero-bog" lens at Dolan and at the Base of Errisbeg.

The siting of the relevés in these cases was therefore different from that used in the lakes. Relevés were made in those places, wich represented clearly the "relative homogeneous" vegetation, but there were also exceptions, locations that were different from the surrounding vegetation: wetter or richer sites or seepage spots. The location of these relevés is indicated on the maps (see fig. 3,4,5).

Lough Anaserd, Lough Derreen and Lough Nacorrussaunbeg were lakes too big to map and study in total, therefore only a representative part of the lake was mapped and studied.

Truska Mire was too extensive and too complicated to map in detail, only the relevés are indicated on the map.

During the mapping of the vegetation, some transverse sections were drawn in detail of the lake-shore vegetations. These diagrams from west and east shores, from bog lakes and coast fens can be used to show schematically which vegetation types are adjacent or may replace each other along a gradient.

3.7.2. Measurement of the relative surface of vegetation units

In order to quantify the contribution of the different vegetation types to the composition of the total vegetation of the lakes, we used an OTT-planimeter (type 30113). We measured the proportion of each vegetation type in the total vegetation cover of the lakes.

The total vegetation surface of each lake was fixed at 100%. Places without vegetation, such as bare inlands or very deep lake bottoms were not included. It was nearly impossible to measure the surface of all the very tiny units we recognized, therefore we only measured the surface of the more general units of the A-maps (see fig. 13.1-13.20). When these cover percentages are collected into a table, it will be easy to study the distribution of plant communities in the three transects and the differences between the transects.

The A-maps represent overall vegetation maps; the different shaded units represent main vegetation groups, as recognized during the vegetation synthesis. The legend of these maps can be found as appendix. The main groups are:

A1-A4	Potametum graminei
A5	Sociation of Polygonum amphibium
A6-A8	Potameto-Nupharetum
A9-A10	Sparganio-Nymphaeetum
D1-D10	Isoeto-Lobelietum
F1-F7	Eleocharetum multicaulis
E1-E3	Samolo-Littorelletum
E4-E6	Carex panicea-Carex demissa nodum
B4-B5	Scirpetum lacustris
B6	Sociation of Typha latifolia
B7	Sociation of Scirpus maritimus
B8	Sociation of Equisetum fluviatile
B9-B10	Cladietum marisci
B11	Sociation of Phragmites australis
B12	Sociation of Eleocharis palustris
B13	Sociation of Juncus subnodulosus
C1-C3	Phragmitetea
G1-G3	Transition from Phragmitetea to Parvocaricetea
B1-B3	Sociation of Menyanthes trifoliata
J1-J7	Caricion curto-nigrae
H1-H2	Sociation of Carex rostrata
K1-K6	Scorpidio-Caricetum lepidocarpae
M1-M4	Molinia caerulea-Myrica gale nodum
L1-L4	Schoenus nigricans-Scorpidium scorpioides nodum
N1-N3	Scheuchzerietea
01-02	Oxycocco-Sphagnetea
I	Transition from Molinio-Arrhenatheretea to Parvocaricetea
P	Alnetea glutinosae
Q	Nardo-Callunetea

3.8. Methods of vegetation synthesis

3.8.1. Introduction

The making of the relevés (see 3.6), the arranging of these relevés into communities and the classification and interpretation of these communities is done with the method of the French-Swiss school according to the system of Braun-Blanquet (Westhoff & van der Maarel, 1973).

In this way we constructed a number of phytocoenoses for Connemara, trying thereby to classify these coena in the existing system of plant communities. A starting point was provided by "Irische Pflanzengesellschaften" of Braun-Blanquet and Tüxen (1952) and in the second place by "Plantengemeenschappen in Nederland" of Westhoff and Den Held (1969).

New communities are recognized; some are well-known but not described for Ireland untill now; a few of them are quite new altogether. Most of the communities have the character of associations and consequently they were given that denomination.

However sometimes we used the term "nodum" (Poore 1956). This indication for non-classified units of vegetation can be used at any level of organisation from sub-association to class, but in practice we used it nearly always at the level of alliance.

As a consequence of the method used, the association is the basic unit of the hierarchical classification, but sometimes we used the term "community" at the same level. Often these types of vegetation were only poorly developed in the survey-area or were missing a specific species combination, or were not completely equivalent with comparable existing associations. Moreover a subdivision of a nodum has been called "community". As a consequence, the term "community" in this work is used both in the common sense as well as in the above indicated special meaning.

The names of the syntaxa occuring in this report are mostly taken from Westhoff en den Held (1969); where we depart from this rule it will be mentioned in the text.

Finally we wish to state that the plant communities described have validity in Connemara; their distribution and validity throughout Ireland remains to be checked. So they have only a provisional character.

3.8.2. The table-board

We started to work with a table-board to make a rough grouping of our relevés. The table-boards we used were originally designed by Müller et al (1972). In Nijmegen slightly modified copies were made that differ only in dimension and instead of rivets we used prefabricated coloured plastic pins to indicate the presence and cover-abundance of a species in a relevé. Some critical notes, related to the use of this table-boards are discussed in chapter 5.

By means of these table-boards, we arrenged the relevés in three groups: the relevés made in the bogs, roughly belonging to the classes Oxycocco-Sphagnetea and Scheuchzerietea; the relevés that formed the species poor communities of the open water and lake bottoms, representing approximately the class of the Potametea and part of the Littorelletea; and the relevés taken from marshes (reedswamp, sedge-dominated fen) and lake-borders. This last very voluminous group roughly contained communities of the Phragmitetea, Parvocaricetea and parts of Littorelletea and all transitions between these vegetation types.

The size of these rough tables and the high internal similarities of the material made it difficult to get an overal view of these tables. It was not possible to make an adequate classification by hand and therefore we used a computer.

3.8.3. The computer

Because of reasons mentioned in 3.8.2. we used numerical techniques. For this purpose we used the Tabord-classification program, available at the IBM computer of URC (Universitair Reken Centrum), Nijmegen.
This program contains agglomerative classification procedures based upon Clustan (Wishart 1975). Out of the similarity coefficients in this program a modified version of Jaccard similarity index was used (Kortekaas & van der Maarel, 1972).
The advantage of this program is that it produces a tabular arrangement of species and relevés, more or less comparable with the classification tables according to Braun-Blanquet. Another advantage is, that the user can influence the program by choosing appropriate parameters that steer the fusion-strategy as well as the tabular output.

These parameters are:

- Treshold value. This value indicates the required level of resemblence between relevés and centroid, to form one cluster. We tried to use a 50% threshold value, but this resulted in a rather extensive group of residual relevés. Therefore we lowered this value to 43% and the remaining residual relevés were placed back by hand in the appropriate clusters.

- Fusion limit: when two clusters have a resemblance higher than this limit, they will be fused. We used a limit of 80% to prevent too easy clustering.
- Number of iterations. At every iterative cycle each relevé is compared with the existing clusters and placed in that cluster having the highest relationship to the relevé, but of course the treshold value has to be exceeded. We choose 20 iteration cycles.
- Presence limit: Species having a presence(%) in a cluster higher than this limit will be placed together on the output table, so this parameter only deals with the legibility of the tables. We used a limit of 60%.

The tabord-program can handle maximally 200 relevés and 250 species. However the species-number on the rough tables exceeds this number and therefore a few species occurring only once or twice were temporarily left out of consideration; after the computer-work they were of course replaced in the original relevés.

The clusters produced by this computer program were used as the base of our classification. The re-arranging of these clusters to higher units, partial tables and the final tables in this report, is completely done by hand.

Finally we created a synoptic table (table 7) representing for each species in each unit, the precence class and the limits of cover-abundance (see 5.3.4.).

IV. FRAMEWORK OF THE INVESTIGATION

After the description of the area and of the methods used, we thought that this was a good place to elaborate again, a little bit more specifically our objectives and methodology (see 1.4.) and how we set about to solve the questions, before discussing our results.
Fig. 5 shows the more or less hypothetical influences that, in our opinion, cause the major patterns in the vegetation.
As outlined in 1.4., we investigated two nearly separate sets of problems, namely the influence of the sea and the influence of parent material, in two different areas in West-Connemara, the coastal strip and the mountains Errisbeg and Ben Glenisky.

As can be seen from fig. 5, we supposed, that the influence of the sea is a gradually decreasing one and that it depends largely on the type of coast. Therefore we choose to use transects in the direction of the prevailing wind, starting at different types of shores, the investigated plots being close together near the coast, with increasing distance between plots further inland; these were accompanied by "rain catchers" to obtain some idea of the airborne influences.
The contents of these "rain catchers" were analysed chemically for the following elements: Ca^{++}+ Mg^{++} as an indication for blowing in of beach materials and Cl^{-} to indicate seaspray.

The major difficulty, as will be clear from the figure, is to separate the influence of the sea from the influence of man. We choose therefore only the water-logged sites and analysed in water samples from the stands, apart from Ca^{++}+ Mg^{++}, Cl^{-} and pH also PO_4^{---} as indicative for human influence.

We tried to quantify the contribution of different vegetation types to the overall composition of the vegetation, with the aid of maps and surface measurements. This has enabled us to see if the changes in these vegetation types are gradual (that is, according to our assumptions caused by the sea) or are as abrupt as the transition between coastal strip and blanket bog.
In our opinion such abrupt transitions are an indication for the influence of men. Moreover we can detect if certain communities occur more in one transect compared with the other two, as a result of a different type of shore.

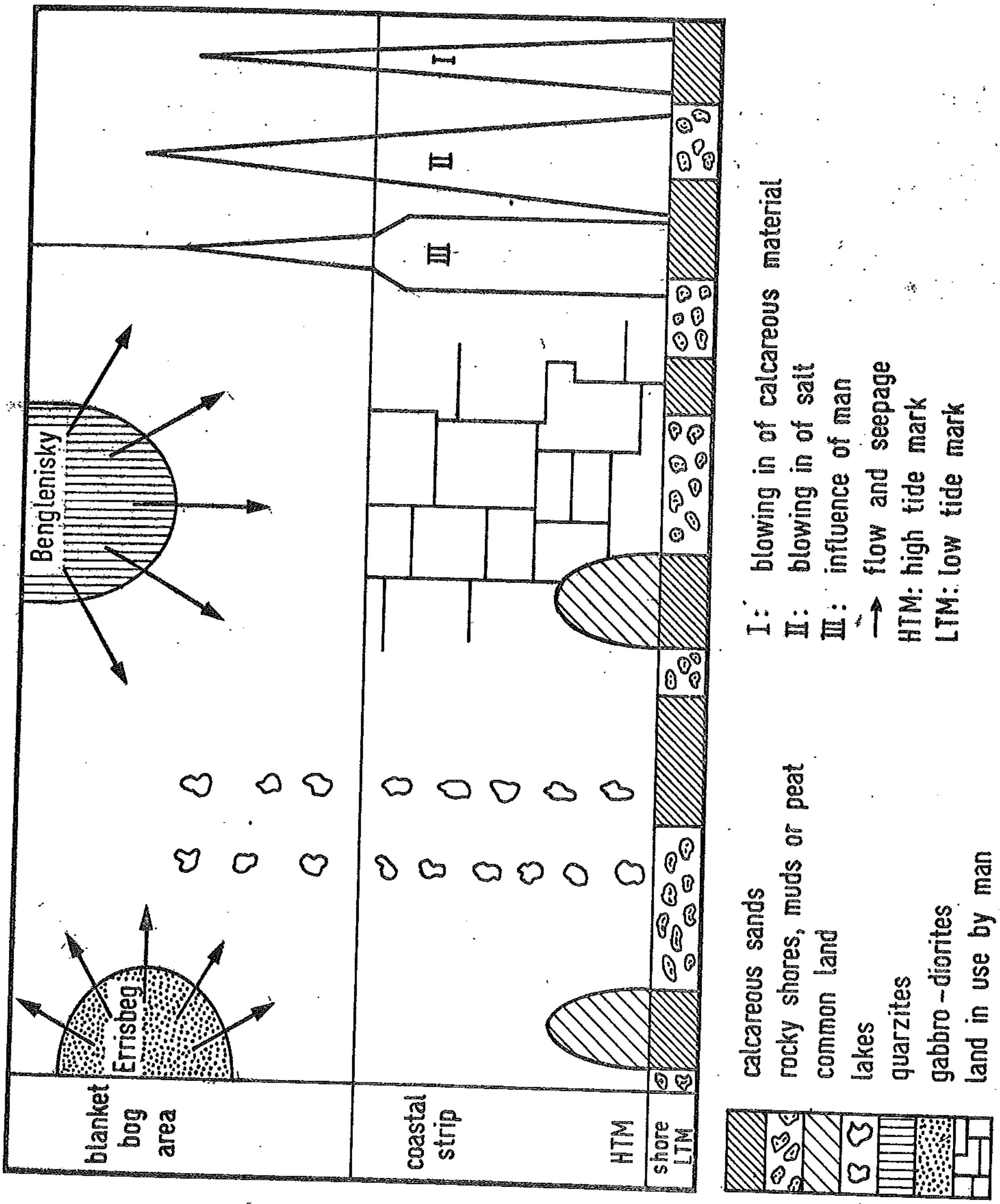


FIG. 5 HYPOTHETICAL INFLUENCES ON THE INVESTIGATED AREA

The major problem in our study of the communities of Ben Glenisky and Errisbeg, was to separate the influence of different parent material in both mountains from the effects purely due to water regime, especially seepage and flow. Therefore we selected comparable spots on both mountains with similar seepage and flow patterns; in both cases the sites occurred at the base of steep slopes, where water running down the mountains is converging. Furthermore we selected drainage channels from these localities, with a more or less permanent outflow of water, to find the additional influences of water flow. In this way we hoped to isolate the influence of the parent material.

In the end, we compared our mountain communities with uninfluenced blanket bog communities in the Dolan area west of Errisbeg (see fig. 14.c), to analyse the influence of water regime.

In the blanket bog of Ben Glenisky and Errisbeg, we looked for "exceptional" communities, to see how far these could "deviate" from the undisturbed situation as observed in the Dolan area. We also analysed chemically water samples from these stands.

The analyses and subsequent syntheses of our vegetation data necessary to give us means of comparison between sites in terms of their vegetation, generates of course results of its own, namely, a classification of the vegetation units on wet sites in the area. This classification will be compared with literature data and we will try to make suggestions as to the position of the west-Connemara vegetation units in a broader context.

V. RESULTS, DISCUSSION AND CONCLUSIONS

5.1. Environmental data

Environmental data, measured at the relevé sites are noted above the vegetation tables. Some introductory remarks need to be made concerning the conventions used.

When a point is indicated, instead of a value, this means that the factor in question at the site of that relevé is not measured. There are three reasons for missing values: in the first place the bottom sometimes was too dry to take an adequate water sample for chemical analysis; in the second place a threatened shortage in chemicals forced us to limit the number of water samples. Therefore no analyses were made for sites situated close together in open water. We assumed that differences between such sites were minor. Thirdly we sometimes estimated the open water stands of complete lake surfaces. In such cases data on depth or height of vegetation are often missing because of inaccessability.

The sign "-" after "depth of water" means: water table at undefined depth beneath soil/surface. A point after "remarks" means: no remarks. The meaning of the different remarks is explained in 3.6. and abbreviations of "type of soil" and location in 3.3 or 3.1.1. The first or first two figures after "date" indicate the day and the last or last two indicate the month.

An evaluation and discussion of our environmental data and a comparison with literature data will be made in the following sections. The environmental data are also summarised and presented in three ways:

1). As a table (table 8) of means with their standard deviations, for the same units as those recognized for the synoptic table of vegetation units (see 5.3.4). This is done for all environmental data, except of course for such data as relevé number, date, location, quadrat size and remarks. The data will be used in describing the vegetation units (5.3.).

2). As histograms of all values for each partial table (table 9). This is done for the following data: type of soil, pH, calcium plus magnesium and chloride.
The percentages occurrence of every bottom type and of classes of pH, Ca^{++}+ Mg^{++}, and Cl^{-} are calculated for each table. The pH classes were divided into regular intervals, whereas classes for Ca^{++}+ Mg^{++} and Cl^{-} were formed with intervals with increasing size, to avoid accumulation of most data into one class and to obtain a more normal distribution.
We will compare these histograms with the synoptic table (5.3.4.) to relate some overall tendencies in vegetation and environment.

3). By listing mean values and standard deviations of pH, Ca^{++}+ Mg^{++} and Cl^{-} for every lake. Changes in pH and in the concentration of Ca^{++}+ Mg^{++} and Cl^{-} from coast to inland can thus be related to changes in the composition of the vegetation along the same gradient. These data can also be compared with "rain catcher" data, measured at the same localities, in order to trace air-borne influences. This comparison and evaluation will be done in 5.4.3.

The water samples from the lakes were collected at three different times: 9/9, 1/10 and 6/10. Due to heavy rainfall, just before the second sampling, we were afraid that these data would be unreliable. Therefore, the two lakes already sampled that day (Aillebrack-South and Nalawney) were resampled on the last sampling day, together with the rest of the samples. That day we also took some samples from lakes already sampled on 9/9, to get an idea of the changes between those two days.

Data from 1/10 and 6/10 (table 1) clearly show a significant increase (student t-test) for Cl^{-} in Aillebrack-South only.
It was expected that the values would be higher on 6/10, because the samples of 1/10 were probably diluted by the heavy rain. It is however not surprising that the only significant increase occurred in a coastal lake, because of the relative high Cl^{-} in those lakes. The difference between the chloride in rain and boglakes is less pronounced, so diluting effects will be more obvious in lakes close to the sea.

When we compare data from 9/9 and 6/10 from Aturtaun and Aillebrack-North, again only chloride was significantly higher on the first data. The samples from 6/10 probably still show some dilution due to the heavy rainfall in the end of September.

Table 1: The influence of rainfall on the chemical composition of water samples. The samples were collected at 9/9, 1/10 and 6/10. For further explanation see text.

Location	Factor	1/10	6/10	Change	t
Nalawney	pH	6,60±0,50	6,50±0,30	-1,7%	ns
	Ca^{++}+Mg^{++}	0,45±0,03	0,41±0,15	-9,7%	ns
	Cl^{-}	0,42±0,02	0,36±0,11	-14,3%	ns
Aillebrack S	pH	7,40±0,50	7,30±0,60	-1,3%	ns
	Ca^{++}+Mg^{++}	3,69±1,53	4,55±1,42	+18,9%	ns
	Cl^{-}	0,86±0,11	0,99±0,13	+13,1%	**

Location	Factor	9/9	6/10	Change	t
Aturtaun	pH	5,90±1,10	6,00±1,30	+1,7%	ns
	Ca^{++}+Mg^{++}	0,71±0,18	0,54±0,27	-23,9%	ns
	Cl^{-}	0,82±0,13	0,59±0,13	-28,0%	*
Aillebrack N	pH	7,70±1,20	7,50±0,70	-2,8%	ns
	Ca^{++}+Mg^{++}	6,59±5,14	5,39±3,09	-18,2%	ns
	Cl^{-}	1,38±0,59	1,19±0,31	-13,8%	*

ns: not significant; *: p between 5 and 1%; **: p between 1 and 0,1%.

Conclusions from this "unintentional experiment" are:

1. Heavy rainfall does lower the concentration of ions in the evironment. The influence seems negligeable on the pH (a buffered system) and on Ca^{++}+ Mg^{++} and Cl^{-} it is not big either.
   The change is most pronounced in coastal lakes for Cl^{-}. Here we find a decrease due to dilution. In bog lakes there is no difference or even a slight, not significant increase (flow and seepage from surrounding areas?).
2. Calcium and magnesium do not show significant differences, although they change even more than chloride. This is probably due to the fact that they are exchangeable cations. Therefore there are more local differences caused by differences in absorbtion capacity of the soil; this results in a broader range of values, that is a larger standard deviation and consequently no significance.
3. In Lough Nalawney, where complete areas became flooded before 1/10, other factors besides dilution or concentartion effects were important; the result was a leveling off of the values reflected in the extremely small standard deviation.

5.2. Results from the "rain catchers" and data from the weather station

5.2.1. Introduction

The "rain catchers" were placed in three transects (see fig. 1, 3.1.1. and 3.2) and the distance to the sea of the measuring points is given in table 2. This distance in meters from the high water mark is calculated with the aid of Ordnance Survey maps (see 2.1) in the direction of the prevailing wind, namely South-West. When applicable, the distance in a north-westerly direction is also given, especially when these "rain catchers" stood close to other shores.

Table 2 gives the amounts of blown-in material for the six collecting periods, expressed in mg per pot. The reason for using this unit is that the volume of rainwater in the pots varied considerably during the measuring periods, due to differences in precipitation, but also because of loss of water by shaking of the pots, evaporation and the differences in amount of distilled water used for rinsing the pots.
Because of these two last effects, we did not use a concentration measure, but the total amount caught in the period. At the same time calcium to chloride ratios are calculated and given. The results from table 2 will be discussed in the following sections 5.2.2. and 5.2.3.

The first period was extremely dry (fig. 6) and in nearly all cases the contents of the pots was 0 ml, thus the volume of precipitation could not be measured. Instead, the filtration papers were collected and the pots rinsed with distilled water. These samples were filled up to a volume of 100 ml, which was used for the analysis.

During the third period (24/7-20/8), "rain catchers" S2 and S3 were destroyed and "rain catcher" S1 disappeared during the fourth period (21/8-3/9). These pots were replaced by new ones.
The missing values of these pots are replaced by an interpolated value, derived from the mean percentage decrease or increase in the other "rain catchers" of the transect under discussion for this period as compared with the previous period.

Example:

S1, 3rd period-compared with 2nd period:decrease for Ca of 20,9%.
S4, " " " " " " : " " " " 7,5%.
S5, " " " " " " : " " " " 22,9%.

Mean of decrease for calcium in the 3rd period 17,1%.
With the help of this mean we have calculated the missing values for S2 and S3 in period 3, from data of period 2 as follows:

S2 period 2 =7,33; S2 period 3 =7,33-17,1% =7,33-1,25 = 6,07mg/pot.
S3 " =5,59; S3 " =5,59-17,1% =5,59-0,95 = 4,64mg/pot.

This method has the disadvantage that it only gives a rough approximation. This is especially true for S1 in the fourth period: its values are calculated from already derived values. Other sources of error were in some cases the influence of bird droppings when "rain catchers" were used as resting spots. Loss by blowing away of (parts of) the filtration paper or a sheltered position due to the relief of the landscape were also sources of error. Even though the pots were placed 1,70 m. above ground-level, we sometimes found calcareous sand in "rain catcher" S1 in transect I and S6 and S11 of transect II.

To visualize the results, cumulative histograms are made for the three transects, for chloride (fig. 7) and for calcium (fig. 8). Fig. 9 plots the amounts of calcium and chloride against distance to the sea for the last period (18/9-1/10). This period is chosen because it is the most important one when looking at the absolute amounts blowing in and because it indicates most clearly the tendency in the results. Calcium and chloride are expressed in mg/litre, to make the figures comparable with those of the watersamples of the lakes. In this wet period with little evaporation it makes little difference to express the data in mg /pot or in mg /l.

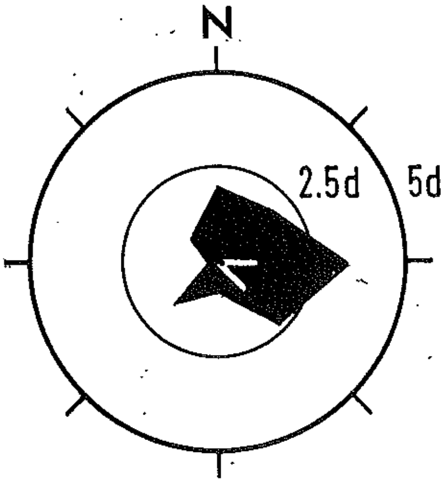
Fig. 6 shows periodical weather data, collected at the weather-station next to S16 (see 3.2). The diagrams represent a combination of wind direction (black) and wind velocity (white).

TABLE 2: Distance to the sea of the raincatchers; amounts of water and ions (calcium and chloride, expressed in mg:pot); calcium to chloride ratio per raincatcher per period.

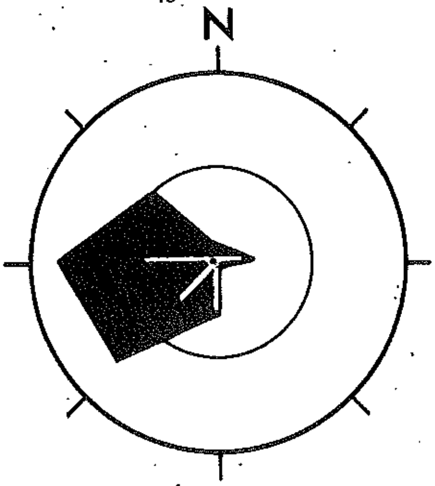
collecting period			26/6-9/7				10/7-23/7				24/7-20/8			
rain-catcher	distance to sea (1) SW	(2) NW	cont-tent (ml)	Ca	Cl	Ca/Cl	con-tent (ml)	Ca	Cl	Ca/Cl	con-tent (ml)	Ca	Cl	Ca/Cl
transect 1														
S1	180		(3) nm	0,82	0,33	2,52	262	9,37	49,43	0,19	218	7,41	45,66	0,16
S2	740		nm	0,74	0,16	4,79	243	3,66	20,27	0,18	-(4)	3,04	15,71	0,19
S3	1820		nm	0,36	0,20	1,85	209	2,79	12,59	0,22	-(4)	2,32	9,76	0,24
S4	3000		nm	0,91	0,31	2,93	229	2,73	15,02	0,18	215	2,52	13,90	0,18
S5	8440		nm	1,17	0,19	6,20	189	2,03	10,51	0,19	165	1,56	4,98	0,31
transect 2														
S6	90	1290	nm	1,18	0,19	6,22	130	6,04	33,35	0,18	174	11,65	65,06	0,18
S7	1060	2090	nm	1,26	0,25	5,09	143	5,56	31,44	0,18	176	7,15	45,16	0,16
S16	1720	2060	nm	0,74	0,18	4,23	165	2,95	16,69	0,18	225	3,22	20,08	0,16
S8	1930	2800	nm	0,87	0,20	4,33	188	4,16	24,09	0,17	226	4,19	25,65	0,16
S9	3250	2880	nm	0,95	0,21	4,44	246	4,01	21,84	0,18	230	3,99	21,34	0,18
S10	4250	160	nm	1,73	0,32	5,44	173	4,57	18,95	0,24	207	3,29	17,90	0,18
S11	3780	1530	nm	1,46	0,28	5,33	96	2,90	16,59	0,17	164	4,74	24,67	0,19
transect 3														
S12	120	5840	nm	0,88	0,34	2,63	174	2,80	13,38	0,20	176	4,83	22,64	0,21
S13	460	5490	nm	0,91	0,27	3,42	178	3,19	16,40	0,20	182	4,02	19,44	0,21
S14	1430	2400	nm	0,55	0,12	4,55	206	3,32	15,24	0,22	221	3,49	11,13	0,31
S15	2570	2870	nm	1,12	0,27	4,16	192	3,06	16,99	0,18	234	4,18	22,36	0,19
mean ± standarddeviation						4,26±1,30				0,19±0,02				0,27±0,05

collecting period	21/8-3/9				4/9-17/9				18/9-1/10			
rain-catcher	Con-tent (ml)	Ca	Cl	Ca/Cl	con-tent (ml)	Ca	Cl	Ca/Cl	con-tent (ml)	Ca	Cl	Ca/Cl
transect 1												
S1	-(4)	4,25	15,79	0,27	211	4,17	28,28	0,15	294	35,16	245,30	0,14
S2	112	1,14	4,31	0,27	172	2,99	17,29	0,17	275	13,68	104,15	0,13
S3	113	2,19	2,78	0,79	210	3,55	17,81	0,20	113	3,72	21,45	0,17
S4	112	0,99	3,81	0,26	208	2,68	16,38	0,16	279	7,82	58,79	0,13
S5	100	0,90	2,74	0,33	144	1,63	9,07	0,18	174	2,06	13,96	0,15
transect 2												
S6	102	1,55	7,46	0,21	102	3,51	24,37	0,14	242	8,09	74,51	0,11
S7	107	1,96	9,47	0.21	115	4,85	30,53	0,16	185	11,79	89,02	0,13
S16	97	0,70	4,41	0,16	191	3,25	20,99	0,15	349	10,00	75,97	0,13
S8	116	0,90	5,77	0,16	184	6,53	27,30	0,24	271	10,27	78,15	0,13
S9	114	1,05	5,80	0,18	211	4,81	27,94	0,17	337	9,02	71,12	0,13
S10	110	1,25	5,00	0,25	150	2,68	18,71	0,14	201	3,05	21,12	0,14
S11	112	0,99	6,82	0,15	214	6,18	42,10	0,15	323	8,04	67,32	0,12
transect 3												
S12	118	0,68	1,83	0,37	190	1,09	11,95	0,09	236	9,61	73,17	0,13
S13	115	1,22	4,20	0,19	149	2,29	14,12	0,16	327	10,46	78,23	0,13
S14	108	1,17	5,07	0,23	200	3,41	21,29	0,16	342	11,99	89,44	0,13
S15	120	1,19	5,23	0,23	169	2,78	17,49	0,16	279	9,35	69,92	0,13
mean ± standarddeviation				0,27±0,15				0,16±0,03				0,14±0,01

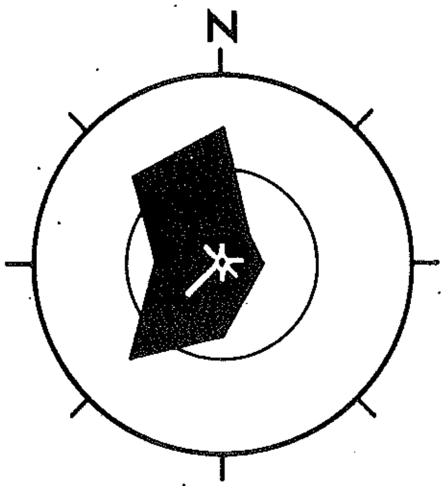
(1) Distance to the sea is expressed in metres, starting from high water mark.
(2) When applicable North-Western distance is also given, especially when these raincatchers where close to other shores.
(3) nm = not measured; in nearly all cases however, the content was 0ml. The first period was extremely dry (see Fig 6).
(4) These raincatchers were destroyed. Data for calcium and chloride are inferred from other data (see text).



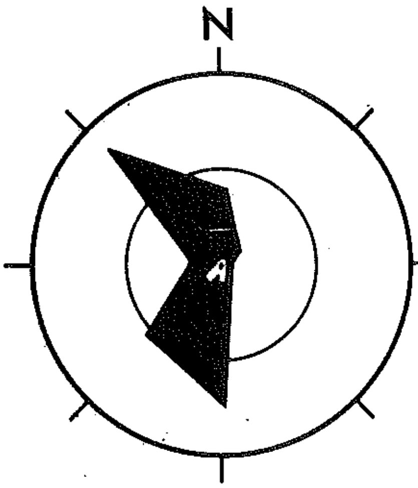
period 26/6-9/7
precipitation 2 mm
min. 12,6 °C
max. 25,3 °C



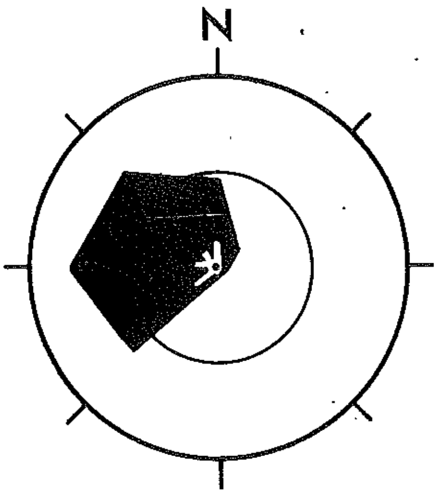
10/7-23/7
67 mm
min. 14,1 °C
max. 21,7 °C



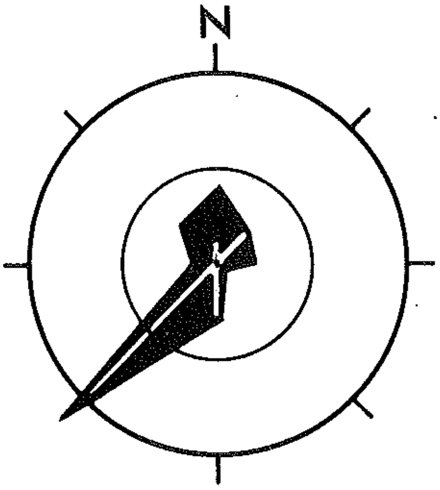
24/7-20/8
36 mm
min. 13,7 °C
max. 21,5 °C



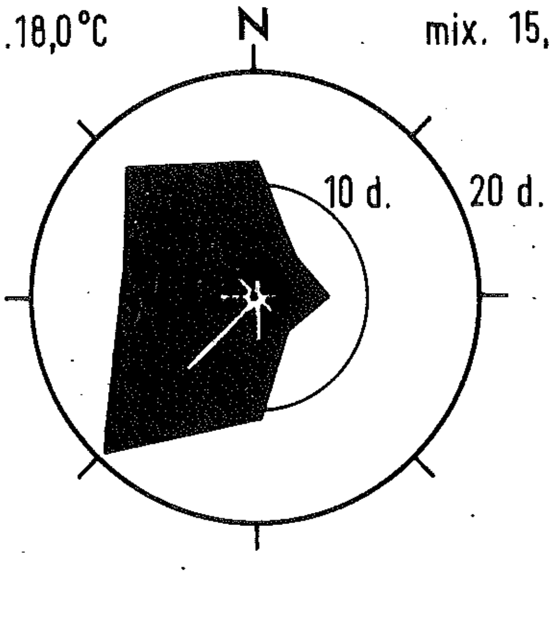
period 21/8-3/9
precipitation 13 mm
min. 13,4 °C
min. 19,2 °C



4/9-17/9
42 mm
min. 11,6 °C
max. 18,0 °C



18/9-1/10
58 mm
min. 9,8 °C
mix. 15,7 °C



total period 26/6-1/10
total precipitation 218 mm

FIG. 6 PERIODICAL WEATHER DATA
FOR EXPLANATION SEE p. 47

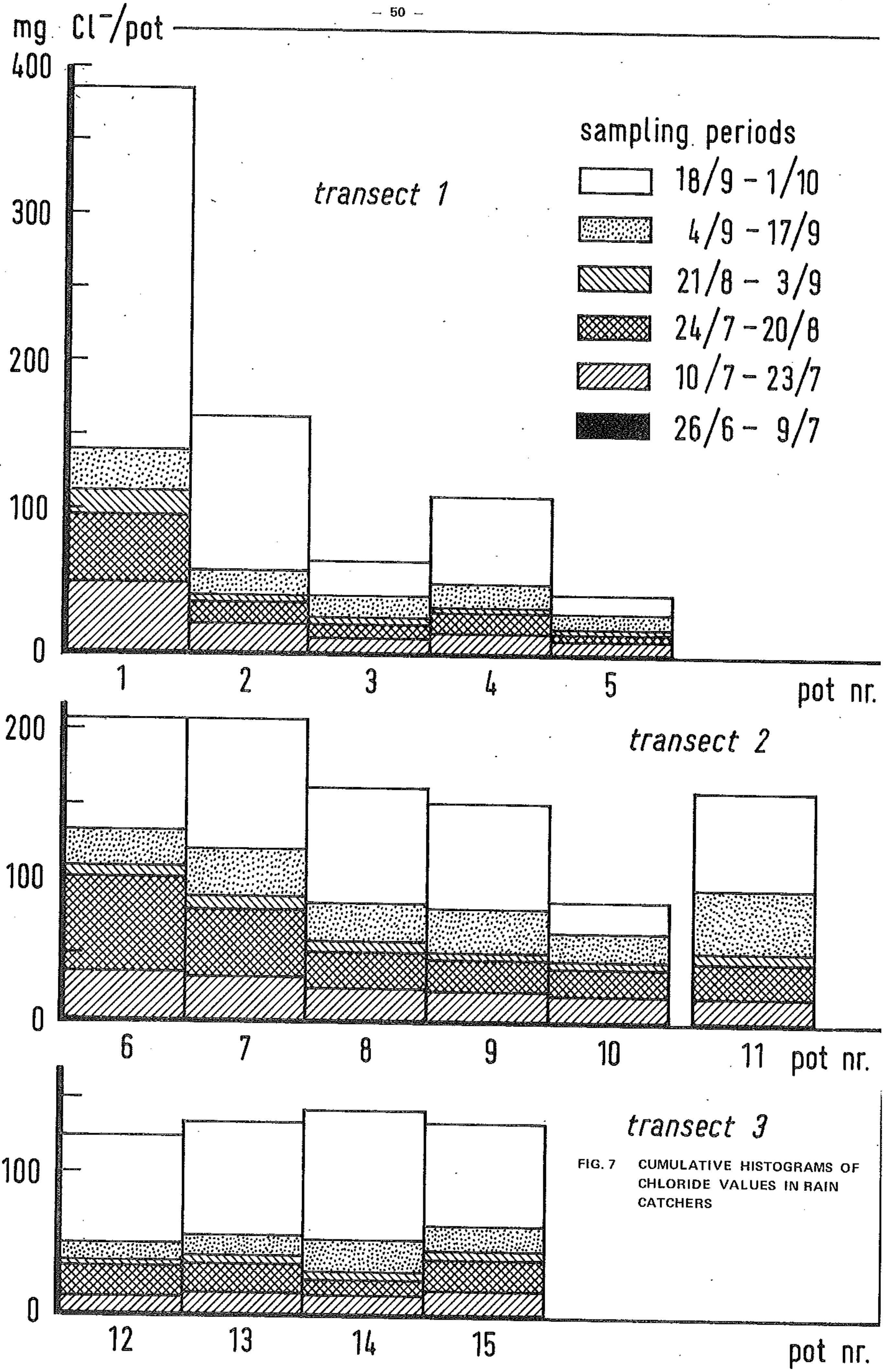


FIG. 7 CUMULATIVE HISTOGRAMS OF CHLORIDE VALUES IN RAIN CATCHERS

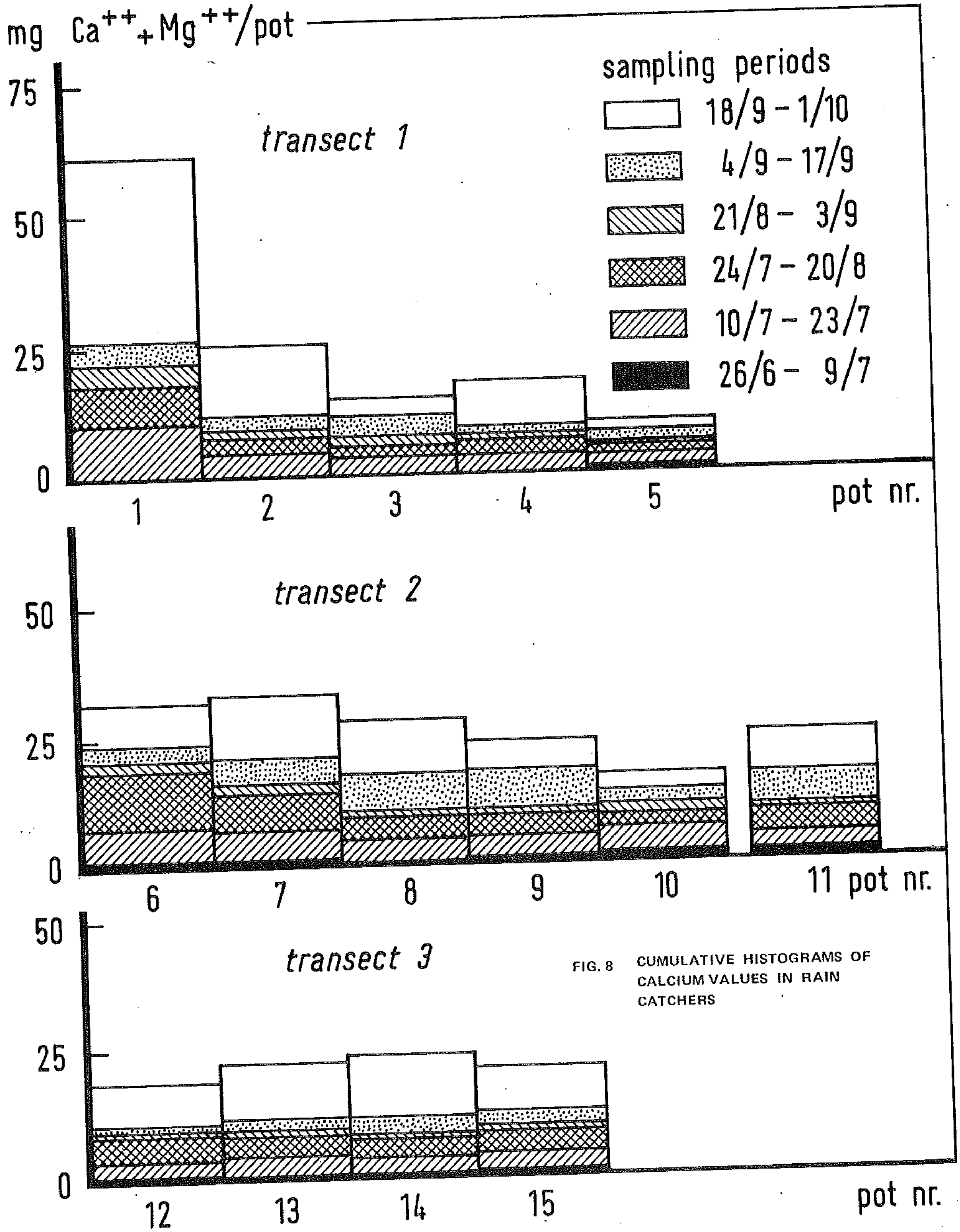


FIG. 8 CUMULATIVE HISTOGRAMS OF CALCIUM VALUES IN RAIN CATCHERS

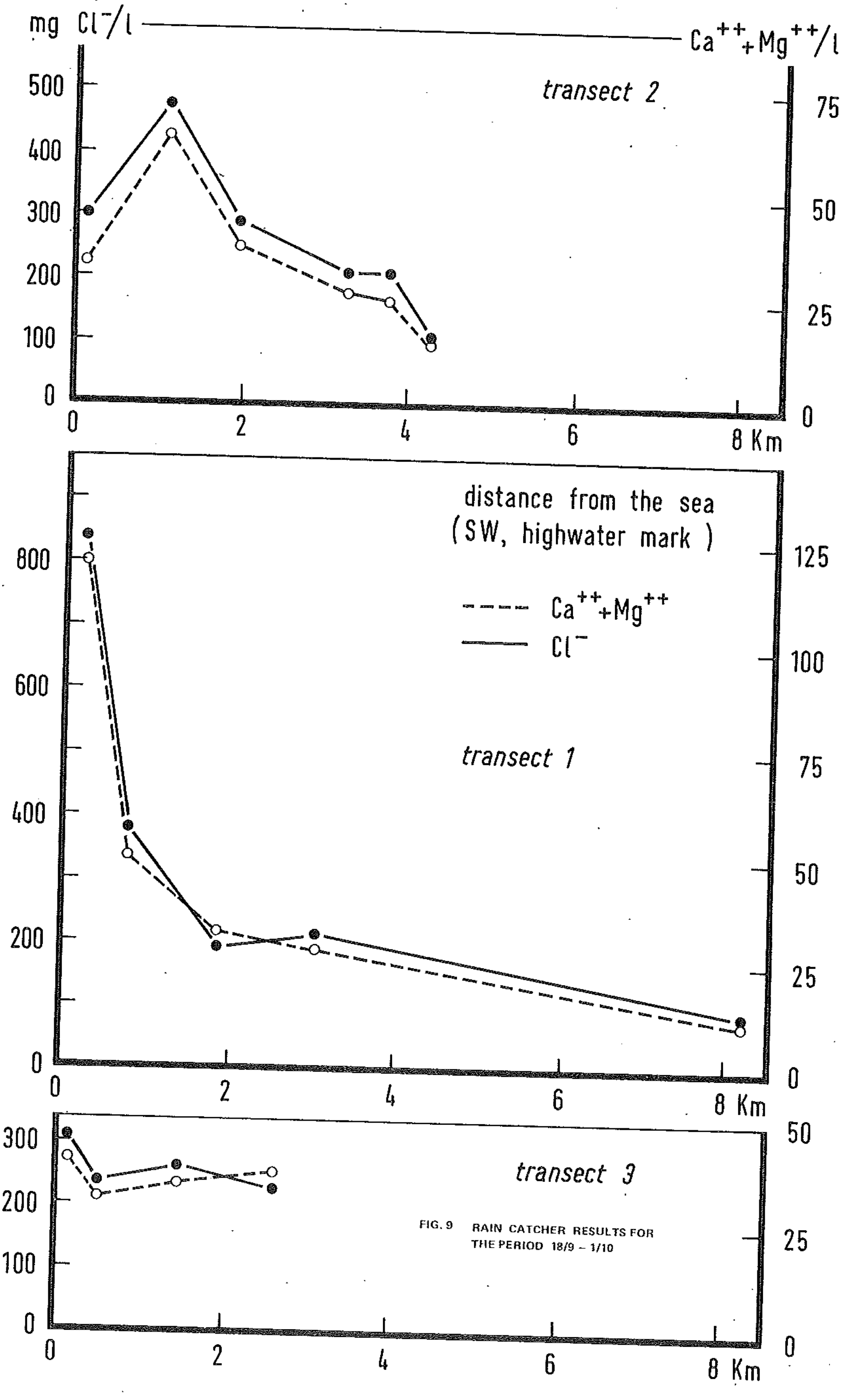


FIG. 9 RAIN CATCHER RESULTS FOR THE PERIOD 18/9 – 1/10

For wind velocity only a rough estimation of three windintensities, viz. moderate to strong, strong and stormy have been taken into account. Precipitation was measured daily and preserved for later analysis of calcium and chloride. The total quantity of rain for each period is given in figure 6 as well as the average minimum and maximum temperatures. These figures reflect clearly the unusually warm and dry summer of 1975.

5.2.2. Detailed description of the "rain catcher" results for each transect

Transect I

This transect starts on a calcareous sandbeach (see fig. 1; 3.1.1) and ends in the middle of the blanket bog area (Craiggamore, hill 201) about 8 miles inland, measured in N.E. direction (S1-S5).
The general course of the graphs (fig. 6,7 and 8) shows a clear decline in calcium + magnesium and chloride concentrations from coast more inland.

"Rain catcher" S1, only 180 m N.E. from the shoreline, has the highest input of ions of all transects and "rain catcher" S5, near Craiggamore, furthest inland (8440 m), has the lowest ion input of all the transects. This declining tendency is obvious in sampling-period 2,3,5 and 6, in which precipitation was reasonably high and S.W. winds were dominant and quite strong (see fig. 6).
Period 1 and 4 however, were periods with low winds and very little precipitation (2 mm and 13 mm resp.); the Ca^{++} and Cl^{-}-values are at a constantly low level (except pot S1, period 4, an estimated value; see 5.2.1.). The values for Cl^{-} in the last sampling-period are relatively high; the same can be said for the Ca^{++}-values. The reason for this is the combined effect of high precipitation and strong south-westerly winds. We even found inblown sand in "rain catcher" S1 that period. "Rain catcher" S3 is a pot which has been contaminated in nearly all periods. It was used as a bird perching spot and twice destroyed by man. The values for calcium and chloride therefore are not very reliable. Furthermore the position of this "rain catcher" was more or less sheltered and therefore unsuitable.

Transect II

This transect on Bunowen peninsula starts again on lime-rich beaches on the S.W.-coast and ends on the opposite rocky shore. (S6-S11+S16, see fig.1). Roughly the same tendency of decline of Cl^- and Ca^{++} ions from S.W.-N.E. occurs in this transect, although the graphs show this less clearly. The reason for the relativly low Ca^{++} and Cl^- content of "rain catcher" S6 is caused by a combination of factors: the pot was somewhat sheltered, on a golf course; in the last two periods the filter paper had gone and the water content was low, compared with the other pots. "Rain catcher" S7 was also affected in these last two sampling periods; the paper was gone and waterloss was observed.

This is reflected in the results: The values for sampling periods 1 and 4 are constantly low (compare transect 1); this is caused by the same factors as in transect 1 (see above). "Rain catcher" S11, situated in Truska mire, had comparable values with pot S9. The distance of both these pots to the S.W. coast is nearly equal (3250 and 3780 meter respectively), but there is a considerable difference when measured in N.W. direction, 2880 and 1530 meters respectively. The influence of the N.W. winds and thus the influence of the lime-rich beaches of Doonloughan, on the "rain catcher" S11 is not obvious (not significant).

Transect III

This transect starts on a rocky shore and ends in the blanket bog area, near Lough Naccorussaunbeg (S12-S15). The graphs of this transect are reasonably level; no obvious decline in Ca^{++} or Cl^- content of the "rain catchers" can be detected from coast to sites further inland. One reason probably is the position of pot S12, which had, after the second sampling period, a very sheltered position, directly behind a hay stack. The variation within the other periods between the "rain catchers", of the Cl^- and Ca^{++} concentrations, is very likely caused by bird perching and waterloss due to the shaking or evaporation in dry periods. Another reason could be that "rain catcher" S14 and S15 have unexpectedly high values for all periods; (period 6 for "rain catcher" S15 should have had even higher values, because the filter paper had gone in that period). A probable cause for these high values is that these pots are not only influenced by S.W. winds from the rocky shore coast (2570 m for S15 and 1430 m for S14) but also by N.W. winds from the sandy beach coast of Mannin Bay (2870 m for S15 and 2400 m for S14).

When looking at these transects and comparing them with each other, some trends are obvious:

- The decline in concentrations of the ions is obvious, indicating a sea-borne origin for these ions. This is supported by the similarity in the declines of both Ca^{++} and Cl^- (see fig. 7, 8 and 9).
- Periods 1 and 4, both dry and with very little wind, have the lowest recorded values of Ca^{++} and Cl^-. Periods 2,3,5 and 6, with more rain and some strong winds from the S.W., have considerably higher values.
- Period 6 has the highest values. The rainfall was not exceptionally high in this period, but the S.W. winds in this period were much stronger than in other periods. This indicates the important part played by the wind.
- There is no conclusive evidence that the type of shore does have influence on the Ca^{++} and Cl^- content of the "rain catchers". Transect III has rather low values at the start, but comparatively high ones further inland; other explanations can be given apart from type of coast.
- There is some indication in transect III that N.W. winds have also an influence on the Ca^{++} and Cl^- loading of the air, although this influence is minor when compared with the influence of S.W. winds (see 5.2.3.)
- As a final remark it must be mentioned that we have carried out measurements for the period 9/7-1/10, i.e. summer and a part of the autumn; the larger sea, rain and wind(storm) influences are confined however to the late autumn and winter months. Therefore our data are not adequate to give overall conclusions.

5.2.3 Quantitative considerations on the calcium and chloride content of the "rain catchers"

In this section we will try to compare the contents of our "rain catchers" quantitatively with data from other sources. This will be done by comparing absolute amounts of ions, as well as relative amounts, expressed as a calcium over chloride ratio, following the suggestion of Sparling (1967) that the comparison of the ratios of any ion to chloride with the same ratios in seawater could provide us with an indication of the origin of the airborne ions, that is seawater-derived, or dust-derived.

For this comparison it is essential to assume that chloride is always derived from seawater. This assumption is supported by data from Sloet van Oldruitenborgh & Heeres (1969) who measured, with the same instrument, none or only very little salt when there was wind blowing from other directions than from sea. This observation is in agreement with our own observations (see 5.2.2) and with data from Sparling (1967) and Gorham (1958).

Table 2 gives the absolute amounts of ions measured per rain catcher, per period, as well as the calcium to chloride ratios. In order to be able to compare these results with those of other authors, table 3 presents ionic content of rainwater from different sources. Because our methods did not discriminate between calcium and magnesium (see 3.5), the magnesium figures are also expressed as mg calcium/liter, and added to the real calcium figures.
Again where possible Ca/Cl ratio's are calculated.

When comparing the data in table 3, several points are worth-while noting:

- Our rain data fit in very well with Irish weather data, especially from those stations situated close to the coast (Valentia, Glenamoy).
- When going inland, the absolute amounts of ions decrease rapidly (Glenamoy, Rosscahill). When comparing with continental data (Bitner 1960, Sparling 1967) this decrease is even more pronounced. This is especially true for chloride. The high amount of magnesium in all these data is also attributed to the influence of the sea (Gorham 1957, Sparling 1967, Visser & Zoer 1972).

TABLE 3 : Literature data on ion contents of rainwater compared with our own rainwater analysis, and the analysis of sea-water from Doonloughan Bay.

source	location	distance to sea	period	Ca^{++} (mg/l)	Mg^{++} (mg/l)	Mg^{++} as Ca^{++} (mg/l)	$Ca^{++} + Mg^{++}$ (mg/l)	Cl^- (mg/l)	$\frac{Ca^{++} + Mg^{++}}{Cl^-}$
Visser & Zoer (1972)	Valentia, S.W.-Ireland	- *	1964	0,72	1,00	1,67	2,39	12,72	0,20
			1965	0,95	2,20	3,67	4,62	25,37	0,18
			1966	0,69	1,39	2,32	3,01	19,83	0,15
			1967	0,92	1,89	3,16	4,08	23,01	0,18
			1968	0,69	0,99	1,65	2,34	13,65	0,17
			1969	0,86	1,04	1,74	2,60	13,40	0,19
			1970	0,88	0,68	1,14	2,02	11,90	0,17
	Den Helder, The Netherlands	-	1964	1,49	4,32	7,06	8,55	32,70	0,26
			1965	1,13	5,50	9,19	10,32	29,04	0,36
			1966	0,99	3,15	5,26	6,25	20,66	0,30
Sparling (1967)	Glenamoy, Ireland	8km	jan'61-jun'62	1,50	3,67	2,20	5,17	33,17	0,16
			jan'61-dec'61	1,20	3,67	2,20	4,87	26,75	0,18
			jun'61-sep'61	1,25	3,17	1,85	4,42	20,50	0,22
		15km	jan'61-jun'62	1,39	3,23	1,95	4,62	22,89	0,20
			jan'61-dec'62	0,78	2,97	1,78	3,75	18,92	0,20
			jun'61-sep'61	0,63	2,22	1,33	2,85	12,00	0,24
	Bogpool, Scotland	-	-	0,90	1,84	1,10	2,74	-	-

Gorham (1958)	Roscahill, Ireland	32km	1957	1,70	0,84	0,50	2,54	-	-
	Lake district, England	-	1958	0,30	0,33	0,20	0,63	-	-
Bitner (1960)	Poland	-	1960	0,90	-	-	-	3,60	-
present survey	Ballyconneely, Ireland	1,7km	jun'75–sep'75	-	-	-	2,03	13,96	0,15
	seawater	0km	1975	-	-	-	2579,0	20603,0	0,13
Sverdrup et al. (1942)	seawater	0km	-	400,0	1272,0	2120,0	2520,0	18980,0	0,13

* – means no data

- The main bulk of these ions is accumulated during the winter period, which again supports the hypothesis, that close to the coast those ions are mainly derived from the sea, and that the loading of ions is highest in the time of strong south-westerly winds (Sparling 1967). Glenamoy data show highest content when two winterperiods are included and lowest when only summer data are taken into account. The dry and hot summer of 1975, during which we collected our data, probably results in our data being relatively low, when taken into account the short distance to the sea (1,7 km) compared for instance with Glenamoy (8 and 15 km).

Additional conclusions about seaborne character of the calcium and magnesium in our "rain catchers" can be drawn from the Ca/Cl-ratio's in table 1 and 2. Compared with seawater (Ca/Cl= 0,13) all these ratio's are higher, with the exception of one (S12, period 5). This suggests an additional source for calcium + magnesium apart from the sea, when chloride is considered as completely sea-borne (see above). This other source is supposed to be dust (Gorham 1958, Sparling 1967). Both authors give percentages fot the inferred origin of the calcium and magnesium (Sparling 1967 - calcium: 35% derived from the sea; Gorham 1958 - magnesium: 67% derived from the sea). Assuming that the amount of magnesium close to the coast is approximatily twice the amount of calcium, expressed in mg/l (see table 3), the combined percentage "derived from the sea" for calcium + magnesium is about 55 - 60%.

Assuming all this is true one should expect an increase of dust-derived calcium + magnesium, when going inland and/or with easterly winds. This should then result in an increase in Ca/Cl ratio, because the former ions will decline less rapidly than the completely sea-borne chloride. When inspecting our data this can indeed be observed. Highest values for the Ca/Cl ratio are found in period 1 (table 2), with very little rainfall and predominantly easterly winds. Second highest is period 4, again with little precipitation and frequent southerly winds. The ratio closest to seawater is found in period 6, which had south-westerly gales and high precipitation. Another effect of such gales is to reduce the standard deviation, that is the composition of air borne ions becomes more homogeneous, pointing in the direction of a common source, namely seawater.

When going more inland not only does the absolute amount of ions decrease rapidly (see fig. 7,8 and 9; supporting the evidence in table 2) but also the Ca^{++}/Cl^{-} ratio increases as expected, mainly in transect 1, the longest transect. One should however discount the results from "rain catcher" S3, which has higher values, very likely due to contamination (see previous chapter 5.2.2.).

Furthermore, as is shown in table 3, the values of the Ca^{++}/Cl^{-} ratios in Glenamoy are lowest when measured over 2 winter-periods and 1 summer, and highest when measured over 1 summer-period only, when winds are relatively weak. The mean Ca/Cl ratio in our own rain data in table 3 is comparatively low, due to one "outlier" in our observations (see table 4).

The last remarkable point in our Ca/Cl values is the fact, that differences between the transects are virtually absent. This means that the calcareous beaches do not seem to contribute to the Ca^{++} + Mg^{++} measured in our "rain catchers". This probably is due to the fact that calcareous beach materials, when blown into our "rain catchers" (as observed, see 5.2.1.), do not dissolve rapidly and are therefore not measured. Those materials will then have a long term effect, in contrast to the short term supply by seaspray, dissolving slowly and thereby supplying Ca ions from a "store".

The absolute amounts of ions measured (see table 2), give some indirect support to the idea of a common origin of the Ca^{++} + Mg^{++} and Cl^{-} from the sea, because they show ~~an~~ identical behaviour when graphed (see fig. 6,7 and 8). The most striking point, when comparing the amounts in our "rain catchers" with the amounts in rain water, is the fact that the "rain catcher" values are all about ten times as high as the rain-water data (see table 2 and 3). This could be caused by evaporation, concentrating the actual amounts and/or by the enlargement of the trapping surface by the pipe in our device.
The enlargement is 30 cm^2 (10 cm of pipe emerging from pot x 3 cm diameter) at its maximum. In order to get an estimation of these effects, we compared "rain catcher" S16, which was firmly attached on top of a wall and therefore could not have lost water by shaking, with the data from our weather station (3.2.) placed next to S16.

We calculated the expected amount of water in "rain catcher" S16 from cm precipitation x surface S16 ($50cm^2$) and expressed the amount of ions measured in S16 per liter expected rainwater (see table 4). The effect of the pipe was not taken into account in this method.

TABLE 4: Comparison of the amounts of calcium + magnesium and chloride expressed as mg/l, in raincatcher Sr and in rainwater.

period	cm precipitation	content Sr (ml)	expected content	mg Ca+Mg/l in Sr	mg Ca+Mg/l in rainwater	mg Cl/l in Sr	mg Cl/L in rainwater	Ca/Cl in rainwater
1	0,2	0	10	7,4	nm *	18,0	nm	nm
2	6,7	165	335	8,8	1,24	49,82	5,37	0,246
3	3,6	225	180	17,9	nm	111,57	nm	nm
4	1,3	97	65	10,7	1,77	67,89	5,99	0,296
5	4,2	191	210	15,5	2,40	99,96	22,81	0,105
6	5,8	349	290	34,5	2,92	261,98	21,68	0,135

*. nm = not measured

Table 4 shows that sometimes evaporation is higher (periods 1,2 and 5) than the extra amount of water caught by the emerging pipe. In the periods 3,4 and 6 it is the other way around. It is clear that correcting for evaporation does not bring the values of rainwater and the "rain catchers" on the same level. Even when taking 30 cm^2 additional surface area, there still will remain a discrepancy of the order of 5 times more caught by "rain catchers". The difference to our opinion is due to blown in salt and dust-particles, caught on the pipe and subsequently washed down into the "rain catchers".

Summarising one can conclude that:

- the sea is the main source of airborne Ca^{++} + Mg^{++} and Cl^-, found in our "rain catchers".
- for Ca+Mg another source does exist, probably dust, that becomes more important further inland and/or when winds are blowing from the East.
- this other source is likely to be more important for calcium than for magnesium, but our methods did not discriminate between the two.
- calcareous beaches do not seem to have any influence on the airborne Ca^{++} + Mg^{++}.
- the ionic content of rainwater alone, greatly underestimates the actual amounts blown-in onto the vegetation, taking into account the vertical structure of the vegetation.

5.3. Communities

5.3.1. Introduction

As already mentioned in 3.1, we selected certain types of communities for description. Because of our technique of analysis, where we chose a representative sample of each recognized vegetation type within each locality (see 3.7.1.), abundant vegetation types are represented with a greater number of relevés than are less abundant types. This has the advantage that our tables represent more or less the real contribution of each type to the overall vegetation investigated in the area.
The disadvantage however is that partial tables, necessary because of the large amount of relevés, do not represent equal syntaxonomic levels.

Sometimes they give only one association, or one alliance, notably within the widely represented classes Littorelletea and Parvocaricetea; at other times they represent a total class of vegetation like Potametea or Molinio-Arrhenateretea. The exception to this rule are the classes Scheuchzerietea and Oxycocco-Sphagnetea.
These were sampled differently (3.7.1), so that the most abundant communities of Western Connemara are only represented by a relatively small number of relevés.

Furthermore finer subdivisions are possible (and have indeed been made) in well represented associations, whereas the division remains crude and sometimes unsatisfactory in an ill-represented class, like for instance the Molinio-Arrhenatheretea. These discrepancies simply reflect the restricted area of investigation and our choice of vegetation to be investigated. The synoptic table partly restores the overview, lost by the construction of partial tables at a low syntaxonomical level. It shows the coherence between the tables and the major discontinuities on which our partial tables were based. The synoptic table is constructed out of our partial tables by summarising approximately 10 relevés into one column. When changes are rapid within a partial table, less relevés are united (e.g. Scheuchzerietea, Phragmitetea, Potametea in table 7). Sometimes in well represented associations, larger numbers of relevés are taken together (e.g. Parvocaricetea, Isoeto-Lobelietum in the same table). It is a compromise based on practical considerations of summarising as much as possible at the cost of as little loss of detail as possible. It still shows, to a certain but smaller extent, the distortion in the data mentioned above.

Apart from placing relevés into units according to the classification techniques described in 3.8., we also placed the species into syntaxonomical groups, derived from the literature. This provided us with a syntaxonomical framework within which to place the recognized units. Moreover this enables us to place within such groupings new species, without any previously published syntaxonomical value, or with a value at variance with those that are found to "behave" in a similar manner in our area. To facilitate the presentation of our results, we give this syntaxonomical framework in a separate section (5.3.2.) before discussing the position of units and species in more detail later on, together with synecological information.

Throughout the following text, each unit will be characterised by a letter-number combination. The letters A-O indicate the partial table, to which the unit belongs; the number refers to one of the possible finest divisions in such a table. The same combination will also be used in the vegetation maps of the lakes we investigated (see also 3.7.1.).

5.3.2. Syntaxonomical framework and abbreviations

In this section we present the syntaxonomical framework as we used it. We also present the species that are typical for each level and the source of literature from which they are derived. When there is not such a source, or if we think the species has a different behaviour from the one cited in other works, we used the term "local" and a fuller description will follow in the appropriate section of 5.3.3. (description in detail of vegetation units). The term "transgressive" is used, when a species has a function on a certain level, as well as on a lower level. The term "differential" is used only for species discriminating two or more classes with regard to all other classes. The divisions in the framework are presented in a hierarchical manner down to the level of the units in the synoptic table for reasons of conciseness. Due to the nature of our data, this can be any syntaxonomical level, ranging from order to subassociation. Finer divisions and species characteristic for these finer divisions, will be discussed when describing the units in particular (5.3.3.). When necessary, discussion of syntaxonomy will be given in that section as well. Units of uncertain position in the framework, as our "noda" and "communities" are given separately at the end; their position will be discussed more fully in the appropriate sections of 5.3.3. as well as in the discussion of the synoptic table (5.3.4).

Because part of our syntaxonomical framework is based on data obtained from Westhoff (unplublished), these data, a synoptic table of wetland vegetation compiled from literature will be published in this thesis as an appendix (table 10). This table does not necessarily represent the current opinion of the authors, but overview tables of this kind are relatively rare in syntaxonomical literature. Such information, in our opinion, could provide the basis for a more fruitful discussion about syntaxonomy and therefore, with the kind permission of the author, is included in this thesis.

After the syntaxonomical framework follows a list of abbreviations, used in our tables. These abbreviations indicate the function of a species in a species grouping, when differing from the heading of such a group. For example: all species under the heading "Parvocaricetea" are character species of the class, unless abbreviations indicate otherwise. Moreover these prefixes are only added to the relevant species groupings, that is those groups of species that form a substantial part of the vegetation under consideration. In general: the more uncertain the syntaxonomical position of a set of relevés in a table, the more detailed are these indications in order to facilitate the placing of such units into the system.

The syntaxonomical framework, ordered by class, follows hereafter, including the characteristic species combinations of the noda.

Class POTAMETEA	Tüxen et Preising 1942 em.auct.div.
character species:	
Potamogeton natans (transgr.)	according to Westhoff & den Held 1969.
Potamogeton pectinatus	" " " " " " "
Potamogeton obtusifolius (transgr.)	" " " " " " "
Myriophyllum spicatum (transgr.)	" " " " " " "
Order Magnopotametalia	Den Hartog et Segal 1964.
character species:	
Potamogeton perfoliatus	according to Westhoff & den Held 1969.
Alliance Nymphaeion	Oberdorfer 1975 em. Neuhäusl 1959.
character species:	
Nymphaea alba (transgr.)	according to Westhoff & den Held 1969.
Nuphar lutea (transgr.)	" " " " " " "
Potamogeton natans	" " " " " " "
Sociation of Polygonum amphibium (A5)	
Association Potameto-Nupharetum (A6-A8)	Müller et Görs 1960 em. Segal 1965.
Association Spargano-Nymphaeetum (A9-A10)	
Order Luronio-Potametalia	Den Hartog et Segal 1964.
Alliance Potamion graminei	(Den Hartog et Segal 1964) Westhoff & den Held 1969.
character species of order and alliance:	
Potamogeton gramineus (transgr.)	according to Westhoff & den Held 1969.
Myriophyllum alterniflorum (transgr.)	" " " " " " "
Association Potametum graminei (A1-A4)	(W. Koch 1926) Passarge 1964

<u>Class PHRAGMITETEA</u>	Tüxen et Preising 1942, revised by Segal, Westhoff et den Held 1969.
character species:	
Phragmites australis	according to Westhoff & den Held 1969.
Rumex hydrolapathum	" " " " " " "
Lycopus europaeus	" " " " " " "
Berula erecta	" " " " " " "
Equisetum fluviatile	" " " " " " "
Sparganium erectum	" " " " " " "
<u>Order Nasturtio-Glycerietalia</u>	Pignatti 1953 em. Segal 1969.
Veronica beccabunga	according to Westhoff & den Held 1969.
Apium nodiflorum	" " " " " " "
Hippuris vulgaris	" " " " " " "
Rorippa nasturtium-aquaticum	" " " " " " "
Drepanocladus aduncus (local)	
<u>Order Phragmitetalia</u>	Koch 1926 em. Pignatti 1953 denuo em. Segal et Westhoff 1969.
character species:	
Typha latifolia	according to Westhoff & den Held 1969.
Schoenoplectus lacustris	" " " " " " "
Ranunculus lingua	" " " " " " "
Schoenoplectus tabernaemontani	" " " " " " "
Scirpus maritimus	" " " " " " "
Eleocharis palustris	" " " " " " "
<u>Order Magnocaricetalia</u>	Pignatti 1953.
character species:	
Cladium mariscus	

<u>Class LITTORELLETEA</u> Braun-Blanquet et Tüxen 1943.

Character species:

Juncus bulbosus according to Schoof-van Pelt 1973.

<u>Order Littorelletalia</u> Koch 1926.

character species:

Littorella uniflora	according to Schoof-van Pelt 1973.
Elatine hexandra	" " " " "

<u>Alliance Lobelio-Isoëtion</u> Pietsch 1965.

<u>Association Isoëto-Lobelietum</u> (Koch 1926) Tüxen 1937.

character species of All. and Ass.

Lobelia dortmanna	according to Schoof-van Pelt 1973
Isoëtes setacea	" " " " "
Subularia aquatica	" " " " "
Eriocaulon septangulare	" " " " "

<u>Subassociations</u>:- of Eleocharis palustris (D1)
- of Cladium mariscus (D2-D4)
- of inops (D5-D7) Schoof-van Pelt 1973
- of Myriophyllum alterniflorum (D8-D10)

<u>Alliance Eleocharition acicularis</u> Pietsch 1965.

character species:

Baldellia ranunculoides	according to Schoof-van Pelt 1973.
Apium inundatum	" " " " "

<u>Association Eleocharetum multicaulis</u> Allorge '22 em. Tüxen 1937.

character species:

Eleocharis multicaulis	according to Schoof-van Pelt 1973.
Eleogiton fluitans	" " " " "
Hypericum elodes	" " " " "
Deschampsia setacea	" " " " "
Potamogeton polygonifolius	" " " " "

<u>Subassociation potametosum polygonifolii</u> Schoof-van Pelt 1973.

Variant with Eleogiton fluitans   Schoof-van Pelt 1973.

Subvariant "typical"   Schoof-van Pelt 1973.

- without Eleocharis multicaulis (F1-F2)
- with Parvocaricetea species (F3-F4)
- like the type (F5)

Variant typical   Schoof-van Pelt 1973.

Subvariant
- typical (F6)
- Carex lasiocarpa (F7)

Association Samolo-Littorelletum   Westhoff 1943 (E1-E3)

Class PARVOCARICETEA (Westhoff 1961 mscr.) Westhoff & den Held 1969.

character species:

Potentilla palustris	according to Westhoff & den Held 1969.
Carex diandra (transgr.)	" " " " " " "
Epilobium palustre (transgr.)	" " " " " " "
Pedicularis palustris	" " " " " " "
Bryum pseudotriquetrum (local)	
Carex panicea	" " Braun-Blanquet & Tüxen 1943.
Triglochin palustris	" " " " " " "
Riccardia pinguis	" " Westhoff & den Held 1969.

Order Caricetalia nigrae Koch 1926 em.Nordhagen 1936 denuo em. Tüxen 1937.

Alliance Caricion curto-nigrae Koch 1926 em. Nordhagen 1936.

character species of order and alliance:

Calliergon giganteum (local)	
Juncus articulatus	according to Braun-Blanquet & Tüxen 1943.
Carex demissa (transgr.) (local)	
Carex nigra (transgr.)	according to Westhoff & den Held 1969.
Carex echinata (transgr.)	" " " " " " "
Pellia epiphylla (local)	

Association Carex nigra-Juncus articulatus (J1-J3) Braun-Blanquet & Tüxen 1952.

Association Anagallido-Caricetum diandrae (J4-J7).

Subassociation typicum (J4-J5).

Subassociation of Sphagnum contortum (J6-J7).

Transition from Phragmitetea to Parvocaricetea (G1-G3)

Sociation of Carex rostrata (H1-H2).

Transition from Molinio-Arrhenatheretea to Parvocaricetea (I).

Order Tofieldietalia Preising apud Oberdorfer 1949.

Alliance Caricion davallianae Klika 1934

character species of order and alliance:

Eriophorum gracile (local)

Utricularia minor (local)
Juncus subnodulosus (local)
Utricularia intermedia (local)
Schoenus nigricans (local)

Carex dioica	according to Wheeler 1975.
Carex lasiocarpa	" " Braun-Blanquet & Tüxen 1943.
Sagina nodosa	" " Westhoff & den Held 1969.
Campylium elodes	" " " " " " "
Campylium stellatum	" " " " " " "
Scorpidium scorpioides	" " " " " " "
Riccardia multifida	" " " " " " "
Carex lepidocarpa (transgr.)	" " " " " " "
Epipactis palustris	" " " " " " "
Eleocharis quinqueflora	" " " " " " "
Eriophorum latifolium	" " " " " " "
Pinguicula vulgaris	" " " " " " "
Carex pulicaris	" " " " " " "

Association Scorpidio-Caricetum lepidocarpae

character species:

Carex elata (local)
Philonotis calcarea (local)
Cratoneuron filicinum (local)
Subassociation typicum (K1+K2).
Subassociation inops (K3).
Transition to Molina caerulea - Myrica gale nodum (K4).
Transition to Eleocharetum multicaulis (K5).
Transition to Caricion curto-nigrae (K6).

Class SCHEUCHZERIETEA Den Held, Barkman et Westhoff 1969.

Order Scheuchzerietalia palustris Nordhagen 1936.

Alliance Rhynchosporion albae Koch 1926.

character species of class, order and alliance:

Rhynchospora alba (transgr.)	according to Westhoff & den Held 1969.
Sphagnum cuspidatum (transgr.)	" " " " " " "
Cladopodiella fluitans	" " " " " " "
Drosera anglica (transgr.)	according to unpubl. table Westhoff.
Drosera intermedia (transgr.)	" " " " "
Sphagnum auriculatum (transgr.)	" " " " "
Sphagnum palustre	" " " " "

Association Drosero-Schoenetum nigricantis (N2-N3) Braun-Blanquet & Tüxen 1952.

Association of Eriophorum angustifolium and Sphagnum cuspidatum (N1) Birks 1973.

Class OXYCOCCO-SPHAGNETEA Braun-Blanquet et Tüxen 1943.

character species

Sphagnum rubellum (transgr.)	according to Westhoff & den Held 1969.
Narthecium ossifragum	" " " " " " "
Drosera rotundifolia	" " " " " " "
Odontoschisma sphagni	" " " " " " "
Telaranea setacea	" " " " " " "
Sphagnum fimbriatum	" " " " " " "
Trichophorum caespitosum (transgr.)	" " " " " " "
Eriophorum vaginatum (transgr.)	" " " " " " "
Aulacomnium palustre	" " " " " " "
Cephalozia connivens	" " " " " " "
Calypogeia sphagnicola (trangr.)	according to unpubl. table Westhoff.
Sphagnum magellanicum	" " " " " " "
Myrica gale (local)	" " " " " " "
Campylopus flexuosus (local)	" " " " " " "

<u>Order Ericetalia tetralicis</u> Moore 1968.

character species:

Erica tetralix	according to Westhoff & den Held 1969.
Zygogonium ericetorum	accoring to unpublished table Westhoff.
Schoenus nigricans	" " " " "
Campylopus atrovirens	" " " " "
Pleurozia purpurea	" " " " "

<u>Alliance Ericion tetralicis</u> Schwick 1933.

character species:

Cladonia uncialis (local)	
Cladonia impexa (local)	
Erica tetralix	according to Westhoff & den Held 1969.
Zygogonium ericetorum	" " " " " " "

<u>Association of Pleurozia purpurea and Erica tetralix</u> (01). Braun-Blanquet & Tüxen 1952.

<u>Order Sphagnetalia magellanici</u> Moore 1968.

character species:

Sphagnum magellanicum	according to Westhoff & den Held 1969.
Sphagnum rubellum	" " " " " " "
Eriophorum vaginatum	" " " " " " "
Calypogeia sphagnicola	" " " " " " "

<u>Alliance Erico-Sphagnion</u> Moore 1968.

character species:

Erica tetralix (local)	
Sphagnum papillosum	according to Westhoff & den Held 1969.

<u>Association of Leucobryum glaucum and Eriophorum vaginatum</u> (02).

Carex panicea-Carex demissa nodum.
char.cteristic species combination:
Juncus bulbosus
Eleocharis multicaulis
Potamogeton polygonifolius
Carex panicea
Carex demissa
Campylium stellatum
Community of Scorpidium scorpioides (E4).
Community of Molinia caerulea and Carex echinata (E5+E6).

Molinia caerulea-Myrica gale nodum.
characteristic species combination:
Myrica gale (dominant)
Molinia caerulea (dominant)
Eriophorum angustifolium
Carex echinata
Community of Carex limosa and Potentilla palustre (M1).
Community of Eleocharis multicaulis and Carex panicea (M2+M3).
Community with dominance of Myrica gale and Schoenus nigricans (M4).

Schoenus nigricans-Scorpidium scorpioides nodum.
characteristic species combination:
Schoenus nigricans (dominant)
Scorpidium scorpioides (dominant)
Molinia caerulea
Eriophorum angustifolium
Potamogeton polygonifolius
Juncus bulbosus
Community of Carex dioica and Potentilla erecta (L1).
Community with dominance of Scorpidium scorpioides (L2).
Transition to Carex panicea - Carex demissa nodum (L3).
Community of Drosera intermedia and Narthecium ossifragum (L4).

The abbreviations used in our tables, consist at most of three parts. The first part indicates if there is something special about a characteristic species. Possibilities are (see also the introduction of this section): l= local; t= transgressive; d= differential: d_1= Oxycocco-Sphagnetea + Scheuchzerietea, d_2= d_1 + character taxon of Tofieldietalia, d_3= Parvocaricetea + Scheuchzerietea; lt= local transgressive and ж = character taxon of undefined status, usually restricted to a certain unit, but too little data are available to place them more precisely.

The second part indicates the syntaxonomical level of a character species. Letters used are: C= class; O= order; A= alliance; a= association; s= sociation, this is a unit defined by the dominant species in one of the vegetation layers, and sa= subassociation.

The third part gives in abbreviated form the name of the syntaxonomic level as presented in the framework. A list of the second and third parts of the abbreviations used are given below, ordered by class:

Potametea

CCh= class Charetea, for convenience they have been put with the class Potametea

CR = class Ruppietea, same remark

CL = class Lemnetea, " "

OLP= order Luronio-Potametalia

AN = alliance Nymphaeion

aPN= association Potameto-Nupharetum

aPg= association Potametum graminei

aSN= association Sparganio-Nymphaeëtum

sPa= sociation of Polygonum amphibium

Phragmitetea

OP = order Phragmitetalia

ONG= order Nasturtio-Glycerietalia

OM = order Magnocaricetalia

Littorelletea

OL = order Littorelletalia

AEa= alliance Eleocharition acicularis

aSL= association Samolo-Littorelletum

aIL= association Isoëto-Lobelietum

aEm= association Eleocharetum multicaulis

Parvocaricetea

OCn= order Caricetalia nigrae

OTo= order Tofieldietalia

aSC= association Scorpidio-Caricetum lepidocarpae

aAC= association Anagallido-Caricetum diandrae

sCr= sociation of Carex rostrata

Scheuchzerietea

aDS= association Drosero -Schoenetum nigricantis

aES= association of Eriophorum angustifolium and Sphagnum cuspidatum

Oxycocco-Sphagnetea

CVP= class Vaccinio-Piceëtea, same remark as above

AEt= alliance Ericion tetralicis

aPE= association of Pleurozia purpurea and Erica tetralix

Molinio-Arrhenathereta

This class is represented with few relevés only, so no further division is made.

5.3.3. Description of the vegetation

5.3.3.A. Potametea

The available relevé data are rather limited, due to the sampling method and do not pretend to give full details of the class Potametea in the survey area.

The syntaxonomical division of the class is done with the help of Westhoff & den Held (1969),(see 5.3.2.). In this way, the relevés could be classified into two alliances namely, the Potamion graminei (Den Hartog et Segal, 1964) Westhoff et den Held 1969 (A1-A4) and the Nymphaeion Oberdorfer 1957 em. Neuhäusl 1959 (A5-A10).

On the basis of our data it is not clear if the maintenance of the order Luronio-Potametalia Den Hartog et Segal 1964, is justified. The only "faithfull" taxa we find are Potamogeton gramineus and Myriophyllum alterniflorum, which both are transgressive species and also occur in other vegetation units. Furthermore, character-species of other syntaxonomical units are well represented. For instance, Potamogeton berchtoldii, Utricularia vulgaris(weak) and Najas flexilis(weak), all character-species of, or within the Parvopotametalia and Ruppia maritima, character-species of the class Ruppietea.
According to the classification of the Potametea by Oberdorfer (1977), only one order, Potamogetonetalia Koch'26, is left. The association of Potamogeton gramineus (Potamogetonetum panormitanograminei Koch'26 em. Görs'77), is placed in the alliance Potamogetonion Koch'26 em. Oberdorfer '57, which contains all communities of submerged rooted water-plants. The Nymphaeion Oberdorfer'57, still exists as a separate alliance.

Being Hydrophytes, the following three taxa are conveniently placed under the heading Potametea: Ruppia maritima, Characeae and Lemna minor (see list of abbreviations in 5.3.2).

Potametum graminei (W. Koch 1926) Passarge 1964. A1-A4.

Potamogeton gramineus is a preferential character-taxon and Fontinalis antipyretica is a local character-taxon of the association. (Bennema & Westhoff, 1943 and Tüxen & Braun-Blanquet, 1952, take Fontinalis antipyretica as a character-taxon of the order Potametalia Koch'26 and alliance Potamion eurosibericum Koch '26).

Myriophyllum alterniflorum is a transgredient character-taxon of the alliance, but is typical in this combination. Characeae often have a great share in the underwater layer.

The association described does not completely correspond with the association mentioned by Bennema & Westhoff (1943), Passarge (1964), Den Hartog & Segal (1964) and Westhoff & den Held (1969). Our data have a greater number of species and do not contain Sparganium minimum or Potamogeton polygonifolius.

The community is built up mainly by submerged taxa of Elodeids and small Nymphaeids, in the rather shallow water of lakes in the coastal zone, in which wind and wave action have free scope. The soil consists of organic mud, the water is alkaline with a pH varying from 7,7-8,4.

The alliance forms a transition to the class Littorelletea and often can be seen together with associations of this class, in a zonation, in which these latter associations periodically may become dry (Westhoff & den Held 1969).

The association can be divided into two subassociations:

- subassociation of Myriophyllum spicatum, with the differentiating species Myriophyllum spicatum and Phragmites australis.
  variant A1: with Littorella uniflora
  variant A2: with Potamogeton berchtoldii
- subassociation "inops"
  variant A3: with Ruppia maritima
  variant A4: with Schoenoplectus tabernaemontani

The first variant is confined to one lake at the beginning of transect III. It is relatively "nutrient poor" and shows a clear transition to the subassociation myriophylletosum alterniflori of the Isoëto-Lobelietum. The second "nutrient rich" variant is confined to a lake on the peninsula.

The subassociation "inops", we found in lakes surrounded by calcareous dunesands. Ca^{++}+ Mg^{++} values are high. Relevé number 120 also shows a very high Cl^- value (2153 mg/l). The stand, which is very close to the sea, is probably still under direct influence of the sea.

Nymphaeion Oberdorfer 1957 em. Neuhäusl 1959. A5-A10.

The alliance contains communities of large Nymphaeids in rather deep water (mean 90cm) of lakes sheltered from wind and wave action. Usually these communities are foregoing communities of the Phragmitetea.

The relevés are classified into the following phytosociological units:

Sociation of Polygonum amphibium.
A5.

Polygonum amphibium is a character-taxon of the alliance Nymphaeion according to Westhoff & den Held (1969). We consider it a local character-taxon of the sociation, because of the high abundance and cover percentage in this vegetation unit.
Potamogeton obtusifolius is a differentiating taxon of the sociation within the class.

Synecologically, the sociation can be characterised as growing in shallow, alkaline water at the south shore of a lake bordered on calcareous sanddunes (Aillebrack North). The vegetation consists of rhizophytes (waterplants rooted in the bottom); the underwater layer is composed of Characeae. The mean values of Ca^{++}+ Mg^{++} and Cl^{-} are respectivily 100mg/l and 83mg/l.

Association Potameto-Nupharetum Müller et Görs 1960 em. Segal 1965.
A6,A7,A8.

Character-species of the association are Nuphar lutea and Nymphaea alba.

Within this association three local variants can be distinguished:
- variant A6: with Nuphar lutea and Schoenoplectus lacustris
- variant A7: "typical"
- variant A8: with Nymphaea alba.

The Potameto-Nupharetum occurs mixed with elements of the Phragmitetalia and is often followed up in the zonation by stands of polycorms (of Cladium mariscus, Phragmites australis, Typha latifolia, Scirpus maritimus). The soil consists of organic material and varies in depth. The water is alkaline (pH 7,3-9,0), with a depth varying from 20-250cm.

Ca^{++}+ Mg^{++} and Cl^{-} values are relatively high. Respectively 86-197mg/l and 63-83mg/l. All relevés in this association are coming from lakes in the coastal region of the peninsula (transect II).

Association Sparganio-Nymphaeetum prov. A9-A10

The characteristic species combination is: Sparganium minimum, Juncus bulbosus, Potamogeton natans and Nymphaea alba. Sparganium minimum and Juncus bulbosus occur constantly, together with high abundance and cover percentage of Potamogeton natans and Nymphaea alba.

The community described at this place has no resemblance with the Sparganietum minimi Schaaf 1925, which by many authors has been placed in several alliances of the class Littorelletea. Müller & Görs (1960) report all kind of transitions between the Sparganietum minimi Schaaf '25 and the Nymphaeion Oberdorfer '57 em. Neuhäusl '59. Some phytosociologists think Sparganium minimum as more characteristic for the Potametea than for the Littorelletea. They consider Sparganium minimum as a character-species of the Potameto panormitano-graminei (Koch, 1926; the community of Sparganium minimum and Scirpus fluitans, described by Meyer & de Wit, 1955), or describe communities of Sparganium minimum in the Potamion graminei (Sparganietum minimi by Den Hartog & Segal, 1964; community of Sparganium minimum by Westhoff & den Held, 1969).
Schoof-van Pelt (1973) considers the community of Sparganium minimum, as classified by Westhoff & den Held (1969), as an impoverished representative of the Sparganietum minimi Schaaf '25, which should be classified into the Littorelletea.

Our relevé data are about similar to the Potamogeton natans variant rendered by Schoof-van Pelt. However, because of the position of Sparganium minimum in the vegetation of the investigated area, the absence of character-species of the Potamion graminei and because of the constant presence of Potamogeton natans and Nymphaea alba, we think it best to put "our" community into the Nymphaeion, as an association that reproduces a transition of this alliance to the Littorelletea. We consider Sparganium minimum as a character-species of the association.

The following subunits can be distinguished:

- variant A 9: with Utricularia intermedia
- variant A10: with Eleogiton fluitans.

The vegetation is found in lakes at the beginning of transect 1, except relevé number 222, which is coming from Lough Antony (transect II). The water is about 80 cm deep, with a pH of 6,8-7,4; the soil consists of organic material. Ca^{++}+ Mg^{++} and Cl^{-} values are relatively low, respectively 23-52mg/l and 55-83mg/l. The community is usually foregoing stands of polycorms.

5.3.3.B. Polycorms

In this table are brought together all those stands, characterised by high dominances of polycorm forming species, usually a dominance of one single species, with very little other species. This characteristic poorness of species makes it very difficult to classify these relevés and this is the main reason why they are united in this table. They form the impoverished remains of more "typical", that is "easier to classify" vegetation types of the classes Phragmitetea and Parvocaricetea, to which these species belong. Very typically they are found to penetrate deepest into the open water, obtaining dominance under these difficult conditions and lacking competition from other non-aquatic species. Not surprisingly, the only species found frequently together with the polycorms, under these wet conditions, are species mainly from the Potametea and Littorelletea, but it is obvious, that the stands considered here do not belong to those two classes.

By penetrating deepest, these stands also are pioneers of the proces of "Verlandung". It is mainly for this reason that the stands dominated by Carex rostrata(table H) are treated elsewhere (5.3.3.H) (they do not form a pioneer community), apart from the fact that more other species are able to penetrate in these communities. Another characteristic of these polycorms is, that they hardly penetrate into each other, forming a course pattern with sharp boundaries, related to a highly dynamic environment, according to the theories of Van Leeuwen (1966).

The polycorms are found as the first belt of non-aquatic plants in the zonation pattern, following mostly communities of the Potametea (A) and sometimes the submerged communities of the Littorelletea (Isoeto-Lobelietum, table D). Behind the polycorms virtually all other types of communities are found (apart from pure blanket bog), depending on the nutrient status of the lake, shore characteristics, exposure to winds etc. (see also below).

The sociations of table B are all but one described by Westhoff & den Held (1969) (exception is the sociation of Menyanthes trifoliata as a pioneer community B1-B3). We used the same names, although the position of these communities higher up in the hierarchical system remains obscure, because of lack of species. In the field three more sociations were recognized and mapped, without relevés made in these communities: B11= sociation of Phragmites australis; B12= sociation of Eleocharis palustris; B13= sociation of Juncus subnodulosus. Their belonging to this table however is, even without relevés, sufficiently clear.

Synecologically, there exist some differences between the sociations although they all occur in open water. They have relatively high values for pH (see table 8 and 9), although vegetation has a strong acidifying influence, once firmly established (see also 5.3.4). The values for calcium+magnesium and chloride are also relatively high, indicating a general preference for more coastal habitats.

The polycorms built up by Menyanthes trifoliata (B1-B3) are usually found in an intermediate situation: not in very rich, sheltered coastal lakes like Silverhill and Aillebrack-N., nor in typical bog lakes but preferably in lakes like Namanawaun, Lettershask, Murvey etc. (see also 5.4). It is the common pioneer, replacing Phragmitetea pioneer-species under more nutrient poor conditions (but see below). It forms floating rafts, usually preceding communities from Carex panicea-Carex demissa nodum, Eleocharetum multicaulis and Caricion curto-nigrae.

Polycorms built up by Schoenoplectus lacustris (B4-B5) and Cladium mariscus (B9-B10) are found in a broad range of lake-types from coast till inland. This corresponds with their broad ecological amplitude in our area of investigation(see also 5.3.4). Polycorms of these two species are sometimes found under conditions even too poor for Menyanthes trifoliata. Their optimum however is in lakes close to the coast. Because of this wide range, all kinds of communities can follow behind these polycorms, from very rich (Caricion davallianae) to rather poor (Molinia caerulea-Myrica gale nodum). Typically, pH-values for these units are lower, with a broad standard deviation in the case of Cladium mariscus, due to the broad distribution of the considered vegetation types (see table 8).

Polycorms built up by Typha latifolia (B6), Scirpus maritimus (B7), and Equisetum fluviatile (B8) are restricted to coastal lakes and have high pH-values, although this is less true for polycorms of Equisetum fluviatile. They are followed by true Phragmitetea units (table C) or by sedge communities of all kind, never by stands from Eleocharetum multicaulis or or oligotrophic communities.

5.3.3.C. Phragmitetea

Communities with a great share of Pragmitetea species are placed into three tables, namely:

table B: "noda built up by polycorms"
table C: "Phragmitetea"
table G: "Transition from Phragmitetea to Parvocaricetea"

The syntaxonomical division up to the level of order is according to Westhoff & den Held (1969). Further classification presented difficulties, because of the large presence of other classes, especially Potametea and Parvocaricetea.

Character-species from syntaxonomical units lower than the order, are therefore placed into the tables without prefixes, under the name of the concerning order.

This table "Phragmitetea" comprises the complex communities of the class within the survey area. The described stands are restricted to the coastal lakes on the peninsula; they are situated behind the dune grass-lands, where regularly calcareous material is dispersed.

Community of Schoenoplectus tabernaemontani C1

The typical species combination is: Schoenoplectus tabernaemontani, Sparganium erectum, Berula erecta and Ranunculus lingua.

This Phragmition community is found in slightly alkaline water of 4-50 cm depth, together with some Potametea species. In the zonation it follows stands of polycorms of Equisetum fluviatile or Phragmites australis or it follows the subassociation inops (A3-A4) of the Potametum graminei. The community is often followed by Caricion curto-nigrae.

Sometimes calcareous dune sand was found under the 0.3-3.0 meter deep soil of organic material. Ca^{++} and Mg^{++} values are rather high (115-128 mg/l) and the Cl^{-} values vary between 66-93 mg/l.

Eleocharito-Hippuridetum Passarge 1955. C2

Hippurus vulgaris is a character-species of the association, while Eleocharis palustris functions as a differentiating species within the alliance (according to Westhoff & den Held, 1969). Calliergon giganteum and Juncus articulatus indicate the Parvocaricetea element. The association has been described for places with seepage features and other contact zones with fluctuating water levels and in general on stands disturbed by man or cattle (Westhoff & den Held, 1969).

The present relevés are from places with varying soil types, (COM,OMB,TOM) and soil depth (0.1-3.5m.), usually with calcareous material in the subsoil. The water is shallow and has an average pH of about 7.0, although Ca^{++} and Mg^{++} values are high (156-359mg/l). Chloride varies from 50-399 mg/l.

Community of Apium nodiflorum C3

This community is a local unit of the Apion nodiflori Segal (1969), with Apium nodiflorum as character-taxon. Rorippa nasturtium-aquaticum, which is called a character-taxon of the alliance as well, is also present in the Eleocharito-Hippuridetum.

Differentiating species within the order Nasturtio-Glycerietalia are Veronica beccabunga and Drepanocladus aduncus. The share of Parvocaricetea species, companions and elements of the Molinio-Arrhenatheretea and Agropyro-Rumicion crispi is rather large. Following on a zone of polycorms, this community can change into Caricion curto-nigrae or Molinio-Arrhenatheretea communities.

The soil is shallow and consists of organic material with calcareous dune sand in the subsoil. The pH of the soil water is neutral. Ca^{++} and Mg^{++} and Cl^{-} values are relatively high. The relevé data from Silverhill are collected near a ditch that runs to the sea; the PO_4^{---} data are very high on these places.

5.3.3.D. Isoëto-Lobelietum

The character-species of this association, according to Schoof-van Pelt (1973) are: Lobelia dortmanna, Isoëtes setacea, Subularia aquatica and Eriocaulon septangulare. Isoëtes species and Subularia aquatica are less frequent. The following units were recognized:

Subassociation of Eleocharis palustris D1

This subassociation is not mentioned by Schoof-van Pelt. Eleocharis palustris is a differentiating species with regard to the other units in the table. Companions like Ranunculus flammula, Hydrocotyle vulgaris, Agrostis stolonifera etc. show the Parvocaricetea element. This vegetation type forms a transition in the "Verlandung"-series and is found on organic substratum with the water at or just above ground level and a circumneutral pH(see table 6). The mean calcium+magnesium content is 29mg/l, the mean chloride content 56mg/l; both values are rather low.

Subassociation of Cladium mariscus D2-D4

Cladium mariscus is the only differentiating species of the sub-association. This vegetation type has not been described for Ireland, neither by Braun-Blanquet and Tüxen (1952), nor by Visser and Zoer (1972), nor by Schoof-van Pelt (1973), although its presence is very common in boglakes. The subassociation is characterised by a high cover-percentage of Eriocaulon septangulare in the under-water layer and Cladium mariscus in the helophytic layer. Littorella uniflora is lacking, probably because of the rather thick layer of sapropelium that has been deposited in the quiet bays or corners of the lakes.

The depth of the bottom varies from 5-200cm (table 8). The water is slightly acid to neutral (pH 5,2-7,1) with a depth of 20-75cm. Calcium + magnesium and chloride values are relatively low.

D3 is the typical variant, D2 is a variant with Eleocharis multi-caulis and Eleogiton fluitans, D4 is a variant with Nymphaea alba and Scorpidium scorpioides. The stands of this subassociation are often followed up in the zonation by other Littorelletea communities (Eleocharetum multicaulis) or by stands from the Molinia caerulea-Myrica gale nodum.

Subassociation inops D5-D7

The relevés represent a subassociation (according to Schoof-van Pelt, 1973) which is characterised by Lobelia dortmanna, Juncus bulbosus, Eriocaulon septangulare and Littorella uniflora.

Three variants are distinguished:

- Variant with Phragmites australis and Potamogeton natans (D5) that is found in rather deep water (20-100cm), on a sometimes deep organic soil. It often occurs as facies in other Littorelletea communities or as a zone with polycorms or Potametea communities. Littorella uniflora is lacking.
- Typical variant (D6), of which the first 3 relevés consist of very few species. With exception of Juncus bulbosus the relevés are comform to the "strongly impoverished variant" of Schoof-van Pelt (1973). The next 3 relevés have Littorella uniflora and Eleocharis multicaulis. The other relevés from this typical variant are like the "moderately impoverished variant" of Schoof-van Pelt (1973). Almost all data are derived from the bog lakes, from an usually stony soil with a thin layer of organic mud. The water is acid to circumneutral, with a depth varying from 10-60 cm.
- Variant with Isoetes setacea and Apium inundatum, (D7), is represented by 3 relevés. Floristically, the variant has not much resemblance with the subassociation of Isoetes setacea described for Ireland by Schoof-van Pelt (1973). In our communities Eriocaulon septangulare, Lobelia dortmanna and Littorella uniflora are well represented. Isoetes setacea only has low abundance values. The vegetation was found on organic soil with a depth of 5-70 cm. Communities with dominance of Isoetes setacea probably do occur in the Connemara lakes. This species however is growing in much deeper water than where we made our relevés; in the autumn we often found the lakeshores covered with Isoetes leaves.

Subassociation of Myriophyllum alterniflorum D8-D10

In this subassociation, Myriophyllum alterniflorum, Potamogeton gramineus and Characeae are differential taxa. The character-species of the class Potametea have a relatively great share in this vegetation. This is not conform the subassociation Myriophylletosum alterniflori as described by Schoof-van Pelt (1973), which is rather poor in species.

- a variant with Elatine hexandra and Subularia aquatica (D8) is formed by 3 relevés, in which also Isoetes setacea and Baldellia ranunculoides occur.
- a variant "typical" (D9) is represented by 4 relevés.
- a variant with Potamogeton perfoliatus and Potamogeton berchtoldii (D10), has the greatest Potametea share.

The relevés are made on places with shallow organic soils, (OMB); the water is alkaline (pH 8,0); $Ca^{++}$and $Mg^{++}$and Cl^{-} values are relatively high, especially those from Truska lake.

The subassociation forms a clear transition to the Potamion graminei and is present in those lakes where this Potamion graminei has well developed. This is very obvious in the coastal lakes of the third transect. Within a zonational pattern the community is often followed by a zone of the Samolo-Littorelletum. -

5.3.3.E. Samolo-Littorelletum and Carex panicea-Carex demissa nodum

Although this table is divided into two separate syntaxonomical units it will be clear from table E, that these two units merge into each other gradually, based upon their floristic composition.

The first part, the Samolo-Littorelletum, is characterised by Samolus valerandi and Littorella uniflora. The second differential species, apart from Samolus valerandi, namely Potamogeton gramineus, recognized by Schoof-van Pelt (1973), for Ireland, is lacking from the present data (for a full syntaxonomical discussion see Schoof-van Pelt, 1973).

Samolo-Littorelletum E1-E3

In this association two new subassociations can be recognized; a subassociation "typicum" (E1), and a subassociation "caricetosum" (E2+E3) with high presence of Carex panicea and Carex demissa; in the latter the contribution of species from the Parvocaricetea, especially the Caricetalia nigrae, is higher. Both Carex species (Carex serotina however instead of Carex demissa) are considered typical for the Irish form of the association (Schoof-van Pelt, 1973).

The Samolo-Littorelletum does occur on stony substratum along lakes, in the marginal zone; that is the zone on the shore that is temporarily inundated, temporarily dried out.

This zone is also called the "Beijerinck" zone (Beijerinck, 1934) and is characterised by a relatively low number of adapted species and a depressed biomass production due to the harsh unpredictable environment. Typically it is restricted to those coastal lakes with high pH, Ca^{++}+Mg^{++} and Cl^{-} values (see table 8), where wind and waves prevent the accumulation of organic matter and the processes of "Verlandung". Usually the shore is steep.

The subassociation of Carex panicea and Carex demissa penetrates deeper inland, but has the same characteristics. The vegetation is never closed and bryophytes are virtually absent. Because of its habitat, it forms small belts in zonation with communities from the Isoeto-Lobelietum lower down in the water. Higher up, grassland communities are formed that are left out of this survey.

Carex panicea-Carex demissa nodum E4-E6

The second part of table E is called Carex panicea-Carex demissa nodum and is characterised by these two low Carex species, Campylium stellatum and a high proportion of species from the Littorelletea, notably Eleocharis multicaulis, Potamogeton polygonifolius and Juncus bulbosus. It resembles the Carex panicea-Carex demissa nodum described by Poore (1955) for Breadalbane and the Carex panicea-Campylium stellatum nodum described by McVean and Ratcliffe (1962) for Scotland. The latter consider it a highly heterogeneous nodum still to be worked out.
We agree with their remark and suggest its main position within the Littorelletea, floristically between Samolo-Littorelletum and Eleocharetum multicaulis (see next section). There are however, also in this nodum, strong floristic connections with the Carex nigra-Juncus articulatus association (see table J1) and the Schoenus nigricans-Scorpidium scorpioides nodum (see table L1+L3) causing the confusion mentioned above.

Two communities are recognized, one with dominance of Scorpidium scorpioides, transitional between Samolo-Littorelletum and the present nodum, and a for this nodum more typical community with Molinia caerulea, Eriophorum angustifolium, Carex echinata, Carex nigra and Potamogeton polygonifolius optimal, the latter species showing the connections with Eleocharetum multicaulis.

The Carex panicea- Carex demissa nodum occurs on deeper soils of predominantly organic character;pH and ion content are both slightly lower (see table 8), but still on neutral or medium levels. The environment is less harsh (more soil, shallow water), vegetation cover is nearly closed and bryophytes are present in varying amounts. They are predominantly found in somewhat nutrient deficient lakes more inland, like Anaserd, Kankoge and Nalawney, but not in the poor bog lakes. Again zonation is obvious. It forms a belt between Isoeto-Lobelietum lower down and communities from the Molinia caerulea - Myrica gale nodum (table M) higher up. Those communities with which the nodum has the strongest floristic connections, are seldom found in zonation with the nodum. They do not occur together, they replace each other (see also 5.3.5).

5.3.3.F. Eleocharetum multicaulis F1-F7

Floristically, this association is very similar to the previously described nodum and is characterised by Eleocharis multicaulis, Potamogeton polygonifolius, Eleogiton fluitans and Hypericum elodes, although the first two species penetrate considerably into other communities (e.g. Parvocaricetea, Scheuchzerietea) in West-Ireland (see also 5.3.4). The name of the association is according to Schoof-van Pelt (1973). If compared with her relevés, our data show greater heterogeneity. They contain more species, especially more species from the class Parvocaricetea. This is understandable when taken into account, that our technique of analysis yields more "in between" stands, especially in such "in between" community as this one is.

There has been considerable confusion as to the names and syntaxonomical position for such communities as described in table F (see Braun-Blanquet & Tüxen, 1952, Visser & Zoer, 1972, Schoof-van Pelt, 1973); the latter author discusses these problems in depth). We have adopted the classification of Schoof-van Pelt, in order not to enlarge the already existing confusion. Some criticism is possible however, so that we will give a classification of our own below, which is meant to be tentative till more is known about the exact place of these difficult communities.

In the classification of Schoof-van Pelt, all our relevés belong to the subassociation potametosum polygonifolii of the Eleocharetum multicaulis, but they are in general as already mentioned, richer in species from the Parvocaricetea. The first five communities belong more or less to the typical subvariant of the variant with Eleogiton fluitans, which is best represented by F5. The other four, all show some deviation from the type, by having great amounts of Parvocaricetea species (Eriophorum gracile) as in F3+F4, or lacking Eleocharis multicaulis, one of the character-species of the association as is the case in F1+F2. The last two units F6+F7, belong to the other variant(typical) of this subassociation. The subvariant with Carex lasiocarpa(F7) has not been recorded for Ireland previously (see Schoof-van Pelt, 1973). Floristically, the association has affinities with the Carex nigra-Juncus articulatus association (J1-J3) and with the Scorpidio-Caricetum diandrae (K5). This latter connection is especially clear between F7 and K5.

It will be clear from the description given above, that there is considerable variability within the Eleocharetum multicaulis, a fact also acknowledged by Schoof-van Pelt. To our opinion it would perhaps be better, to accomodate this variability, to establish a new alliance, the "Eleocharition multicaulis", more or less identical with the "Helodo-Sparganion" (Tüxen, 1955, Braun-Blanquet & Tüxen, 1952) with an atlantic distribution, next to the already existing Lobelio-Isoëtion and Eleocharition acicularis p.p. (Schoof-van Pelt, 1973). As character-taxa we propose Eleocharis multicaulis and Potamogeton polygonifolius. This alliance then contains 3 associations that merge into each other gradually:
-the "Scirpetum fluitantis", with dominance of Eleogiton fluitans and a lesser presence of Eleocharis multicaulis;
-the "Eleocharetum multicaulis", with or without Eleogiton fluitans and only little Hypericum elodes; and
-the "Potameto-Hypericetum elodis", with dominance of Hypericum elodes.
In our table these correspond with F1+F2, F3+F4+F6+F7 and F5 respectively.

The problems of classifying such communities are comparable with the problems encountered in classifying sedge communities within the Parvocaricetea: usually the species present are the same but the dominances shift. In these cases, dominance based noda or associations with large "intermediate" communities seem appropriate to describe the many variations found in the field.

The ecology and distribution of the association shows again considerable overlap with the previously described nodum. Again these communities are found within the "Beijerink" zone of those lakes where some or sometimes considerable "Verlandung" has taken place, judging from the organic substratum of varying depth. It replaces the communities of the previous table in zonation patterns, but is seldom found together with these on the same spot, although they do occur together in the same lakes. Optimally, the association is found as a zone between Isoëto-Lobelietum and Molinia-Myrica nodum (c.f. previous table), in lakes that show some nutrient deficiency (F5 in Kankoge and Anaserd). It is also found in the same position in somewhat richer, rocky coastal lakes like Lettershask. It is however, also found in medium-rich lakes as Derreen and Antony, where extensive quaking mires occur.
Here the community is again found as a belt occupying the "Beijerinck" zone, between quaking mire and Molinia-Myrica communities higher up, but it also penetrates in low depressions within the quaking mire. In such cases it forms a mosaic with the Caricion davallianae (Derreen F7+K5, these two units are also very close floristically) or with Molinia-Myrica vegetation (Antony).

Ecologically there is little or no distinction between the subunits, as to their species richness, pH, ion contents, type/depth of soil etc.. The main differences are floristic. Where they penetrate into richer areas, bigger Cyperaceae (Eriophorum gracile, Carex lasiocarpa) and Juncaceae (Juncus subnodulosus) occur, together with higher values for Scorpidium scorpioïdes. Dominances of Eleogiton fluitans seem to be coast-bound, with some indication of disturbance by cattle (remark b). Impoverished remains of the association penetrate deeply into the blanket bog area, where they are found almost everywhere on wet, enriched places (see sections L-O).

5.3.3.G. Transition from Phragmitetea to Parvocaricetea G1-G3

In this table those relevés are placed, that could not easily be assigned to a certain class of vegetation. Instead of discarding these, we preferred to arrange them separately in a sequence from relevés with a preponderance of Phragmitetea species to relevés with a preponderance of Parvocaricetea species.

In fact the present relevés are one extreme of a "gradient", ranging from exact identity with a described type, via stands more or less belonging to a type, to a position exactly in between 2 or more types and therefore belonging to none of them. Such relevés simply illustrate the shortcomings of each system of classifying vegetations, as long as these do not have sharp boundaries and exclusiveness of species. As such, this table is illustrative and the relevés are therefore not rejected.

As one may expect, these communities are found where the water table is at or above groundlevel. The part with the largest Phragmition component (G1), grows in lakes closer to the coast, containing water with more Ca^{++}+Mg^{++} and Cl^{-}, than the other end of the gradient (G3). The former part is usually found in a rather indistinct zonation pattern, preceding Parvocaricetea communities from tables J en K. In the richer coastal lakes they follow communities built up by polycorms (table B); in poorer lakes they directly border the open water, replacing pure Phragmitetea stands (G3 in Antony). This transition also occurs in mosaic with Parvocaricetea communities on the wetter spots, that are too productive for Eleocharetum-like communities (G2 in mosaic with Caricion davallianae vegetation in Derreen, G3 in mosaic with Caricion curto-nigrae vegetation in Antony).

5.3.3.H. Sociation of Carex rostrata H1+H2

In this table we have brought together those relevés that are dominated by Carex rostrata. Westhoff & den Held (1969) are of the opinion that Carex rostrata has too broad an ecological amplitude to maintain the Caricetum rostratae (Rübel 1912). They consider it a differential taxon for Parvocaricetea + Scheuchzerietea, also occurring in the Magnocaricetalia of the class Phragmitetea. They think it best to describe Carex rostrata facies of already existing associations in the 3 classes mentioned above, whenever the species is abundant.

McVean and Ratcliffe (1962) recognized for Scotland a vegetation dominated by Carex rostrata in pure stands, as well as a vegetation dominated by the combination of Carex rostrata and Menyanthes trifoliata.

In both of them some other Parvocaticetea species are present. Furthermore they defined a rare Carex rostrata-brown moss mire, with Carex rostrata dominant and in the moss layer "brown" pleurocarp mosses like Campylium stellatum and Scorpidium scorpioides. So the species in Scotland has a considerably smaller amplitude, occurring predominantly in the Parvocaricetea, with affinities to the Caricetalia nigrae (the sociation), as well as to the Tofieldietalia (Carex rostrata-brown moss mire).

In our investigation, the species has this same smaller amplitude. It does occur locally in low quantities in enriched places in the bog (once in the Schoenus nigricans-Scorpidium scorpioides nodum, table L) and in communities transitional between Phragmitetea and Parvocaricetea (table G). Whenever else it is found, it reaches dominance with only few other species present, usually in low quantities. These other species however, indicate a position of the sociation within the Parvocaricetea. We therefore consider Carex rostrata as a local character-taxon of this sociation within the class. Further hierarchical placing is more difficult, but a slight preference for Caricetalia nigrae can be detected. Part of it, notably H1, may belong to the Tofieldietalia and is comparable with the Carex rostrata-brown moss mire of McVean and Ratcliffe.

The community itself is more or less coast-bound and does, as a rule, not occur in quantities in the inland blanket bog area. It is found preferably in thick quaking mires, that is lakes that show considerable "Verlandung", like Antony, Murvey and Derreen. It is absent however in the richest lakes like Silverhill and Dog's bay. It is forming smaller or bigger patches within other Parvocaricetea communities, but always on "the wet side"; that is in depressions or close to the open water, either bordering Potametea communities or following after communities built up by polycorms (table B). In this position it resembles very much Carex rostrata communities of the Magnocaricetalia, described by Westhoff & den Held lc., as a transition between Phragmition and the smaller sedge communities of the Parvocaricetea. In our area this position is occupied, under slightly nutrient-richer conditions by communities from table G (transition from Phragmitetea to Parvocaricetea), whereas under poorer conditions the Eleocharetum multicaulis element will prevail.

The chemical data (see table 8) do show the same tendencies; all values are somewhat intermediate. pH is more within the range of those from table J (Caricion curto-nigrae), than those of table K (Caricion davallianae). This is even true for H1, where a slight preference of Tofieldietalia species is noticeable.
Values for pH, Ca^{++}+Mg^{++} and Cl^{-} of H1 are all somewhat lower than in H2, where more Caricetalia nigrae species are found. This again confirms the slightly stronger connections with the latter order.

5.3.3.I. Transition from Molinio-Arrhenatheretea to Parvocaricetea

Due to the high number of species of the Molinio-Arrhenatheretea we had to consider this community as a transition one.

It is difficult to indicate to which alliance of the Molinio-Arrhenatheretea this community is closest related. It contains elements of both the Arrhenatherion elatioris (Trifolium repens, Rhinanthus minor and Anthoxanthum odoratum), the Filipendulion (Filipendula ulmaria and Hypericum tetrapterum), the Calthion palustris (Lychnis flos-cuculi) and the Junco-Molinion (Succisa pratentis and Carex hostiana). The communities may develop into communities of the alliance Junco-Molinion, a succession series that often has been recognized (Kuiper 1958). No Sphagnum stage is developing which may be caused by strong fluctuations of groundwater level and indeed the vegetation does not form a floating mat. The soil consists of humic earth or compact organic mud, so the vegetation is not able to 'follow' the water table. Another indication for fluctuation of the groundwater may be the presence of a few species from the alliance Agropyro-Rumicion crispi.

Especially in coastal lakes of the second transect (Bunowen peninsula) the communities are present, occupying the highest places on the lake shores. These communities are often connected with more typical communities of the Molinio-Arrhenatheretea but since this vegetation types were excluded from the investigation, it is not possible to make a detailed comparison.

5.3.3.J. Caricion curto-nigrae

Due to the number of relevés, made in stands belonging to the Parvocaricetea, five tables were necessary to make an adequate description. These tables are: These tables are: G (transition from Phragmitetea to Parvocaricetea), H (sociation of Carex rostrata) and I (transition from Molinio-Arrhenatheretea to Parvocaricetea), already described in the previous paragraphs and the following tables J and K, respectively the alliances Caricion curto-nigrae W. Koch 1926 em. Nordh. 1936 and Caricion davallianae Klika 1934. Especially these last two tables comprise typical Parvocaricetea communities that fit very well in the existing systems of plant communities. In spite of this we thougt it necessary to describe two new associations, one in both the alliances, but once again it must be obvious that these associations have a provisional character because the area from where they are described is relative small and comparable material from other parts of Ireland is lacking.

Although there were sufficient indicative species to classify the communities, a number of species are considered as local character-species (see 5.3.2.). In Westhoff & den Held (1969) and Braun-Blanquet & Tüxen (1952) these species are character-species of other communities of the same or other levels of the hierarchical system. Before discussing these species it must be clear that, according to Westhoff & den Held (1969), we did not separate the character-species of the order and alliance. It is not very probable that other alliances are present in Ireland, so where we are talking about character-species of an alliance we mean character-species of order and alliance together.

With regard to the local character-taxa of the Parvocaricetea and Caricion curto-nigrae, the following remarks can be made.

- Bryum pseudotriquetrum and Calliergon giganteum, considered by Westhoff & den Held (1969) as character-species of the Caricion davallianae, are considered by us as local character-species of respectively the Parvocaricetea and the Caricion curto nigrae.
- Carex demissa, according to Westhoff & den Held (1969) a character-species of the class, is nearly completely absent in communities of the Caricion davallianae, therefore we consider this species as a local character-species of the Caricion curto-nigrae.

- Furthermore it is obvious (see also the synoptic table) that a number of Caricion curto-nigrae species have a broad distribution, especially Carex demissa, Carex echinata and Juncus articulatus; but also Galium palustre and Carex nigra are species that have nearly the same range as class character-species.

Although remarks about species of the Caricion davallianae are given in the following paragraph it is interesting to notice already that the last remarks are nearly identical, only different species are involved. A conclusion from these last remarks might be that in Connemara the floristic differences between these two alliances is less clear than in continental situations. But we have to consider that the fidelity degree of the character-species is not always known in the different locations. In our case there are only very few character-species exclusive (fidelity degree 5). Most character-species are selective or preferential (fidelity degree respectively 4 and 3). However, the occurence of Parvocaricetea species in communities of the Littorelletea is a strong indication of the relative low fidelity degree of much Parvocaricetea species. It is not easy to give an explanation for this phenomenon, but it might be possible that more space is available for these species. In the first place because a number of Parvocaricetea species is lacking in Connemara (in general, the number of species in Ireland is relatively small) so there might be space left. In the second place the growing season is probably much longer in this region with a eu-atlantic climate (many plants in Ireland flower intermittently throughout a mild winter), resulting in more time-separated niches per locality.

Carex nigra-Juncus articulatus association Braun-Blanquet & Tüxen 1952 (J1-J3)

The characteristic species combination consists of: Carex nigra, Carex panicea and Carex demissa. Differentiating against the Anagallido-Caricetum diandrae are: Juncus bulbosus and Potamogeton polygonifolius.

These quaking mire communities, belonging to the Caricion curto-nigrae can ecologically hardly be distinguished from communities of the following association, Anagallido-Caricetum diandrae. They occur in mosaic with these communities in the same lakes. This is especially so for the variants J2 en J3. Variant J1 (inops) mostly follows the Anagallido-Caricetum diandrae as band shaped community along the lake shores. Besides species composition, this clearly indicates the relation to the Carex panicea-Carex demissa nodum (table E).

The association floristically resembles very much the association of Carex fusca (=nigra) and Juncus articulatus, described by Braun-Blanquet & Tüxen (1952). They are correct in regarding their relevés (from lake and river shores) as a nitrophile subassociation, characterized by a number of species from the alliance Agropyro-Rumicion crispi (such as Potentilla anserina). We did not recognize this subassociation in S.W.-Connemara. Our material probably represents the typical subassociation.

The variants of the association are: J1 inops
J2 with Riccardia pinguis
J3 with Samolus valerandi

This last variant with Samolus valerandi is considered as a coastal variant, only occurring very close to the sea (Silverhill). Indicative for this variant are the high Ca^{++}, Cl^{-} and pH values in the environment and the presence of Caricion davallianae species, such as Eleocharis quinqueflora and Philonotis calcarea.

Anagallido-Caricetum diandrae prov. (J4-J7)

The local character-species of the association are: Epilobium palustre, Galium palustre, Carex diandra and Calliergonella cuspidata.

Due to the low presence of Caricion davallianae species it is clear that this community belongs to the Caricion curto-nigrae.
It is a very species rich quaking mire community, characterized by a dominance of sedges and a often high cover of bryophytes. These "Verlandungs" communities often occupy extensive areas and neatly indicate the former dimensions of the lakes.

The soil under these stands consists of a thick layer of compact or thin organic mud. The Ca^{++} and Cl^{-} values are relatively high, very probably indicating the influence of the sea. Also the distribution of these communities indicates this, they are restricted to the shores of coastal lakes in transect 1 and 2 (calcareous beach transects). In transect 3 this association is completely absent. The subassociation typicum is nearly completely restricted to one lake, Lough Antony.

In the zonation, this community is mostly situated behind initial "Verlandungs" communities from the Phragmitetea or Parvocaricetea, that are very poor in species.

The use of the name Caricetum diandrae suggest a relation to formerly described communities with the same name. This is partly true, mainly for communities such as: Caricetum diandrae sphagnetosum (Kuiper 1958) and Caricetum diandrae Jonas 1932 (see van Zinderen Bakker 1942, Oberdorfer 1957 and Passarge 1964). These communities are taken together by Westhoff & den Held (1969) in the association Sphagno-Caricetum lasiocarpae (Carex lasiocarpa is absent in our association). We do not intend to indicate a relation to typical Caricion davallianae communities such as: Scorpidio-Caricetum diandrae (W. Koch 1926) Westhoff 1969, Caricetum diandrae scorpdietosum (Kuiper 1958) and the Eriophoro-Caricetum diandrae Jeschke 1959 (see Passarge 1964).
We used the prefix "Anagallido" to discriminate between this and more continental associations of this alliance.

Subassociation of Sphagnum contortum (J6-J7)

The subassociation of Sphagnum contortum is rather similar to the above mentioned Sphagno-Caricetum lasiocarpae. Typical species of this subassociation are: Sphagnum contortum, Carex limosa, Myrica gale, Drosera rotundifolia and Aulacomnium palustre. These species might indicate the beginning of isolation from the ground water. Although this is not expressed by the pH values, the Ca^{++} values are lower when we compare this subassociation with the typical subassociation. It is a well known fact that species as Sphagnum squarrosum and Sphagnum contortum can start Sphagnum "Verlandung" (Kuiper 1958, Meyer & de Wit 1955).

These authors and Westhoff & den Held (1969) consider the optimal Sphagnum phase as a succession of communities of the Caricion davallianae (especially the Scorpidio-Caricetum diandrae). We think that this community is a transition to the Sphagno-Caricetum lasiocarpae, only a number of typical Sphagna species are still missing.

In the zonation, this Sphagnum phase is following on sociations of Carex rostrata (H1) or directly on oligotraphent communities of the Nymphaeion (Sparganio-Nymphaeetum A10) and followed by floristically and ecologically related communities of Molinia caerulea and Myrica gale (M1). The subassociation does not make contact with communities of the Caricion davallianae nor does the subassociation typicum with which it is floristically close related. Therefore we consider the subassociation as an autonomous existing "Verlandungs" community, mainly determined by the trophical conditions of the water (see chapter succession).

There are two variants to be distinguished: J6 typical
J7 with Carex echinata.

There are only minor differences between these variants. The soil under the variant with Carex echinata is a little bit drier and has a lower pH value.

Subassociation typicum (J5-J4)

The typical subassociation is also related to the association Sphagno-Caricetum lasiocarpae, but because of the absence of Carex lasiocarpa and a number of acid-indicative species, the relation is less pronounced.

In the zonation, the stands of this typical subassociation are situated behind sociations with Cladium mariscus (B9+B10) and with Typha latifolia (B6), both very poor in species, and behind well developed stands of the Phragmitetea (table C). They also occur in a mosaic pattern with units of the Carex nigra-Juncus articulatus association (J2 and J3). The typical subassociation is followed in the zonation by the other part of the Carex nigra-Juncus articulatus association (J1) or, more frequently by transitional communities from Caricion curto-nigrae to Molinio-Arrhenatheretea (table I).

The variants distinguished are: J4 with Carex nigra
J5 with Juncus subnodulosus

The differences between these variants are only floristic.

5.3.3.K. Scorpidio-Caricetum lepidocarpae prov. (K1-K6)

Before discussing this association, it is necessary to make some remarks with regard to the character-species of the Caricion davallianae (see also the synoptic table).

- We consider the species Utricularia minor, Utricularia intermedia Juncus subnodulosus, Schoenus nigricans (but see 5.3.3.M) and Eriophorum gracile as local character-species of the Caricion davallianae. We do not think that these species are characteristic for lower syntaxa, as do Westhoff & den Held (1969).
- A number of species, by Westhoff & den Held (1969) considered as character-species of the alliance, do not occur in the communities of this alliance in S.W.-Connemara. These species are: Eriophorum latifolium, Sagina nodosa, Pinguicula vulgaris and Carex pulicaris. They do occur in other communities. The reason for this change of biotope is not clear to us.
- Just like some species of the Caricion curto-nigrae, some species of the Caricion davallianae also have a very broad distribution. Campylium stellatum, Juncus subnodulosus, Utricularia intermedia, Scorpidium scorpioides and Riccardia multifida are represented in most communities of the Parvocaricetea. The occurrence of Schoenus nigricans in the blanket bogs is well known.

Species that characterize the alliance and therefore also the only association occurring in the studied area are: Carex lepidocarpa, Carex lasiocarpa, Carex dioica and Epipactis palustris. This is also true for species nearly completely restricted to the first subassociation, typicum (K1 + K2): Carex elata, Eleocharis quinqueflora, Philonotis calcarea and Cratoneuron filicinum. All these species we consider as the most faithful taxa of the Caricion davallianae in Connemara. For Carex elata, being typical for communities of the Magnocaricion this might be strange but not abnormal, also Passarge (1964), Kaule (1968) and Kuiper (1958) do report the occurrence of Carex elata in Parvocaricetea communities.

The character-species of the Scorpidio-Caricetum lepidocarpae are: Carex lepidocarpa, Carex elata, Philonotis calcarea and Cratoneuron filicinum. Differentiating against the Caricion curto-nigrae is Schoenus nigricans.

Stands of this association are, just as stands of the Caricion curto-nigrae, closed and very species-rich "Verlandungs" communities, characterized by a dominance of sedges or Juncus species and a high cover of bryophytes. In contrast to communities of the Caricion curto-nigrae, these stands form a more compact cover and also the organic mud under the vegetation is more compact.

The occurrence of this community is nearly completely restricted to transect 2 (on Bunowen peninsula), especially to the coastal lakes.

Subassociation typicum (K1-K2)

The most typical relevés of the Caricion davallianae are represented in the typical subassociation. Most of the character-taxa of this association and some Caricion davallianae species, such as Eleocharis quinqueflora and Epipactis palustris are restricted to this subassociation. This community is only recognized in Truska Mire, a mire directly bordering calcium-rich sanddunes. The mean calcium and chloride values are the highest of the area of investigation.

It is not clear which place this community occupies in the zonation because we did not make a vegetation map of this mire. The variants of this subassociation are: K1 with Eleocharis quinqueflora
K2 typical

The first variant is differentiated from the second by Eleocharis quinqueflora and Scorpidium scorpioides. This coincides with very high calcium values.

Subassociation inops (K3)

This subassociation is differentiated from the first one by the absence of most of the association character-taxa. The mean calcium level in this subassociation is also lower. Just as in the previous subassociation, most of the relevés are situated in Truska Mire, so its place in the zonation is not known.

Although the last three subassociations are lacking most of the association character-taxa they are close related to the typical sub-association. They are similar in being a floristical transition to other communities. The fact that this coincides with a decreasing number of Caricion davallianae species is no surprise.

Transition to Molinia caerulea-Myrica gale nodum (K4)

This community sometimes provided with Drosera anglica, Narthecium ossifragum, Eriophorum angustifolium and Sphagnum contortum indicates (just as the subassociation of Sphagnum contortum of the previous association) isolation from the groundwater. The groundwater level is clearly below the surface and mean calcium, chloride and pH values are the lowest of the whole association. Even more obvious than the above mentioned subassociation, does this form a distinct transition to stands of the Molinia-Myrica nodum (table M). This transitional community is manifesting itself also as a band-shaped vegetation around coastal lakes, just out of the range of the groundwater. The question, if this facies is a succession stage of the typical subassociation indeed, can't be answered. In the field this community follows in the zonation only on the next two subassociations, not on the former ones.

Transition to Eleocharetum multicaulis (K5)

This community is differentiated from the others by the presence of Eleocharis multicaulis, Juncus bulbosus and Potamogeton polygonifolius. Also Hypericum elodes, Scirpus fluitans and Baldellia ranunculoides are sometimes present in this community. As mentioned before, vegetations of this type are mostly followed in the zonation by the Molinia-Myrica facies (K4) and are following on communities of polycorms (table B) or communities of Carex panicea and Carex demissa (table E) or communities of the Eleocharetum multicaulis itself (table F).

Transition to Caricion curto-nigrae (K6)

This community is differentiated by the presence of Juncus articulatus, Carex nigra,
Calliergon giganteum and Galium palustre and by the smallest number of Caricion davallianae species. The bottom under this vegetation has lower mean values for calcium, chloride and pH than the typical subassociation. In the field this vegetation can be preceded by several communities as those of Polycorms (table B), Potametea (table A), Littorelletea (table F) or Caricion curto-nigrae (table J).

Although there is a strong floristical similarity between this association and the Scorpidio-Caricetum diandrae (W. Koch 1926) Westhoff & den Held 1969, the differences are such that we have chosen for the provisional name: Scorpidio-Caricetum lepidocarpae. The more so as the occurrence of Carex diandra is not optimal in this community. Also Eriophorum gracile, another important charactertaxon is completely absent in this vegetation type. Especially Carex lepidocarpa, in combination with Carex dioica are most characteristic for this community. Du Rietz (1949) considers Carex lepidocarpa as one of the most useful indicators of rich fen.

It is striking for this community to comprise an element from the association Junco baltici-Schoenetum nigricantis (Westhoff & den Held 1969), namely the species Schoenus nigricans and Anagallis tenella. Perhaps this can be explained in the following way. The most typical communities of this association were found in one mire (Truska Mire), directly bordering the calcium-rich sand dunes. The association Junco baltici-Schoenetum nigricantis seems to be typical for no longer salty, wet, lime-rich and nitrogen-poor young dune valleys (Westhoff & den Held 1969). The occurrence of Schoenus nigricans is, except for the bogs, nearly completely restricted to this mire; whether the combination of a "Verlandungs" vegetation and a calcium-rich dune area is unic or not in Ireland is not known.

At last, the association: Scorpidio-Utricularietosum (Westhoff & den Held 1969), with the characteristic species, Utricularia minor, Utricularia intermedia, Scorpidium scorpioides and a number of Campylium species, is described as microcoenon within the alliance Caricion davallianae. Communities of this type are present in small hollows, in mosaic with the association Scorpidio-Caricetum diandrae (Westhoff & den Held 1969). In S.W.-Connemara, these species are an integrated part of the Caricion davallianae communities. Again a fine example of broadening of species occurrence in West-Ireland.

5.3.3.L. Schoenus nigricans-Scorpidium scorpioides nodum

This nodum is characterised by the dominance of Schoenus nigricans and Scorpidium scorpioides, but quite a list of other constant species can be given. With a presence of nearly a 100% also occur: Molinia caerulea, Eriophorum angustifolium, Potamogeton polygonifolius and Juncus bulbosus. Faithful companions are Eleocharis multicaulis, Riccardia pinguis, Campylium stellatum, Utricularia intermedia, Carex dioica, Carex panicea, Carex demissa, Erica tetralix, Myrica gale and Anagallis tenella.

The characteristic species combination therefore consists of Parvocaricetea (Tofieldietalia), Littorelletea (Eleocharetum multicaulis) and Oxycocco-Sphagnetea species, with special emphasis on the Parvocaricetea ones. The occurrence of many of these Tofieldietalia species does not justify however a classification of this nodum within the Parvocaricetea. The difference with the Scorpidio-Caricetum lepidocarpae (especially with the subassociation K3) is, that the nodum has a high representation of the Oxycocco-Sphagnetea and the Scheuchzerietea element, which K3 misses.

Schoenus nigricans (d2) is placed within the Parvocaricetea in this table, but in Ireland also has a function as a differentiating species for Oxycocco-Sphagnetea and Scheuchzerietea.

It is not only a species characterising rich fen (sensu Du Rietz), but also a species indicating enrichment within the blanket bog of West-Ireland.

The species differentiating this nodum with regard to the rest of the communities described in this survey are: Eriophorum latifolium and Pinguicula vulgaris.

The nodum can be described roughly as a transitional vegetation between the Scorpidion (sensu Du Rietz) and the Scheuchzerietea Oxycocco-Sphagnetea, the wet to semi-wet enriched vegetation of the ditches in the blanket bog.

The nodum has been described partly by other authors. Birks (1973), describes a Schoenus nigricans-association within the Tofieldietalia in Scotland, which is partly comparable with our nodum.

He indicates that this association appears to favour flat or gently sloping areas with in general low rates of water movement. Furthermore it occurs in soligenous seepage areas, receiving water from ultra- basic rocks. This association of Birks however has few species from the Oxycocco-Sphagnetea and Scheuchzerietea and pH values are comparatively higher (pH 6,4-7,0) compared with the pH values of our nodum (pH 5,4-6,7).

The ecology of this association in Scottish mires, but also in the blanket bogs, is in agreement with the ecology of the Schoenus nigricans-Scorpidium scorpioides nodum. Slow movement of water over the vegetation (flow) and enrichment through this water are the major ecological factors influencing the vegetation of the nodum. It is therefore obvious that the nodum mainly occurs on the two investigated mountains, on the saddle of Errisbeg and on the Ben Glenisky lens, on those spots where flow and/or seepage were obvious. It does also occur on the lakeshores, but only in the bog lakes and only in the flow ditches within the "Verlandungs-vegetation".

An exception to this is Lough Nalawney, where the nodum vegetation occurs alongside the lake border, not only in the ditches. This is very likely caused by the ultra-basic substratum(gabbro-diorite) around this lake. Indications for this enrichment within the blanket bog vegetation are not only Schoenus nigricans and Scorpidium scorpioides, but also the high abundance of Eleocharetum multicaulis species, like Juncus bulbosus, Eleocharis multicaulis and Potamogeton polygonifolius indicate this. Birks(1973) mentiones the occurrence of Schoenus nigricans in West-Ireland blanket bogs as an indicator for water movement and enrichment! McVean and Ratcliffe(1962) also mention increased abundance of Erica tetralix and Narthecium ossifragum together with Carex panicea and Carex demissa, as the first indicators of soligenous influences (see L1-L4).

The nodum has an own typical ecology, clearly different from the Scorpidio-Caricetum lepidocarpae (see tables 7, 8). The soil type is mainly pure bog, no quaking mire(COM) anymore and the soil depth varies from 0.2-4.5 meter. The pH values, Ca and Mg values and Cl values are all clearly lower than of the communities A-K (see 5.3.4).

A major split in species composition, but also in pH, Ca and Mg and Cl values occurs between the vegetation of the Scorpidio-Caricetum lepidocarpae and this Schoenus nigricans-Scorpidium scorpioides nodum.

Community of Carex dioica and Potentilla erecta L1

This community with a relative shallow soil, only occurs on the investigated mountains on gently sloping flow spots just above the origin of the little streams. The species composition of this blanket bog vegetation in an undisturbed area, far from human influences, does indicate natural enrichment.

The occurrence of the many Parvocaricetea species, especially Carex dioica and Carex echinata indicates this enrichment, which is caused by transport of minerals from underlying substrata through seepage water. Water from higher situated places flows over the vegetation; an obvious indicator for this flow is Eleogiton fluitans. The high amount of Oxycocco-Sphagnetea species (nearly no Scheuchzerietea) illustrates that this vegetation does not grow on water-logged spots, but on more semi-wet places.

Community with dominance of Scorpidium scorpioides L2

This less species-rich part of the nodum, occurs (together with L3) in a somewhat wetter habitat. The presence of Menyanthes trifoliata and Carex limosa together with the three main characteristic species of the Scheuchzerietea illustrate this feature and again a certain enrichment. On the mountains this vegetation occurs just on typical seepage spots (Fe-colour of the bog substratum), near the origin of the little streams. In Lough Aturtaun this vegetation occurs in the flow ditches (Scorpidium ditches) that transport the water flowing from the road along this lake into the lake. In Lough Truska near Errisbeg the vegetation occurs in flow ditches which transport the water from the gabbro-diorite surroundings into the lake .

Transition to Carex panicea - Carex demissa nodum L3

The name of this part of the nodum already stresses that there is a close link with the Carex panicea-Carex demissa nodum (especially with E6).

In this relatively species-poor community, which mainly occurs in Lough Nalawney, there is nearly no Oxycocco-Sphagnetea or Scheuchzerietea element and only Parvocaricetea and Littorelletea species are well represented. Also remarkable is the occurrence of mineral parts and guttja in the subsoil of this vegetation. This is something the community has in common with M4 of the Molinia caerulea-Myrica gale nodum; these communities both do occur in Lough Nalawney, next to each other.

Community of Drosera intermedia and Narthecium ossifragum L4

This "wet" vegetation with very high dominance of Schoenus nigricans and Molinia caerulea is the most species-rich part of the nodum, in which no flow and/or seepage occurs. It resembles the Phragmites australis-Schoenus nigricans swamp, described by Conolly (1930), which is a vegetation described as the transition from real reed swamps to Molinia bog. In this sense the community occurring in bog lakes as well as on the mountains most clearly forms the link between the rich and poor fen vegetation types: between the Scorpidio-Caricetum lepidocarpae(K) and the Molinia caerulea-Myrica gale nodum (M) of this survey. The amounts of Oxycocco-Sphagnetea/Scheuchzerietea and Parvocaricetea species, of "rich" and "poor", "wet" and "dry" species are distributed evenly.

5.3.3.M. Molinia caerulea-Myrica gale nodum

This nodum consists of a series of transitional vegetation types in which aspects change from wet and dry, nutrient-rich to nutrient poor. The classes which are represented rather equally within the nodum are Oxycocco-Sphagnetea, Parvocaricetea, Nardo-Callunetea, Scheuchzerietea, Littorelletea and Molinio-Arrhenatheretea. The communities within this nodum all represent transitions between these classes, which will be discussed in detail (see below).

The characteristic species combination for this nodum consists of: Myrica gale and Molinia caerulea, which are often dominant, together with the other constant species Eriophorum angustifolium, Carex echinata, Succisa pratensis and Anagallis tenella. Species which are differentiating for this nodum with regard to the rest of the communities of this survey, are: Carex pulicaris, Sphagnum palustre, Aulacomnium palustre and Campylopus introflexus.

Menyanthes trifoliata, Carex limosa and Sphagnum subnitens are three species which are differentiating Parvocaricetea and Scheuchzerietea with regard to the other classes.

Molinia caerulea, Eriophorum angustifolium and Schoenus nigricans have the same function for Scheuchzerietea and Oxycocco-Sphagnetea.

Schoenus nigricans is the only species which has got a double function in this survey. It is regarded as the character-species of the Scorpidio-Caricetum lepidocarpae, but also functions as the differentiating species for Scheuchzerietea and Oxycocco-Sphagnetea. This indicates the strange "behaviour" of this species in Western Connemara (see 5.3.3.L).

The vegetation is relatively rich in species. The communities of this nodum occur in the coastal mires as well as in the bog lakes, in Truska mire, Namanawaun, Antony, Letterhask-East, Base Errisbeg, Suffrauncam, Kankoge, Truska near Errisbeg, Nacorrussaunbeg, Nalawney and on Errisbeg itself. Thus, the distribution of this vegetation type is rather wide within the survey area. (A restriction to this is vegetation M1, which mainly occurs in Antony and Namanawaun, not in the bog lakes further from the sea).

If compared with other literature data, this nodum resembles the:

-Molinia-Myrica association of Birks(1973)
-Molinia-Myrica nodum of McVean and Ratcliffe(1962)
-Molinia-Myrica mire of Ratcliffe(1964)
-Molinia-Myrica nodum of Wheeler (1975).

It differs however from all these described communities in respect to species-number, which is higher in our case, and in respect to the contribution of Littorelletea species and Parvocaricetea species. Literature data indicate that the vegetation of Molinia and Myrica is strongly under influence of soligenic factors or periodically inundated (Birks, 1973, Mc Vean and Ratcliffe, 1962).

The species-rich nodum of this survey however, does not only occur in bog communities under soligenic influences, but also occurs in the zonation along lake borders on dry, higher situated edges, the last part of the zonation from open water to lake border.

Wheeler (1975) also recognized this richer Molinia-Myrica nodum within the "Verlandung" of mires, but placed this community within the Molinietalia. In our case however, the absence of the Molinio-Arrhenatheretea aspect does not suggest such a placing.

Community of Carex limosa and Potentilla palustris M1

The species combination characteristic for this vegetation consists of those taxa characteristic for the nodum and furthermore Menyanthes trifoliata, Carex limosa, Calliergonella cuspidata, Potentilla palustris, Juncus articulatus, Phragmites australis, Equisetum fluviatile, Juncus bulbosus, Potamogeton polygonifolius, Hydrocotyle vulgaris, Agrostis stolonifera and Ranunculus flammula.
This large amount of Parvocaricetea and Littorelletea species together with the general occurrence of Oxycocco-Sphagnetea species indicates that this vegetation is a transition between Parvocaricetea and Oxycocco-Sphagnetea.

Compared with the other communities of this nodum, the absence of Nardo-Callunetea species and the presence of Phragmitetea species shows, that we deal with a rather wet stand, although the groundwater level is just below the surface of the vegetation.
Indicative is the type of substratum, which consists of quaking mire with TOM or COM under it.

The vegetation occurs largely in Lough Antony and Lough Namanawaun, directly along the lake border, or as drier islands within the typical quaking mire vegetation.

Within the zonation pattern it follows after communities of J6 or J7, Anagallido-Caricetum diandrae subassociation of Sphagnum contortum or on F6 or F5, Eleocharetum multicaulis subassociation potametosum.

The Cl^-, Ca^{++}+ Mg^{++} values of M1 and those of its neighbouring communities have comparable values. The pH of M1 however, is clearly lower (mean value 5,7). This lower pH and the presence of the Oxycocco-Sphagnetea species, can be seen as an indication for the tendency to acidification, especially when seen in the light of "Verlandung" of a rich mire:
When this "Verlandung" continues and the vegetation which forms the quaking mire grows higher about the watersurface, it becomes independant from the groundwater table; by means of a rich Sphagnum and Bryophytes growth the community creates an own groundwater table and acidification takes place.

Compared with Meyer & De Wit (1955), the zonation of J6 and M1 is typical for a "Verlandung" series from rich Scorpidium quaking mire with Carex diandra to a Sphagnum stage with many herbs, and Myrica gale to a drier, more acid, nutrient-poor vegetation.

Birks (1973) describes an association of Trichophorum caespitosum-Carex panicea, a community of poor fen (sensu Du Rietz, 1954) indicating soligenous conditions, which does resemble the community of Carex limosa-Potentilla palustre, except that the latter misses Trichophorum caespitosum and Erica tetralix.

The vegetation M1 can be regarded as a wetter, somewhat nutrient- and species-richer form of this Trichophorum caespitosum-Carex panicea association (Birks 1973), and can also be regarded as the stage between a degenerating Anagallido-Caricetum diandrae and the development of ombrotrophic bog in West-Ireland. It is floristically and chemically the richest and also the wettest association of the Molinia-Myrica nodum, as described for the survey area. A distinctive feature is furthermore the presence of guttja in the subsoil of this vegetation.

Community of Eleocharis multicaulis and Carex panicea M2+M3

The species combination which is characteristic for the nodum together with the species Eleocharis multicaulis, Carex panicea, Erica tetralix, Drosera rotundifolia, Potentilla erecta, Hypnum cupressiforme var. ericetorum, Selaginella selaginoides, Calluna vulgaris and Sphagnum inundatum are typical for this community.

The relative high amount of Nardo-Callunetea and Oxycocco-Sphagnetea species already indicates that this vegetation occurs in drier situations than those from the first part of this nodum.

The soil type consists of bog, no quaking mire any more. The majority of this vegetation occurs on the borders of the lakes which are situated more inland, within the blanket bog area; only M2 does still occur in coastal mires.

No typical adjacent vegetation types can be recognized which follow M2 or M3 in the zonation of the lake vegetation.

This community has two facies, a drier variant with Calluna vulgaris with no large influence of Scheuchzerietea or Littorelletea species. Cephalozia bicuspidata is typical for this facies. The wetter variant with Rhynchospora alba and Sphagnum papillosum has a higher proportion of Scheuchzerietea species and the presence of Eleocharetum multicaulis element in the form of Eleocharis multicaulis and Juncus bulbosus indicates that this vegetation forms a transitional stage between Littorelletea and Oxycocco-Sphagnetea (still with a relatively high presence of Parvocaricetea species).

The community as a whole resembles the Trichophetum-Eriophoretum caricetosum described by Ratcliffe (1964), but the occurrence of Eleocharis multicaulis, Juncus bulbosus, Potamogeton polygonifolius and Sphagnum inundatum shows that this vegetation is a wetter stage. The presence of Myrica gale is not mentioned either in the description by McVean and Ratcliffe (1962).

The wetter variant M3 with Sphagnum papillosum and Rhynchospora alba is a transitional vegetation between the Molinieto-Callunetum of McVean and Ratcliffe (1962), Birks (1973) and the Trichophoreto-Eriophoretum, as described by McVean and Ratcliffe (1962).

The variant with Calluna vulgaris, M2 is neither Trichophoreto-Callunetum (McVean and Ratcliffe, 1962) because it contains Myrica gale, nor a Molinia/Myrica nodum as described by the same authors because it is too rich in species. Still the soligenous influences are clear, especially if we regard Myrica gale as one of the major "Grundwasserzeiger"; therefore this variant can only be regarded as the drier form of M3.

Community with dominance of Myrica gale and Schoenus nigricans (M4)

This last association is the most species-poor form of the nodum and resembles most clearly the described forms of Molinia/Myrica nodum. The abundance of Schoenus nigricans however shows that this association is typical for West-Ireland blanket bog (see 5.3.3.L.). We can regard this community not as the drier but as more species-poor variant of the Molinia caerulea-Myrica gale nodum of our survey area.

5.3.3.N. Scheuchzerietea

The character-species of class, order and alliance are listed in 5.3.2. The differentiating species for the Scheuchzerietea and Oxycocco-Sphagnetea, with regard to the other classes are Eriophorum angustifolium, Molinia caerulea and Schoenus nigricans (concerning Schoenus nigricans see 5.3.3.L. and 5.3.3.M.). The differentiating species for Scheuchzerietea and Parvocaricetea, with regard to the other classes are Carex limosa, Menyanthes trifoliata and Sphagnum nitens.

Due to a different sampling method (3.7.1.) this class is only represented by a small number of relevés; the vegetation-units which are recognized in tabel N only represent therefore the level of association.

Drosero-Schoenetum nigricantis Braun-Blanquet et Tüxen 1952. N2+N3

The character-taxa of this association are Zygogonium ericetorum (following Braun-Blanquet & Tüxen 1952), Carex limosa and Drosera intermedia. The occurrence of Schoenus nigricans and Molinia caerulea in this vegetation is typical for the West-Ireland blanket bog (Braun-Blanquet & Tüxen, 1952). Erica tetralix, Narthecium ossifragum and Odontoschisma sphagni represent the Oxycocco-Sphagnetea aspect in this community, indicating that it is a less wet stage of the community as described by Braun-Blanquet & Tüxen, (1952).

The vegetation is confined to a deep bog substratum, the pH is ranging from 4,5-6; Ca + Mg, Cl and PO4 values have relatively low values. The vegetation occurs on sites which are not under heavy influence of the sea. Total cover values are high due to a flourishing bryophyte layer, which contains the algae complex Zygogonium ericetorum coll. as a dominant.

Two subassociations can be recognized; a drier one (N3) in which _Sphagnum papillosum_ and _Campylopus atrovirens_ are typical. The Eleocharetum element is missing, but the Oxycocco-Sphagnetea are represented in a high proportion. The wetter subassociation (N2) is characterised by _Potamogeton polygonifolius_, _Carex limosa_ and _Sphagnum auriculatum_. Here the Eleocharetum element shows its presence.

The high occurrence of the Oxycocco-Sphagnetea in both these subassociations and the dominance of _Zygogonium ericetorum_ (which is placed in the Scheuchzerietea following Braun-Blanquet & Tüxen, 1952, but which is often called character-species of the Oxycocco-Sphagnetea, following Moore, 1968), justifies our opinion that the Drosero-Schoenetum nigricantis should go in the Oxycocco-Sphagnetea instead of in the Scheuchzerietea, which has been done. The vegetation forms a transition between the Scheuchzerietea and the Pleurozia purpurea- Erica tetralix association of the Oxycocco-Sphagnetea.

Association of Eriophorum angustifolium and Sphagnum cuspidatum Birks 1973. N1.

This second association, with the typical species _Sphagnum cuspidatum_, _Sphagnum inundatum_ and _Eriophorum angustifolium_ really does belong to the Scheuchzerietea. It is the small zone of vegetation between the base of the Sphagnum hummocks and the waterlevel of the hollows. Rose (1952) describes it as the first stage in the formation of a so-called Sphagnum hummock complex. The substratum consists of thin organic mud, not purely bog; the vegetation is nearly always inundated and with a thin water layer and consists largely of Bryophytes (no Zygogonium). The proportion of the Eleocharetum multicaulis species is relatively high; _Eleocharis multicaulis_ itself is the species differentiating this association with regard to the Drosero-Schoenetum nigricantis.

The association is not confined to blanket-bog areas only, but occurs also in the lakes of the transition zone between coastal area and blanket bog.

5.3.3.0. Oxycocco-Sphagnetea

Within this class we recognized several character-species (see 5.3.2). There are 2 species which are placed in the Oxycocco-Sphagnetea, but have no explicit designation. These species are Erica erigena, which belongs to another association of the Oxycocco-Sphagnetea according to Braun-Blanquet & Tüxen (1952); Cephalozia bicuspidata is a differentiating species for the Oxycocco-Sphagnetea, Scheuchzerietea and the Molinia-Myrica nodum, but with special emphasis on the Oxycocco-Sphagnetea.

In our data set, two associations in the Oxycocco-Sphagnetea could be recognized, which however cause problems within the hierarchical system. The association of Pleurozia purpurea and Erica tetralix can be placed in the alliance Ericion tetralicis, order Ericetalia tetralicis, with the character-species of order and alliance: Erica tetralix, Zygogonium ericetorum, Schoenus nigricans, Campylopus atrovirens and Pleurozia purpurea (the last four species are called character-species according to the unpublished table of Westhoff). The association Pleurozia purpurea- Erica tetralix, was originally situated in the Ericion by Braun-Blanquet & Tüxen (1952), but Moore (1968) did fit this association in the Erico-Sphagnion.

The association of Leucobryum glaucum and Eriophorum vaginatum has the character-species of the alliance Erico-Sphagnion, namely Erica tetralix, Sphagnum papillosum and Trichophorum caespitosum (the last one according to unpubl. table Westhoff); this alliance belongs however to the other order of the Oxycocco-Sphagnetea, the Sphagnetalia magellanici, with its character-species Sphagnum rubellum, Eriophorum vaginatum, Calypogeia sphagnicola and Sphagnum magellanicum (also character-species of the class itself).

The two associations both have character-species of the Ericetalia, namely Erica tetralix and Schoenus nigricans and of the Sphagnetalia, namely Sphagnum rubellum and Eriophorum vaginatum. The emphasis of the first association (01) laying in the Ericion, the other (02) in the Erico-Sphagnion.

It is clear we are dealing with a transitional situation between these two alliances and it would be easiest to regard the two alliances in this case as one group with three local character-species:
Erica tetralix, Cladonia uncialis and Cladonia impexa.

Association of Pleurozia purpurea and Erica tetralix Braun-Blanquet et Tüxen 1952. 01

The charcater-species of this association are Pleurozia purpurea, Campylopus atrovirens, both according to Braun-Blanquet & Tüxen (1952) and Sphagnum papillosum, which is a local one. The differentiating species with respect to the other association are Pleurozia purpurea, Sphagnum papillosum, Campylopus atrovirens, Zygogonium ericetorum, Drosera anglica and Drosera intermedia.

There is a close relationship of this association with the wetter Scheuchzerietea communities and this association can be considered to be the initial stage of hummock formation, situated adjacent to the Drosero-Schoenetum nigricantis (5.3.3.N).

The substratum of this vegetation is bog, with depths of 2 meter or more (this is an indication, if following Moore 1968, that this vegetation should belong in the Erico-Sphagnion). The pH ranges from 4,4-4,9. Ca and Mg, Cl and PO4 occur in relative low quantities.

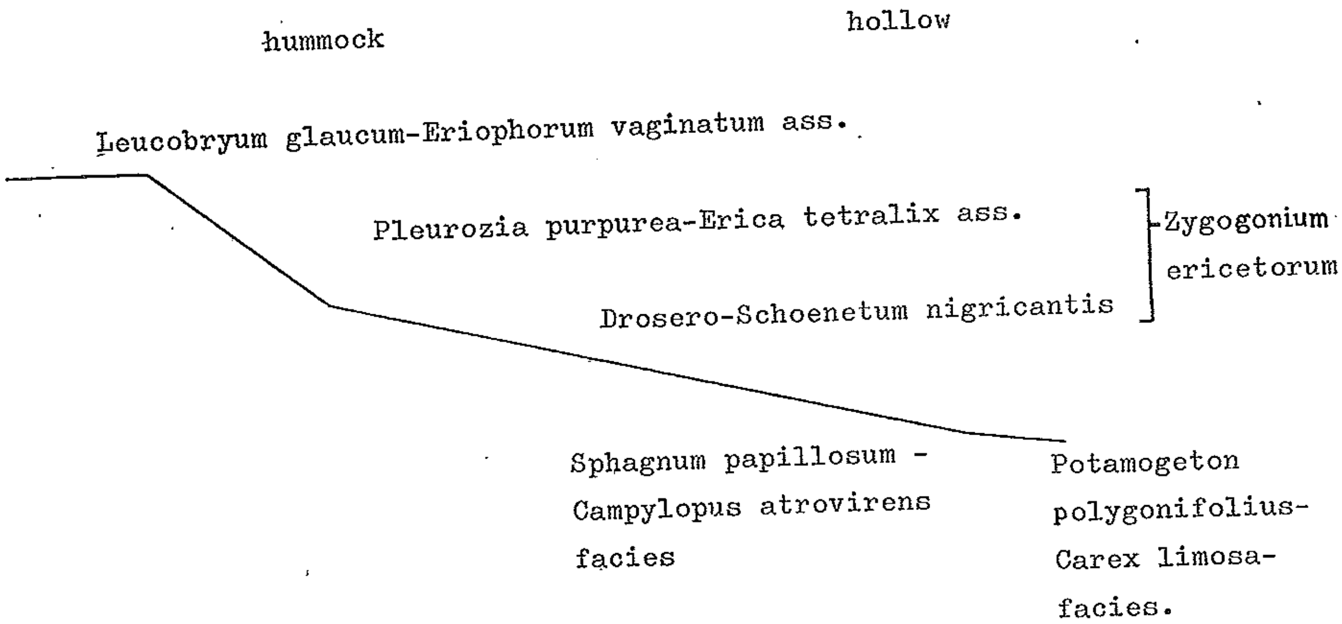
Association of Leucobryum glaucum and Eriophorum vaginatum 02

The local character-species of this association are Trichophorum caespitosum, Leucobryum glaucum (see p. 118), Eriophorum vaginatum, Sphagnum fimbriatum, Polygala serpyllifolia and Myrica gale. The association resembles partly the Trichophoreto-Eriophoretum of McVean and Ratcliffe (1962); it has furthermore close links with the Pleurozia purpurea-Erica tetralix association (Birks, 1973). But the main difference with McVean and Ratcliffe's unit is the absence of Sphagnum papillosum (which strangely enough is a local character-species for the Pleurozia-Erica tetralix association).

The Nardo-Callunetea species are well represented in this unit, especially Calluna vulgaris, Rhaoomitrium lanuginosum, Potentilla erecta, Hypnum cupressiforme and Polygala serpyllifolia.
Leucobryum glaucum, a species from the more continental classes Vaccinio-Piceetea and Quercetea robori-petraeae is also well represented. This all shows that we are dealing with a drier form of the Oxycocco-Sphagnetea in which the Scheuchzerietea influence is fading. The substratum is rather deep bog with pH of about 4,6.

Further remarks:

If we make a sketch of the vegetation described above from Oxycocco-Sphagnetea and Scheuchzerietea we get the following picture.



The only true Scheuchzerietea vegetation we recognized, the association of Eriophorum angustifolium and Sphagnum cuspidatum is not present in this scheme, because it only occurs on the edge of bog lakes, not in the hollows of the blanket bog. The suggestion can be made that the Scheuchzerietea are lacking in the blanket bog of our survey area, because the Drosero-Schoenetum nigricatis resembles the Oxycocco-Sphagnetea very much especially with regard to the position of Zygogonium ericetorum. This means that mainly communities of the Oxycocco-Sphagnetea are incorporated in the formation of blanket bog.

Another remarkable feature is the occurrence of Leucobryum glaucum in the blanket bog. It seems to happen more often that species of the class Vaccinio-Piceetea occur in high level montane blanket bogs (pers.comm. Moore and see Luzula sylvatica in Braun-Blanket & Tüxen, 1952: Blechno-Quercetum extrasylvaticum!).

5.3.4. The synoptic table; general discussion of classification results

When looking at the results of the classification in this and the previous section, a few general questions come into mind: why should one need to classify and how much detail is wanted once a classificatory approach is adopted.

The need for classification is the indirect result of the complexity of the vegetation. Reduction of this complexity is necessary to be able to grasp the essential features of the system. How much reduction is needed depends on the aims of the investigator. Detail is needed in a local investigation, describing only local vegetation. This need for detail has to be reflected in a detailed sampling technique. For comparison of vegetation on a national or international level, far more reduction is necessary. This could profitably start in the sampling phase, with site selection.

In our investigation we wanted to do both: give a detailed vegetation survey of the area, as well as a comparison of our results on a wider scale. In order to achieve these aims, we used the techniques of the Zürich-Montpellier school and their classification system, with a somewhat modified, that is more detailed, sampling technique (see 3.6.). The detailed classification results have been presented in the previous section. In this section we will deal with a higher level of reduction: the synoptic table of all main vegetation types recognized in the area of investigation (see table 7).

The discussion of the synoptic table will concentrate on two main points and a note on a third: first of all the three partition in the table and secondly, the many diffuse vegetation types, for which we adopted the term "nodum"; thirdly, how to interpret the difficulties with classification on the species level.

In essence, each two-way table of vegetation, is a first axis ordination of classification results (Moore, 1972). From this it follows that such a table will be neater when the data contain one dominant gradient.

This is even more so with a synoptic table, where all units are represented. Unfortunately such a gradient is seldom present. In our work at least two dominant gradients are clearly visible: From wet to dry, with only little emphasis on nutrient status; and from nutrient-rich to nutrient-poor, with only slight variation in the watertable. Both gradients are displayed in table 7 (synoptic table): the first gradient from A-K, the second from J-O. The result is the three partition already mentioned:

1. A-D : vegetation units that are always, or nearly always in or under water, mainly with a high nutrient status. Table D, the Isoeto-Lobelietum, forms a unit on its own, transitional between this and the following part.
2. E-K : mire vegetation in the broad sense of the word. Only temporarily in or under water, again mostly fairly rich in nutrients.
3. L-O : blanket bog vegetation, water-logged but never permanently under water. In general with a low nutrient content..

These two gradients and the resulting three partition are also shown in the tables 8 and 9 that summarise the chemical data.
Depth of water (see table 8), pH and type of soil (see table 9) will illustrate the point best. Unfortunately this three-fold partition, based on floristic criteria and backed up by ecological data, does not always coincide with the main syntaxonomical divisions. Between the first and second part (tables D and E), there is only a difference on the alliance level (Lobelio-Isoetion and Eleocharition acicularis) within the same order (Littorelletalia) of the class Littorelletea.
In the second group (E-K), two orders of the class Parvocaricetea occur (Parvocaricetalia nigrae and Tofieldietalia) and in the third group (L-O) two classes are represented: Oxycocco-Sphagnetea and Scheuchzerietea.

Although floristic criteria form the decisive basis for the classification system of the Zürich-Montpellier school (see for instance Westhoff & Den Held, 1969), it will be clear that floristic dissimilarities do not form the only criterium. Physiognomy, similar growth form, similar ecology, all these play an important secundary and often subconscious role. It is often this subconsious fit with ecological reality, prevailing over strict floristic criteria, that keeps the system so widely applicable. This is especially true for some higher syntaxonomical levels, for instance: The class Littorelletea comprises all communities of the fresh-water zone of periodic immersion with one prevailing growth form (Isoetides). The order Tofieldietalia contains all fen communities. Oxycocco-Sphagnetea are only found on deep ombrotrophic peat, etc..

At the same time, those syntaxa with a clear "ecological profile" are sometimes poorly characterised floristically, like the Littorelletea with only one class character-taxon, namely Juncus bulbosus (Schoof-van Pelt, 1973).

Strong ecological similarity and similarity in growth form, rather than floristic criteria were also the base for our table of polycorms (see 5.3.3.B). Nevertheless, our own data, floristically as well as ecologically (tables 7,8,9) suggest some major alterations for western Ireland: The allocation of the Eleocharition acicularis within the Parvocaricetea; the amalgamation of Caricetalia nigrae and Tofieldietalia and perhaps even an amalgamation of Scheuchzerietea and Oxycocco-Sphagnetea.

The second part of the discussion concerns the many vegetation types that could not be assigned to certain existing syntaxonomical units. This can of course be the result of our more detailed sampling technique, yielding many transitional relevés and therefore many "in between" vegetation types, that are only of local interest; that is, we did not reduce our data enough to get a clear picture. On the other hand, we often found similarities with types described for Scotland (McVean and Ratcliffe, 1962) and England and Wales (Wheeler, 1975) (See previous section). This suggests, that at least part of our "noda" are typical for the eu-atlantic parts of the British Isles and could profitably be studied to reveal their syntaxonomical position and relation to similar vegetation types already described for more continental regions.

In essence, all the difficulties discussed above, come down to shifts in ecological amplitudes of the species present, when compared with continental data. Usually, this concerns a broadening of the tolerance of the atlantic species. They therefore lose much of their (continental) indicator value ("Das atlantische Klima verdirbt den Charakter der Pflanzen", Rübel). Species combinations are possible in western Ireland which have never been heard of in more easterly areas. This spread of well adapted atlantic species is not completely compensated for by a gain in indicator value of more continental species, because they often do not occur in Ireland (only 1167 native species in Ireland, Webb. 1952).
One can speculate about the reasons for this. Isolation since the ice ages; a mild, more uniform climate, causing a smaller variability and thus less niche dimensions, in time as well in space (extensive bog areas).

Chemical factors, like the near absence of aluminium, could be involved (Sparling, 1967), causing a less strict separation of calcicole and calcifuge species, etc.. Whatever the explanation may be, many species do show a broader ecological amplitude in Ireland than for instance in the Netherlands. Such species are: Schoenus nigricans, the most obvious one also studied by Sparling l.c., Cladium mariscus, Anagallis tenella, Nymphaea alba, Schoenoplectus lacustris, Riccardia pinguis, Carex echinata, Scorpidium scorpioides, Carex rostrata, Menyanthes trifoliata, Juncus bulbosus, Eleocharis multicaulis, Potamogeton polygonifolius, Drosera ssp., Sphagnum papillosum. It is not surprising that it is just these species that confuse the classification of types within the system.
The opposite of this broadening of ecological amplitude also occurs, but as far as our studies go, not so frequently. A good example of this is given by Carex lasiocarpa and Carex diandra. In the Netherlands (Westhoff and Den Held, 1969), Carex lasiocarpa is found in Phragmitetea (Magnocaricion), Parvocaricetea and Scheuchzerietea, usually together with Carex diandra. In our area of investigation, Carex lasiocarpa is found optimally in the Tofieldietalia and Carex diandra in the Caricetalia nigrae. Here a kind of niche separation occurs, giving the two sedges a higher indicator value than they have in the Netherlands.

Summarising, one can say that we found differences between classification units based on floristic criteria, not in accordance with the classification system of the Zürich-Montpellier school. This remains true, even when we take into account that not only floristic, but sometimes also strong ecological criteria are allowed to play a role. Our ecological information tends to support our classification.
It seems worthwhile to investigate further the syntaxonomical position of the noda described in our survey, because they may represent typical Irish (eu-atlantic) vegetation types.

5.4. Mountain transects

To detect the influence of primary nutrient-rich parent material on the blanket bog vegetation of Errisbeg and to analyse also the effects of flow and seepage on this vegetation, mountain transects were placed on Errisbeg and on Ben Glenisky. The questions arising have been formulated in chapter 1, 2.4, 3.12 and 4.

Situation sketches and locations of the relevés on the slopes of Ben Glenisky and Errisbeg have been indicated on Fig. 1, 14a and 14b.

5.4.1. Description of the vegetation

The relevés 5-7 and 9-15 have been made on the saddle of Errisbeg (see Fig. 14a). Only rainwater and seepage water from the underlying gabbro-diorites bring nutrients to the vegetation.

We recognized the presence of four vegetation types: typical blanket bog communities of the Oxycocco-Sphagnetea and Scheuchzerietea (tables N and O) and more enriched forms of blanket bog vegetation such as communities of the Schoenus nigricans-Scorpidium scorpioides nodum (L1) and the Molinia caerulea-Myrica gale nodum (M3, a community indicating soligenous influences).

Along the drainage stream lower down in the saddle the relevés 8 and 16-22 have been made. Here, the influence of nutrient-rich water, mainly by means of flow, can be recognized in the vegetation. Not only communities of the Oxycocco-Sphagnetea, Schoenus nigricans-Scorpidium scorpioides nodum and Molinia caerulea-Myrica gale nodum occur, but also the Carex panicea-Carex demissa nodum is represented along the river downstream, especially on places where overflow is an important factor, influencing the vegetation.

On the base of Errisbeg, on the west side, many little streams come together (see Fig. 14c) and there,nutrient-rich flow-water from Errisbeg gathers in the main stream that flows through the bog into a swampy lake. The relevés recorded here are: 96, 99, 101, 103, 105, 107, 109 and 110. The enriching influences of the gabbro and diorites of Errisbeg is most clear in this wetland at the base of the mountain (Lough Nalawney, which receives its water from Errisbeg too, has also vegetation types which are clearly associated with nutrient-rich conditions, as is described in 5.5.2). Within this wetland many different communities are recognized which characterize this wetland as an island of nutrient enrichment in the middle of an ombrotrophic blanket bog area. In this area fairly enriched blanket bog vegetation (pH values vary from 6,5 to 7) does occur, such as communities of the Schoenus nigricans-Scorpidium scorpidioides nodum and Molinia caerulea-Myrica gale nodum, but also communities of Carex rostrata, Carex panicea-Carex demissa nodum, Eleocharetum multicaulis and Scorpidio-Caricetum lepidocarpae are present here.

The contrast becomes even more clear when we compare these vegetation types with the relevés 104, 106, 108 and 141, made only a little further on the blanket bog lens at Dolan, where no influence of flow or Errisbeg material occurs. Here we find only pure Oxycocco-Sphagnetea and Scheuchzerietea communities (pH values range from 4,5 to 4,9).

On the lens of Ben Glenisky, relevés 30, 33, 40, 42, 43 and 45 were made. The relevés 31, 32, 34 and 35 were made on the edge of the lens. On those spots flow and/or seepage was observed. The relevés 36-39, 41 and 47 were made along the main drainage system lower down the slopes of this mountain, below the bog lens. On this lens which is a comparable situation with the Errisbeg saddle, nutrients come to the vegetation through rainfall and by seepage water which passes along quartzites underlying the lens. On this lens, only communities of the Oxycocco-Sphagnetea and Scheuchzerietea occur. More lower down the slopes, on the typical areas with flowing water, the vegetation changes; flow and probably seepage from drumlins possibly present below the blanket bog, influence the vegetation. Scheuchzerietea and Oxycocco-Sphagnetea are replaced by communities of the Carex panicea-Carex demissa nodum (E6) and the Schoenus nigricans-Scorpidium scorpioides nodum (L1). The pH values of the vegetation on the lens vary from 4,5-5,2 and those from lower situations vary from 5,7 to 6,4.

A remarkable observation, which is worthwile mentioning in this context, is that on the edges of the Dolan lens (purely ombrotrophic blanket bog) where human activity in the form of peat cutting occurs, decomposition of the peat takes place. On those spots where also flow occurs, a situation of increased dynamics of the ecosystem can be found (species as <u>Potamogeton polygonifolius</u> and <u>Drosera intermedia</u> occur). A suggestion could be made that certain socalled "enriched" communities not only occur as a result of nutrient enrichment from rich parent material, but also because of mineralisation by more dynamical conditions.

5.4.2 Evaluation of the transects

The communities of the lens, saddle and slopes of both mountain transects, together with the "zero bog" lens Dolan and the swamp vegetation on the "base Errisbeg", have been brought into tabular form in table 5, to make a comparison more easily.

Table 5 : Vegetation types and mean values of pH, $Ca^{++}+Mg^{++}$ and Cl^{-} of the mountain transects and the "Dolan" lens.

Vegetation types	"zerobog" Dolan (Dol)	lens Benglenisky (LGl)	"drainage" Benglenisky (Gle)	saddle Errisbeg (Err)	"drainage" Errisbeg (Err)	base Errisbeg(BEr)
Scheuchzerietea (N)	104;	30;33;45;				
Oxycocco-	106;108;	40;42;43;		5;6;14;		
Sphagnetea (O)	141;			13;	8;21;	
Molinia caerulea-						
Myrica gale nodum (M)				11;	17;19;	105;
Schoenus nigricans-						
Scorpidium scorpioides			31;32;34;	7;9;10;	20;22;	97;
nodum (L)			35;39;47;	12;15;		
Carex panicea-Carex						
demissa nodum (E4-E6)			36;37;38;41;		16;18;	102;107;
Scorpidio-Caricetum						
lepidocarpae (K)						99;109;
Eleocharetum						
multicaulis (F)						96;101;
Sociation of Carex						110;
rostrata (H)						103;
pH	4,7	4,6	6,2	5,7	5,6	6.6
$Ca^{++}+Mg^{++}$ mg/l	17,3	5,6	30,9	25,0	14,5	48,5
Cl^{-} mg/l	61,8	21,0	17,5	38,6	38,0	45,1

This table show the relevés that were made on the different locations and the communities to which these relevés belong. In this way we indicated the communities that occur in the different locations. At the bottom of the table we indicated mean values of pH, Ca^{++} + Mg^{++} and Cl^{-} of the different locations.

The influence of the sea on all this blanket bog communities can be established by comparing the Cl^{-} and Ca^{++} + Mg^{++} values. On Dolan and base Errisbeg the Cl^{-} values are rather high, due to the relatively short distance from the ocean to these locations. The high Ca^{++} + Mg^{++} value of base Errisbeg however, is not only caused by the influence of the ocean, certainly not when this value is compared with the Dolan lens situated nearby. Ben Glenisky is situated so far from the ocean, that Ca^{++} + Mg^{++} only originates from the surroundings and not from the ocean. The Cl^{-} values of the saddle and the drainage systems of Errisbeg do indicate some sea-influence, although less than on Dolan or at the base of Errisbeg. Therefore Ca^{++} + Mg^{++} might have two origins on Errisbeg: sea and parent-material. But again, compared with Dolan values, these values are too high to be caused by the sea alone.

From these chemical data we can conclude therefore:

- Dolan and Ben Glenisky lens are two zero situations, although the influence of the sea on Dolan can be detected.
- The high Ca^{++} + Mg^{++} value of the drainage of Benglenisky is caused by flow and seepage and the underlying parent material (drumlins, serpentine).
- The high pH and Ca^{++} + Mg^{++} values on Errisbeg are largely caused by influences of parent material.

The answer to the questions: "Is the influence of different parent material on the blanket bog vegetation obvious?" and "are these effects purely due to water regime (seapage and/or flow) or due to a combination of nutrient enrichment and factors increasing dynamics?" will be given below.

The lens of Ben Glenisky has a vegetation comparable with the "zero-bog lens" Dolan. Also pH and Ca^{++} + Mg^{++} values are comparable. The saddle of Errisbeg has a different vegetation than the comparable situation on the Ben Glenisky lens. The enriching influence of the primary nutrient-rich gabbro-diorites through seepage is significant. Thus, the major question what influences the typical Errisbeg vegetation, compared with purely ombrotrophic blanket bog is answered.

The vegetation of drainage channels on Errisbeg and Ben Glenisky does not differ very much. The major reason for this may be unwanted drumlin effects on Ben Glenisky, which very likely caused the high Ca^{++} + Mg^{++} and pH values.

It is obvious however that flow water does heavely affect the vegetation. The separation of the effects of water action alone from the effects of high concentration of nutrients on the vegetation could, however not be accomplished.

The final conclusion is that differences observed in the vegetation of the mountain transects are caused by a combination of factors. Thus a richer substratum and a higher input of nutrients, derived from parent material and transported by seepage, together with enrichment of the flowing water itself, independant of rock type, gave rise to the typical vegetation of Errisbeg and Ben Glenisky.

5.5. Lakes and wetlands

5.5.1. Introduction

In this part an evaluation of the lake problem will be given. Therefore a short description of each investigated lake will be given in 5.5.2. These lake descriptions give just that kind of information which is not easily derived from the vegetation maps themselves.

In 5.3.3. a description of important, typical or frequently occurring vegetation zonations will be given; from these spatial zonations some general succession hypotheses are generated.

Finally, the questions put forward in the previous chapters will be discussed in 5.5.4. Differences within and between the transects and similarities between the "rain catcher" data as well as the chemical analysis of the lake water and the vegetation pattern will be evaluated. Furthermore an attempt is made to evaluate in what respect human activities are responsible for the observed differences in vegetation.

5.5.2. Lake description and vegetation maps

In these lake descriptions, emphasis is put on that kind of information that is not easily derived from the vegetation maps, including features such as water regulation, "Verlandung", distance to the sea and information about the surroundings of the lakes. The location of the lakes is indicated in fig. 1 where the same abbreviations were used for the names as in 3.1.1. (choice of transects). The descriptions of the lakes refer immediately to the corresponding vegetation maps (see appendix, fig. 13).

Two vegetation maps (A and B) have been made for each lake, as is explained in 3.7.1. The A-maps show only the units of a rather high classificatory level, such as classes, alliances or associations. The legend of the maps (see appendix) gives the names of these main vegetation units; the subdivisions of the main groups (the table units), all have the same kind of shading to show more easily the relation between these subdivisions.
For example, the class Littorelletea is characterised by a vertical shading and within this class, the solid vertical lines represent the Samolo-Littorelletum; the broken lines represent the Isoeto-Lobelietum and alternating solid lines and broken lines are Eleocharetum multicaulis.

The B-maps give much more detailed information. These maps show the mapped field-units, adapted according to the vegetation units of the tables.

The reason for making the A-maps (as well as the B-maps) is, that these A-maps are more easily readable and they give a better overall view of the vegetation types of the lakes.

In the B-maps, asterisks were sometimes used to indicate that the vegetation differs slightly from the units in the tables; these particular types often have one or two mostly dominant species and they do not occur exactly in the tables.
The meaning of the different asterisk numbers is indicated on the maps.

Some of the vegetation maps need further comment, because they have a different construction: Gorteen Bay and Aturtaun are represented by only one map, a combination of A and B. Due to the small size of those lakes and the relatively small number of vegetation units it was not necessary to make two maps. Truska-mire is also represented by only one map in which no complete mapping of the vegetation units is presented, but only the location and the kind of vegetation type of the relevés is indicated. This is explained further in the description of this mire.

TRANSECT I

DOG'S BAY (Dog)

Location: On a small peninsula, south west from Roundstone, only 80m from sea (SW-direction).

Type of lake and shore characteristics: This lake near Dog's Bay is a small lake on the bottom of a little valley. In the southern part a ditch connects the lake with a stone wall at approximately 80m, that forms a natural dike, separating the valley from the pebble beach. The shores are built up by organic material, that forms a thick layer on the underlying rock. The water is brackish, with very high values for Cl^- and $Ca^{++} + Mg^{++}$.

Surroundings: This lake is surrounded by dry dune grassland, in commonage. The lake itself is heavily used as a drinking spot by cattle. As a consequence the shores are heavily trampled.

Water regulation: It is possible that during storms and high tides seawater enters this lake by the above mentioned ditch.

Main vegetation types: Polycorms of Phragmitetea species (Cladium mariscus B9-B10, Typha latifolia B6, Schoenoplectus lacustris B5) and Juncus subnodulosus form the bulk of the vegetation. In the open water the Potametum graminei (A3) and Potameto-Nupharetum (A8) are found.

Remarks: Probably due to the high degree of disturbance by trampling of cattle and fluctuating but high salt concentrations, vegetation types in this lake have a coarse pattern and are poor in species. Polycorms often are built up by only one or two species. The occurrence of Ruppia maritima in this lake also points in the direction of brackish conditions. This lake was surveyed on 16-7-1975.

GORTEEN BAY (Gor)

Location: On a small peninsula, south west from Roundstone (just as Dog's Bay) at 30m from sea (northern direction).

Type of lake and shore characteristics: This lake is very small, (30 x 10m), consisting of two connected lobes and situated in a small valley that is sloping towards the sea in the North. The lake itself is completely filled in, thus having formed a rather thick organic soil, overlying calcareous (=Foraminiferous) dune sand.

Surroundings: The lake is surrounded by dry dune grassland in commonage , heavely grazed. Trampling of the vegetation by cattle was obvious.

Water regulation: No visible in- or outlets from the lake were found. The sea influences this lake, especially from the open north side of the valley.

Main vegetation types: The only vegetation type found in this lake is a variant of the Eleocharetum multicaulis, dominated by Eleogiton fluitans.

Remarks: This lake, although situated closer to the sea than Dog's Bay, shows considerably less influence from the sea. Cl^- and Ca^{++} + Mg^{++} values are high but not extremely. This may be due to a somewhat higher position on the beach, and more shelter from south-westerly gales. The occurrence of Hippuris vulgaris in great amounts still indicates some influence however.

This lake was surveyed on 16-7-1975.

LOUGH NAMANAWAUN (Nam)

Location: The first lake in transect I, about 1000m from the ocean (SW direction).

Type of lake and shore characteristics: The lake consists of two distinct parts, an eastern part that is completely filled in and a western part that still contains open water. The western border of the latter part is steep and rocky, but is now completely filled in and overgrown by a "Verlandungs" vegetation, due to its sheltered position with regard to the prevailing south-western winds. The eastern shore still is stony with only a thin layer of thin organic mud, exposed as it is to the combined action of wind and waves. The main impression is one of high productivity, as expressed by the degree of "Verlandung".

Surroundings: The lake is completely surrounded by pastures and trampling by cattle was obvious mainly on drinking spots.

Water regulation: In the eastern part a pre-existing stream (according to Ordnance Survey maps) has been excavated in order to improve the drainage and with the ultimate objective to turn the swamp into grazing land. This excavation was done 5 years previous to our investigation.

The water in the ditch flows from NE to SW and ultimately reaches the ocean. On the east side, Namanawaun is connected with Murvey by a small ditch.

Main vegetation types: The main vegetation in the west part of the lake consists of polycorms of Menyanthes trifoliata, Schoenoplectus lacustris, Phragmites australis and Cladium mariscus (B1,B5,B11 and B10), preceded by Potametea communities (A6,A9) and followed by sedge communities of the Caricion curto-nigrae (J1), together forming a very good example of a hydro-series. On the east shore, communities of the Isoeto-Lobelietum (D5,D6) do occur. In the east part, large polycorms of Cladium mariscus and Phragmites australis are still to be found, but in a mosaic with communities of a somewhat drier habitat of the Eleocharetum multicaulis (F2,F3,F4) and the Molinia caerulea-Myrica gale nodum (M3, M4).

Remarks: Due to the recent improvement of the drainage by a farmer and the irregular mowing of Cladium mariscus and Phragmites australis, major vegetation changes are occurring in the east part of Lough Namanawaun, causing a very patchy and irregular distribution of vegetation types. Drier and grassier vegetation types are spreading due to drainage, whereas the ample occurrence of Eleocharetum multicaulis communities may be due to the mowing of the tall reed.

Apart from the trampling by cattle the west part looks quite undisturbed and the water is pumped up for water-supply.

Within the large polycorms of Cladium mariscus, the first elements of the Osmundo-Salicetum were noted, namely Salix cinerea and Osmunda regalis.

Eriophorum gracile is found in a stand of the Eleocharetum multicaulis, in between poorer vegetation of the Molinia caerulea-Myrica gale nodum on drier habitat and richer reed swamp vegetation.

Another remarkable species is Najas flexilis, found near the rocky east shore of the west part of the lake in a stand of the Isoeto-Lobelietum.

The lake has been surveyed on 7-7-'75.

LOUGH MURVEY (Mur)

Location: This lake is situated in transect I, at 1370m from the ocean (SW-direction), within the coastal area, which is cultivated by man.

Type of lake and shore characteristics: Lough Murvey is a rather small coastal lake, nearly completely filled in, that is positioned in a SW-NE direction, rather sheltered by rocky oucrops. The north-east shore is rather rocky with only a thin soil layer, the north-west, south-west and south-east borders of the lake have a thicker soil and show considerable "Verlandung".

Surroundings: The lake is bordered by a community of the Molinio-Arrhenatheretea that merges into grassland where cattle is grazing. East of the lake there is a public well, but water is also pumped directly out of the lake.

Water regulation: On the north-west side a ditch connects Lough Namanawaun with Murvey Lough. Inflow of the east side occurs via an 'inflow valley' and further, rainwater and water from the surrounding fill the lake.

Main vegetation types: The main vegetation types occurring in this lake are variants of the Eleocharetum multicaulis (F2, F3 and F4), the Caricion curto-nigrae (J2 and J4) and the Sparganio-Nymphaeetum (A10). In the east part of the lake zonations from Potametea via polycorms of Schoenoplectus lacustris, Equisetum fluviatile and Typha latifolia occur, merging into Littorelletea of which only some species are present. On the west side however the vegetation types mentioned above are followed by broad zones of Caricion curto-nigrae communities (J2, J4 and H2) before merging into Molinio-Arrhenatheretea shores.

Remarks: S.W. Connemara is the only, recently discovered growing place for Eriophorum gracile in Ireland. In this lake it is growing very abundantly just within the transition of Caricion curto-nigrae to Phragmitetea (in F4). The border between H2 and J2 on the west side of the lake is equivalent with a grazing border (fence).

Date of survey, 14-7-1975.

LOUGH ATURTAUN (Atu)

Location: This lake is situated in transect I, at 1900m from the ocean (SW direction), on the border of the blanket bog area and the cultivated land.

Type of lake and shore characteristics: Lough Aturtaun is a rather small lake with "Verlandung" on the west shore, consisting of quaking mire vegetation. The north and west shores are stony, pasture-like, strongly trodden by cattle and horses. The open water holds underwater communities of the Potametea. The edges of the lake sides mainly consist of Molinio-Arrhenatheretea vegetation.

Surroundings: The south side of the lake is bordering the coast road from Clifden to Roundstone, of which drainage water flows into the lake. On the west side a little road for peat transport goes into the bog area, on the north west side there is a trampling spot for horses and cattle. An obvious human influence are the many bottles and cans dumped in the lake.

Water regulation: The water from the main-road situated at a higher level flows into the lake via little flow ditches. No other visible drainage systems were discovered. The lake is mainly fed by rainwater and drainage water from the direct surroundings.

Main vegetation types: This is the first lake of transect I (from coast to inland) in which the class Scheuchzerietea is represented (N).
The occurrence of the Schoenus nigricans-Scorpidium scorpioides nodum (L2 and L4) indicates an enrichment, probably caused by the flow water from the road. A conspicious feature is the nearly pure stands of Cladium mariscus or Menyanthes trifoliata in the open water, just in front of the quaking mire vegetation. The vegetation of the flow ditches resembles the ditch vegetation of the blanket bog.

Remarks: Menyanthes trifoliata "behaves" as a pioneer in the open water. The class Littorelletea is sporadically represented by Eriocaulon septangulare in the south side and Baldellia ranunculoides in the north point of the lake. Eriophorum gracile occurs with Juncus subnodulosus in the south western corner (F4). The quaking mire vegetation of the south and west shores probably is not grazed because of its inaccessibility.
Date of survey: 1-9-1975.

LOUGH TRUSKA NEAR ERRISBEG (TrB)

Location: It is the fourth lake in transect I, at 2534m from the sea in south west direction, in the middle of blanket bog, west of Errisbeg. The addition "near Errisbeg" is made to distinguish the lake from Truska lake and Truska Mire on Bunowen peninsula.

Type of lake and shore characteristics: The lake is a typical bog lake with much open water and no signs of "Verlandung". The shores are stony everywhere. At the west side sharply cut-off peat sometimes forms the shore. The bottom of the lake is rocky, covered with a thin layer of organic mud. As far as our observations went, the lake was reasonably shallow at the west side (nowhere deeper than one metre) but at the east side, especially where steep cliffs were found, its depth attains several metres.

Surroundings: The lake is surrounded by blanket bog and rocky outcrops covered with heather vegetation. Along the west shore runs a road, used for transport of peat cut intensively in the close neighbourhood of Lough Truska.

Water regulation: Water flows into the lake at three places, two on the southern side, coming straight from rocks higher up, and one in the north, coming from a blanket bog area. In the north east the only outlet from the lake occurs.

Main vegetation types: The main vegetation type in the lake is the Isoeto-Lobelietum in its typical form (D6), forming dense mats with much Eriocaulon septangulare on the west side, and a more open vegetation of mainly Lobelia dortmanna and Littorella uniflora on the east side. Cladium mariscus and Schoenoplectus lacustris are often present, the first forming dense clones sometimes. On places where water flows into the lake, a somewhat richer vegetation develops, mainly the Schoenus nigricans-Scorpidium scorpioides nodum (L2). On the open rocky shores of bays on the eastern side, Samolo-Littorelletum is found (E3).

Remarks: The usual distinction between west and east in the lakes is also found in Lough Truska, enhanced by steep cliffs on the eastern shore. Parts of the lake, especially the northside are in use as a dump. Many empty cans and bottles were noted. As a rarity, Najas flexilis was found in this lake. In the Erica cinerea border on the east shore some Salix aurita occurs here and there.

Date of survey 26-9-1975.

LOUGH NALAWNEY (Nal)

Location: Lough Nalawney is situated in transect I, at the northwest base of Errisbeg. The distance to the ocean is 3850m in SW direction.

Type of lake and shore characteristics: A rather big lake along the west-east axis, sheltered from the south by Errisbeg. The north to south-west shores are peaty and overgrown; the eastern part of the lake has bare, stony shores. The west-east division of the vegetation is very clear.

Surroundings: The surrounding vegetation belongs to the Oxycocco-Sphagnetea and reaches the lake at the south-west side. At other places a shore zone is formed by alternation of stands of Molinia caerulea, Myrica gale, Schoenus nigricans and Erica erigena (M4), especially on the low shores, and a community of the Nardo-Callunetea on the steeper rocky shores. No turf is cut in the immediate environment.

Water regulation: There are a few inflow ditches and rivulets; the two most important rivulets, coming from the saddle of Errisbeg, enter Lough Nalawney at the north and east side. There is one main outflow at the west side of the lake.

Main vegetation: The main vegetation types: The Isoeto-Lobelietum can be found on the west side of the lake, where it is forming mats with a loose cover of Phragmitetea species, like Phragmites australis and Cladium mariscus. Most typical for this lake is the hummock and hollow pattern at the north and west side, that consists of an alternation of stands of the Schoenus nigricans-Scorpidium scorpioides nodum (L3) and the Molinia caerulea-Myrica gale nodum (M4). Here, big bushes of Erica erigena occur. In the south-west corner the hummocks (M4) without Erica erigena alternate with communities of the Littorelletea (D2, E4 and F6). A Potametea vegetation with Potamogeton natans and Nymphaea alba is typically following the stream of the rivulets.

Remarks: The lake was surveyed on 30-9-1975 and on 1-10-1975, after heavy rainfall, which caused an inundation of the rivulets, especially on the west shore. The region around this lake and up to the saddle of Errisbeg is the only known place for Connemara where Erica erigena (=mediterranea) grows.

LOUGH SUFFRAUNCAM (Suf)

Location: Lough Suffrauncam is the last lake in transect I, situated about 8230m from the ocean, in the centre of the bog area of South-West Connemara.

Type of lake and shore characteristics: It is a typical, rather deep bog lake. The shores are steep and peaty. Locally the shore is more flat, especially on places where little bog-streams enter the lake. Also the bottom of the lake consists of peat, but sometimes this peat layer is rather thin (20cm).
A "Verlandungs" vegetation does not occur. The most remarkable difference between the western and eastern part of this lake, is the occurrence of vegetation in the western part, consisting of Schoenoplectus lacustris only.

Surrounding: The lake is completely surrounded by a community of the Oxy-cocco-Sphagnetea. Due to the well-drained lake shores, a small border of Erica cinerea or Calluna vulgaris occurs.

Water regulation: As end point of transect I we choose a lake with no connections to other lakes, in order to have the best "zero-situation" as possible. So except from small bog-streams, this lake only receives water from precipitation.

Main vegetation types: The most important vegetation type is typical for a bog lake: the Isoeto-Lobelietum (more than 40% of the total vegetation cover). Both the typical subassociation and the subassociation of Cladium mariscus do occur. Remarkable is the extensive area in the western part of the lake covered with a sparse stand of either Schoenoplectus lacustris or Phragmites australis. As the exact composition of these communities is not known (nearly impossible to investigate), we assign this community to the Phragmitetea, although the under water part of this vegetation might consist of Eriocaulon septangulare or Lobelia dortmanna. The islands in the lake are all covered with a community of the Ulicion.

Remarks: Although Lough Suffrauncam is rather well isolated from the surroundings it is possible that "Hill 201" has a certain influence on the lake vegetation. Water streaming off its slopes and flowing over the bog surface can have certain enrichment effects. This might be a possible explanation for the occurrence of Schoenoplectus lacustris, Phragmites

australis and Potamogeton natans.
An interesting species for this lake is Najas flexilis.
The lake has been surveyed on 29-9-'75.

TRANSECT II

LOUGH SILVERHILL (Sil)

Location: Lough Silverhill is the first lake in transect II, at 740m from the ocean in SW-direction and 1690m from the ocean in NW-direction, on Bunowen peninsula.

Type of lake and shore characteristics: Silverhill is a small coastal lake, consisting of two parts, separated by a dense "Verlandungs"-vegetation and situated in a sand dune area. It has a sandy bottom and rocky or sandy (lime-rich) shores.

Surroundings: The lake has a relatively sheltered position near the sea; on the north-west side the lake is sheltered by a large steep rockwall and on the north side by dunes. The vegetation of the north, north-east and south shore merges into intensively used common grasslands on soils rich in lime. The south-west shore is bordered by a drained hay meadow. The vegetation of the south corner is highly influenced by inflow of salt water.

Water regulation: The lake receives its water mainly from rain and from flow from the direct surroundings. No connections with other lakes are found. An inflow ditch in the south corner forms the connection with the ocean, which, with extremely high tides transports the seawater in the direction of the lake. There is however a little lock built into this ditch. Probably this ditch also functions as outflow ditch for lakewater when the waterlevel is high.

Main vegetation types: The larger part of the lake presents a "Verlandungs"-community of polycorms of Typha latifolia and Phragmites australis (B6 and B11), followed by a community of the Caricion curto-nigrae (J4). The smaller south part of the lake has less broad zones of polycorms of Equisetum fluviatile, adjacent to Phragmitetea communities (C1 and C2), followed by J4 again. Both parts have an open water vegetation belonging to the Potameto-Nupharetum. Typical for this lake is the occurrence of brackish water vegetation (C1 - C3). The occurrence of the following species is very indicative for the saltwater influence:
Triglochin maritima, Hippuris vulgaris, Ranunculus baudotii, Scirpus rufus, Schoenoplectus tabernaemontani, Scirpus maritimus, Juncus bufonius ssp. ambiguus and Ranunculus sceleratus.

Another remarkable feature of this lake is the occurrence of Filipendulion communities, a border vegetation with many tall forbs, on the north-west side of the lake (sheltered side).

Remarks: The lake has been mapped twice, in spring (20-6-1975) and in autumn (3-10-1975). The seasonal changes have been taken into account in the final map.

LOUGH AILLEBRACK SOUTH (AiS)

Location: The second lake in transect II, situated close to Lough Aillebrack North at 1110m from the ocean (SW direction).

Type of lake and shore characteristics: The south side of this lake is directly bordering the lime-rich dunes. This situation probably determines the character of the lake. Under the influence of strong south-westerly winds, large amounts of calcareous material are blown in the lake. The bottom consists nearly completely of this material. Along the south and south-west shore the "blowing in" is probably such a dynamic proces that vegetation on these shores is completely lacking. Along the west and northern shores the situation is probably more stabilized, resulting in deposition of organic mud and in the occurrence of "Verlandungs vegetation".

These "Verlandungs" communities occupy only a small part of this lake.

Surroundings: This lake is nearly completely surrounded by lime-rich dune grasslands, used as common pastures.

Water regulation: At the east side of a small stream enters the lake, bringing in water from Lough Derreen.

Main vegetation types: The main vegetation type of this lake belongs to the association Potametum graminei, in particular the typical subassociation (A3 and A4). This community occupies nearly the whole lake (70%). Other vegetation types like Parvocaricetea and Phragmitetea only occupy small areas.

Remarks: Although this lake is situated close to the ocean it does not show as large a production as one would expect for such a coastal lake. A possible explanation might be the precipitation of phosphate under influence of lime-rich substratum. So the phosphate concentration can be low in these lakes. This might also be an explanation for the occurrence of Littorella uniflora in this lake.

The occurrence of Potamogeton pectinatus, Schoenoplectus tabernaemontani and Ruppia maritima is not strange but worth mentioning.
The lake was surveyed on 2-9-1975.

LOUGH AILLEBRACK NORTH (AiN)

Location: This lake is the second lake in transect II, situated at the edge of the dune area. The distance from the ocean is 1160m in SW- and 2320m in NW-direction.

Type of lake and shore characteristics: Aillebrack North is a lime-rich lake lying along a south-north axis. The west shore shows "Verlandung", the east shore is rocky and rather bare. The sheltered north side of the lake is sandy and overgrown, the south shore consists of bare dune-sand.

Surroundings: For the greater part the lake is surrounded by lime-rich dune grasslands. Only the northern side is bordering pastures. Cattle is grazing around the lake and at some places trampling can be seen.

Water regulation: At the south-east point of the lake there is an outflow ditch. When the water level is high, water from Aillebrack North flows to Aillebrack South. Further more the lake receives water from the surrounding area and from rainfall.

Main vegetation types: In the open water of the lake, communities of the Nymphaeion (A5 and A8) occur, near the shores here and there with polycorms (B6, B7 and B8). At the north and south side of the lake, complex communities of the Phragmitetea, Parvocaricetea and Molinio-Arrhenatheretea alternate. Along the stony east shore a small zone of the typical variant of the Samolo-Littorelletum (E2) occurs.

Remarks: Polygonum amphibium is present and forms dense mats. Characeae are abundant and like Potamogeton species often show lime deposits on the leaves. Potamogeton coloratus is also an abundant species in this lake. Comparison of maps of various age (Geological Survey map, sheet 93, published in 1901) indicates that after about 1876, Aillebrack Lough was partly filled up by blowing sands. By this way two separated lakes were formed. We called them Lough Aillebrack North and Lough Aillebrack South.
This lake was surveyed on 28-8-1975.

EMLAGHARAN LOUGH (Eml)

Location: The lake lies in transect II, within the cultivated land on Bunowen peninsula. The distance to the ocean is 1370 m (SW) and 2110 m (NW).

Type of lake and shore characteristics: A small nutrient-rich lake connected with a westerly lobe. This lobe shows complete "Verlandung" and is not indicated on the Ordnance Survey maps. The lake is surrounded by rocks, the south side has a steep rock wall and the open water is deep. "Verlandungs" zones are present: broad at the west side but narrow and with a different character at the east side of the lake.

Surroundings: The vegetation of the shores merges into the surrounding grassland. Many stone walls are ending at or in the lake. The north side is used as a watering place for cows.

Water regulation: No ditches or connections with other lakes are found. The water supply comes from precipitation and the direct surroundings.

Main vegetation types: Communities of Potametea, Phragmitetea and Parvocaricetea occur with several aspects. No Littorelletea vegetation is present. The main vegetation type belongs to the Parvocaricetea (B3,J1,J5). At the west shore the "Verlandung" is preceded by a Menyanthes trifoliata zone, at the east shore by a stand of Schoenoplectus lacustris. Moreover, Phragmitetea are represented by polycorms of Phragmites australis.

The westerly lobe contains communities of the Molinio-Arrhenatheretea (I), with elements of the Parvocaricetea:
Juncus subnodulosus, Carex nigra and Juncus articulatus.

Remarks: The lake has been mapped and described in June (27-6-'75).
In October (3-10-'75), the data were amplified with more detail. The most remarkable seasonal difference observed during the second survey is the dying off of Menyanthes trifoliata.
Except for the north part of the lake, the soil layer is very deep (more than 3 m).

LOUGH DERREEN (Der)

Location: Lough Derreen is the fourth lake in transect II, on Bunowen peninsula, at 2800m (NW) and 1930 (SW) from the ocean. It consists of two parts, connected by a channel. Only the northern part has been mapped.

Type of lake and shore characteristics: The northern half of the lake shows considerable "Verlandung". This is especially true for the north lobe of the mapped part of the lake. The south-west and east lobe both still have open water, and show again that "Verlandung" is more pronounced on west than on east shores. The east shores are rocky, with only a thin layer of organic depot. The west shore and the complete north lobe have thin organic substrata.

Surroundings: The lake is surrounded by walled meadows, used for hay making and grazing. Large rocky outcrops sometimes occur, penetrating into the lake.

Water regulation: In the south, a small channel connects the two parts of the lake. In the north, water from a ditch flows into the lake and in the south-east two ditches flow out again. Small depressions, sometimes indicated by a slightly different vegetation type, still mark the former streamline of the water in the northern lobe.

Main vegetation types: The main vegetation type of Derreen is a complex mixture of closely related communities from different tables. They were mostly not clearly distinguishable in the field and they have therefore not seperately been mapped. The components of this mixture are: Eleocharetum multicaulis, subassociation potametosum, subvariant with Carex lasiocarpa (F7); a part of the Scorpidio-Caricetum lepidocarpae (transition to the Caricion curto-nigrae, K6); and finally a component that shows some influence of Phragmitetea and in the transition between Phragmitetea and Parvocaricetea. More towards the shore a somewhat dryer stand with a Scorpidio-Caricetum lepidocarpae vegetation occurs, as is shown by the presence of Molinia caerulea and Myrica gale (K4). Bordering the open water more typical zonations are found from Potametea (A2) via polycorms (B2, B5, B7 and B9) to Samolo-Littorelletum subassociation of Carex panicea and Carex demissa (E2) or Carex nigra-Juncus articulatus association itself (J1), after which follows the grassland.

Remarks: The difficulties in classifying the vegetation of Lough Derreen are mainly due to the proces of "Verlandung" over a large area (c.f. Truska Mire, Lough Namanawaun and Lough Antony). Slight differences in the water table cause a mosaic of vegetation types, merging into each other. This is especially difficult in Lough Derreen, situated in the transition from rich to poor in transect II, so that the poorest variant of Tofieldietalia and Phragmitetea meet the richer communities of Littorelletea and Caricetalia nigrae.

This lake was surveyed on 26-8-1975.

LOUGH ANTONY (Ant)

Location: A lake and swamp lying alongside the road to Doonloughan Bay, more or less NW-SE orientated and about 350 m long. The lake lies in transect II, in the middle of Bunowen peninsula, 2590 m (SW) and 2530 m (NW) from the ocean.

Type of lake and shore characteristics: Lough Antony, like most of the lakes on Bunowen peninsula, shows considerable "Verlandung". In fact it is more a swamp than a lake. Bits of open water are only found in the northern and eastern part. The typical contrast between east and west shore is demonstrated. The eastern lobe shows less "Verlandung" than the rest of the lake.

Because of the filling in, the original shore lines, as drawn on the Ordnance Survey maps, became diffuse and in several cases vegetation types are mapped outside the original shore line, because they clearly belong to the lake shore vegetation. Nearly all of the vegetation in the lake forms a floating mat on very thin organic mud of a few metres deep.

Surroundings: The lake is surrounded by walled meadows in use for grazing and hay making. On the western border there is a cottage.

Water regulation: No clear water inlet was found. Water from the surrounding land flows freely into the lake.

In the extreme north, there is evidence of an overgrown ditch.

Main vegetation types: The main vegetation type in the lake is a floating mat of Sphagna with Carex species, mainly Carex diandra, belonging to the Anagallido-Caricetum diandrae, subassociation of Sphagnum contortum (J6,J7). This subassociation is completely restricted to this lake.

In somewhat wetter depressions Carex rostrata is abundant, whereas in somewhat drier parts Myrica gale becomes dominant, mainly as a fringe following the lake shore. In the southern lobe the contrasts between wet and dry are greatest, ranging from Ulicetea on rocky outcrops (Q) to wet parts with Equisetum fluviatile dominant. This causes a complex mosaic of vegetation types also to be found in the eastern lobe. A typical "Beyerinck-zone" has developed between the floating mat and the shore, where there is a fluctuating water level. Here, along the east shore, is the typical place for the Eleocharetum multicaulis type of vegetation (F4,F5,F6).

Remarks: The lake is surveyed on 1-9-'75.
In the southern lobe a fence is running through the lake, separating a grazed and a ungrazed part. This shows up very clearly in the field: the ungrazed vegetation is higher and contains more (flowering) herbs. The syntaxonomical differences however are small.
As to the "Verlandung" of Lough Antony, an older inhabitant of the area could remember the swamp to be a real lake some 30 years ago, of which remained a broad channel running north to south about 20 years ago.
The lake is named after one of the authors, because it had no name on the Ornance Survey maps we used.

LOUGH ANASERD (Ana)

Location: In the centre of Bunowen peninsula and end point of transect II, 3110 m (SW) and 2960 m (NW) from the ocean.

Type of lake and shore characteristics: Although Lough Anaserd is not situated in the bog area, this lake has typical bog lake characteristics. "Verlandung" does not occur, except in some little sheltered bays, but the "Verlandungs" vegetation in these bays is of another type than in coastal lakes.
The most important difference between the eastern and western shore is the size of the area with lake-bottom vegetation. Along the west shore, the Isoeto-Lobelietum occupies a much wider zone than along the east shore. On very stony, exposed places on the east shore vegetation is completely lacking.
The shores are stony or rocky and on very few places sandy.

Surroundings: The lake is surrounded by a locally intensively grazed community of the Nardo-Galion. On drier, well drained shallow bottoms a community of the Ulicion occurs. Communities of the Molinio-Arrhenatheretea are lacking around the lake.

Water regulation: The investigated area is only a part of the lake as a whole. Water circulates freely between these parts.

Main vegetation types: The vegetation of this lake completely belongs to the Littorelletea, notably the Isoeto-Lobelietum. On stony or gravily shores communities of the Samolo-Littorelletum form a narrow zone.

Remarks: The lake is surveyed on 21-9-'75.

Due to the dimensions of Lough Anaserd (about 1x1 km) only a part of this lake has been studied. The most westerly bay, which fitted well in transect II was chosen. In this part also differences between east and west shore could be analysed.

Remarkable species in Lough Anaserd are Subularia aquatica and Isoetes setacea.

TRUSKA LOUGH (TrL)

Location: The lake is situated on Bunowen peninsula, Transect II. The distance from the ocean is 2900 m (SW direction) and 1850 m (NW direction). See also remarks.

Type of lake and shore characteristics: Truska Lough is a very long (1 km), narrow and deep lake. Due to the large area of open water, this lake has the character of a bog lake. This is particularly true for the east shore where "Verlandung" does not occur. On exposed places on the east shore, vegetation is sometimes completely lacking.

The vegetation belt along the west shore is much wider and "Verlandungs"-stadia are present.

The shores of this lake are rather steep and rocky, but in small bays the shore is sandy or gravely and somewhat flatter.

Surroundings: This lake is surrounded by pastures. On drier spots communities of the Nardo-Callunetea occur. The influence of cattle (trampling) is only seen on places with a flat shore.

Water regulation: The south point of Truska Lough is connected with Lough Derreen by a brooklet. There is also a connection with Truska mire, a large mire with rich fen communities west of Truska Lough.

Main vegetation types: The main vegetation types of Truska Lough are polycorms of Schoenoplectus lacustris (B5), bordering the open water especially along the east shore and of Cladium mariscus along the west shore, behind the Schoenoplectus stands.
In particular along the less dynamic east shore, communities of the Isoeto-Lobelietum (subassociation of Myriophyllum alterniflorum) occur.
Communities of the Samolo-Littorelletum often occur as a small zone on sandy or gravely shores.
Also communities of the Caricion davallianae are present (west shore), but these are either stands dominated by Molinia caerulea and Myrica gale (K4) or transitions to other syntaxa (K5,K6).

Remarks: This lake is not exactly situated in transect II (see fig. 1), but we surveyed this lake to trace the influence of north-westerly winds and the lime-rich sand dunes, locally consisting of shifting sands, situated north and west of Truska mire.
Truska mire, Truska Lough and Lough Anaserd are lying in a short north-west transect.
In spite of the connection with Truska mire, there is not much similarity. Communities indicating lime influences are almost absent.
A remarkable species in Truska Lough is Sparganium angustifolium.
Date of survey: 21-8-1975.

TRUSKA MIRE (TrM)

Location: On Bunowen peninsula, west of Truska Lough. The distances from the ocean are 3060 m (SW direction) and 1210 m (NW direction).

Type of lake and shore characteristics: It is not correct to talk about a lake, for in this large mire (about 20 ha), only a few square metres in the easterly part remained open water. This "lake" has completely filled up. It is nearly certain that this mire formerly was a lake, the very thick (up to 3,5 m) organic mud layers under the vegetation testifying to this.
Along the whole north shore the mire is directly bordering the lime-rich dune area of north Bunowen peninsula. The influence is obvious: it results in very high Ca^{++} and Mg^{++} values and typical rich fen communities. The shores of this mire are mostly very flat and the mire vegetation gradually changes into the surrounding vegetation types.

Surroundings: The surrounding vegetation north of the mire consists of lime-rich dune grasslands. South there are pastures and on drier places communities of the Nardo-Callunetea occur.

Water regulation: In the east part of the mire, there is a connection with Truska Lough, but it did not become clear to us if there is free water exchange.

Main vegetation types: The greater part of this mire accomodates communities of the Scorpidio-Caricetum lepidocarpae (K1,K2,K3). These most typical communities of the rich fen association are almost completely restricted to this mire. The aspect of these communities is not the same in the whole mire. Various species can be dominant e.g. Juncus subnodulosus, Carex lasiocarpa, Schoenus nigricans and Carex elata, but the floristic composition of the various aspects do hardly differ. Moreover, the stands gradually merge into each other.

Transitions to surrounding communities are also very gradual, in the westerly part to the Molinio-Arrhenatheretea and along the south shore to the Myrica gale-Molinia caerulea nodum. A few spots with open water present a community of the Potameto-Nupharetum (A6).

Remarks: The shores and borders of the mire were difficult to recognize in the field and did not correspond with the contours on the Ordnance Survey maps. A big north lobe of the mire, indicated on the A map, had completely disappeared. For this reason we did not make a vegetation map of this mire. On the map of Truska mire (see Appendix) only the locations of our relevés are indicated and with the shading (like it is used in the other vegetation maps) the vegetation types to which the relevés belong are marked.

The mire has been surveyed on 18-8-1975.

TRANSECT III

LOUGH LETTERSHASK WEST (LeW)

Location: The first lake in transect III, within the cultivated area, along the Coast-road from Ballyconneely to Roundstone.
The distances from the sea are 470 m (SW) and 2740 m (NW).

Type of lake and shore characteristics: A deep lake that lies very close to the rocky sea-coast and therefore is strongly influenced by wind action. There is hardly a sign of "Verlandung", except for the northern part of the lake. The shores are stony and often bare. The differences between the west and east shore are little: the vegetation zone at the west side is broader than on the east side.

Surroundings: The surroundings vegetation consists of communities of the Molinio-Arrhenatheretea and Nardo-Callunetea. These grasslands are grazed by cattle.
The lake is used as a drinking-water reservoir.

Water regulation: The north part of the lake has a connection with Lettershask North. With high water levels, water may flow through it.

Main vegetation types: The main vegetation types belong to the Potametea, variant A1 of the Potametum graminei, which is restricted to this lake and to the Littorelletea (D8, subassociation of Myriophyllum alterniflorum). High on the shore a zone is formed by Juncus articulatus and some Littorellion species (E2).
Menyanthes trifoliata (B1) occurs as a pioneer in the "Verlandung" at the north side, followed by variant J2 of the Caricetum nigrae.
Communities of the Phragmitetea are present on the west shore with Phragmites australis and Scirpus maritimus.

Remarks: The lake is surveyed on 23-9-'75.
The inner borders of Potametea vegetation are rather roughly rendered.
It is not sure if the deeper central part of the lake has any vegetation.
The presence of some species is noteworth: Najas flexilis, Subularia aquatica in mass, Ranunculus trichophyllus, some Characeae, Polygonum amphibium and Potamogeton perfoliatus.
A vegetation with Eleogiton fluitans is restricted to an inflow ditch.

LOUGH LETTERSHASK EAST (LeE)

Location: This is the second lake in transect III, at 530m (SW) and 2850m (NW) from the ocean, situated within the cultivated area along the coast, along a north-east south-west axis.

Type of lake and shore characteristics: Lettershask East is a deep lake, with nearly no "Verlandungs" vegetation and with much open water. Only the rather sheltered north side has a more closedvegetation. The east shore has a sloping stony profile, the west shore is steeper.

Surroundings: The lake is surrounded by meadows of the Molinio-Arrhenatheretea. In the north part the vegetation merges into a Nardo-Galion grassland. Disturbance by man is not obvious.

Water regulation: An inflow ditch with probably enriched water enters the lake in the north corner, an outflow ditch at the south-west end of the lake connects this lake with Lettershask West.

Main vegetation types: The main vegetation type belongs to the Isoeto-Lobelietum (D8 and D9), subassociation of Myriophyllum alterniflorum. Along the borders of the lake there is a clear zonation from open water via Isoeto-Lobelietum to Samolo- Littorelletum (E1 and E2) and sometimes, to a stand of the Molinia caerulea-Myrica gale nodum (M2). Representation of the class Phragmitetea is small, only polycorms of Cladium mariscus occur. Juncus subnodulosus occurs typically in and nearby flow ditches in the northern part of the lake.

Remarks: Najas flexilis is found washed ashore on the east shore, together with partly decayed material of Eriocaulon septangulare and loose Potamogeton shoots (P. perfoliatus and P. gramineus). On the eastern shore, in a community of Eleocharis palustris some interesting species occur: Polygonum hydropiper, P. persicaria, Montia fontana, Samolus valerandi, Baldellia ranunculoides and Apium inundatum.
This lake was surveyed on 23-9-1975.

LOUGH KANKOGE (Kan)

Location: A lake in transect III at about 1580 m (SW) and 2270 m (NW) from the ocean, on the edge of the cultivated land an the blanket bog area.

Type of lake and shore characteristics: A typical bog lake with much open water. The north-east shore is exposed and stony, with none or nearly no vegetation (only in sheltered bays). Influence by water movement is high. The west and south-west shore is formed by a steep peat wall (perhaps cut off?). The lake is reasonably shallow, with many little islands. The lake bottom is muddy.

There is a very clear difference between the SW and NE sides of the lake. The SW side has a close lake bottom vegetation of Eriocaulon septangulare (100%) on a thin muddy soil, the NE lake bottom has a loose vegetation of Lobelia dortmanna and Eriocaulon septangulare in equal proportions with Littorella uniflora on a stony soil.

Surroundings: Along the east shore there is a road used for peat transport. The west side is bordered by cultivated land, the other lake borders are peat cutting areas. Along the north-east side of the lake watering-places for cattle are found.

Water regulation: A ditch on the north-east shore is connected with a neighbouring bog lake. On this place cattle gathers. Through an inlet on the west side water from the cultivated land flows into the lake.

Main vegetation types: The main vegetation type occurring in the lake is D6, the typical variant of the subassociation inops of the Isoeto-Lobelietum (being the most frequent variant of this association in the area). Sometimes it is found with a thin upper layer of Phragmites australis.

Along the lake shores a zone of Molinia caerulea-Myrica gale vegetation occurs (M2,M3,M4), but on the stony places the typical variants of the Samolo-Littorelletum (E2) and the Carex panicea-Carex demissa nodum (E5) occur frequently. Menyanthes trifoliata occurs as a pioneer in the open water.

Remarks: The presence of Isoetes lacustris and Isoetes setacea is observed. There is much loose growth of Phragmites australis in the whole lake. In the flow-ditches typical flow indicators are found like Potamogeton polygonifolius and Eleogiton fluitans. An enrichment indicator on those spots is Juncus subnodulosus.

Hardly any Potametea vegetation was observed, only some Potamogeton natans and Nymphaea alba.

The lake was surveyed on 24-9-'75.

LOUGH NACORRUSSAUNBEG (Nan)

Location: It is the last lake in transect III, situated in the blanket bog area along the Lettershask Road. The distance from the ocean is 2590 m (SW) and 3060 m (NW).

Type of lake and shore characteristics: Only the northern part of this big bog lake has been mapped and studied.

The lake has a peaty soil and the shores are mostly low, locally stony. Water movement because of the wind shows its influence: the west zone has a broad vegetation zone, the east shore is rather bare and stony except for sheltered bays.

Surroundings: The north-east shore was heavily damaged because of peat-cutting. Locally the cutting ditches reach the water. The lake is surrounded by a blanket bog vegetation of which sheep are grazing. Areas south-west and south-east of the lake have been burned.

Water regulation: The described part is connected with the west part of the lake and with a lake (L. Nacorrussaun) north of the Lettershask Road. At some places small inflow ditches from the bogland and possibly from surrounding lakes enter Lough Nacorrussaunbeg.

Main vegetation types: The main vegetation type belongs to the Isoeto-Lobelietum (D3,D5,D6).

The lake shores are bordered by a zone of Molinia caerulea and Myrica gale (M2,M3) and sometimes, on steeper shores, by a Nardo-Callunetea community. Locally, on stony shores the typical variant of the Samolo-Littorelletum occurs, often followed by variant D6 of the Isoeto-Lobelietum.

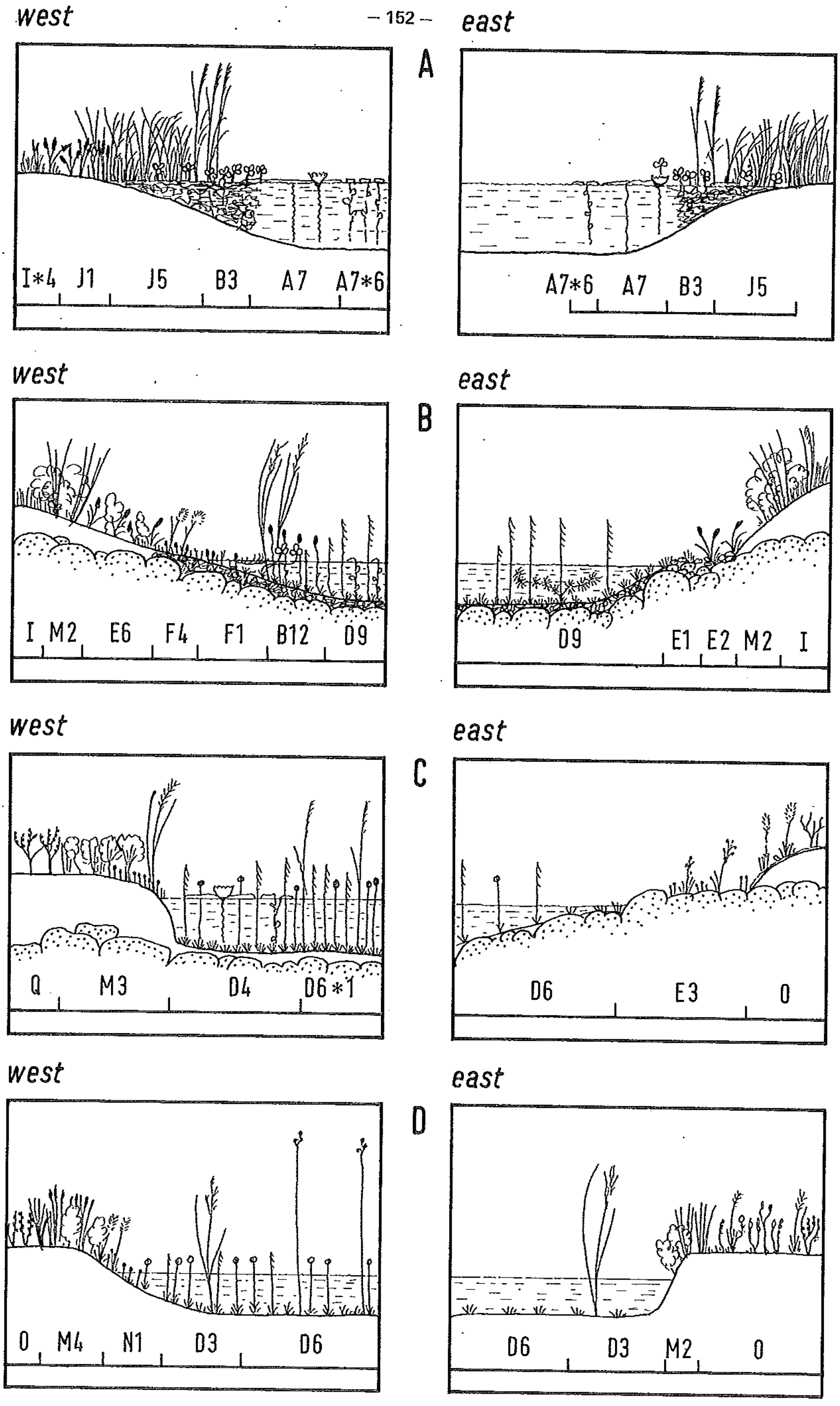
Remarks: The lake was surveyed on 26-9-'75. Along the whole east-shore, leaves of Isoetes setacea were found in large amounts.

5.5.3 Zonation and Succession

After the detailed description of all the lakes, this section will discuss on a more general level, features in common between all lakes, more specially the zonation of more or less belt-like communities found when going from open water to the drier surroundings.

These zonations have different patterns within these lakes. First of all the types of vegetation that contribute to these zonations vary, depending on the nutrient status of the lake. Secondly, within one lake there can be pronounced differences between eastern and western shores, due to wind and wave action. The last point of difference is whether the zonation has developed on thick organic substratum or on more or less bare rock. It will be clear that this is at least partly dependant on the two previous factors. Thick organic substrata are more likely to occur on sheltered shores of productive nutrient-rich coastal lakes, whereas rocky lake shores very often are found on exposed shores of nutrient-poor boglakes.

Out of all the lakes we choose the east and west shore of four lakes with the possible combinations of the three factors mentioned above. They represent to the best of our knowledge more or less typical situations. The first zonation pattern is derived from Emlagharan Lough (see fig. 10a), a nutrient-rich sheltered coastal lake from transect II, but not extremely close to the sea. Thick compact organic substrata have accumulated (left white in the drawing), preceded by a floating mat, under which thin, loose organic mud is accumulating (shaded in the drawing). These quaking mires are typical for these coastal lakes, where they are best developed on western shores. Zones are broader here and changes more gradual. Moreover in this particular lake, an extensive area of wet meadow is found on the western shore (see fig. 13). The morphology of the site (the mapped area forms the bottom of a kettle, completely surrounded by rock outcrops) suggests that this wet meadow land has developed on former fen vegetation. No such meadow is found on the opposite shores. The vegetation types that contribute mostly to this zonation are a nutrient-rich floating stand of Nuphar lutea, Nymphaea alba and Potamogeton spp, followed by Menyanthes trifoliata and tall reeds. Sedge vegetation of the Anagallido-Caricetum diandrae are found thereafter, with the Carex nigra-Juncus articulatus association and the wet meadow typically developed on the western shore.



A. ZONATION PATTERN IN EMLAGHARAN LOUGH

B. ZONATION PATTERN IN LOUGH LETTERSHASK-EAST

C. ZONATION PATTERN IN LOUGH TRUSKA IN THE BOG

D. ZONATION PATTERN IN LOUGH SUFFRAUNCAM

FIG. 10

The second zonation pattern is found in Lough Lettershask-East (see fig. 10b). This is the first lake of transect III close to the sea, exposed, but with no calcareous beaches in the neighbourhood. It is probably somewhat less productive and nutrient-rich than the previous lake. Thin organic substrata have developed on rocky subsoil but sometimes no substratum at all is found, especially not on the extremely exposed eastern shore. Shading again indicates the difference between compact and thin organic mud. There are no traces of larger areas that have been filled in. The plants that contribute mostly to the production are not very tall; especially communities with larger sedges are completely lacking. Instead of these, mats of Lobelia dortmanna and Eriocaulon septangulare cover the lake bottom, with some Potamogeton natans in sheltered corners. On western shores Eleocharis palustris with some Cladium mariscus indicates the tall reed zone, followed by richer units of the Eleocharetum multicaulis with Eleogiton fluitans. The Molinia caerulea variant of the Carex panicea-Carex demissa nodum forms the transition to the Molinia caerulea-Myrica gale fringe that surrounds the complete lake.
On eastern shores, only a sparse vegetation from the Samolo-Littorelletum on bare rock is found between this fringe and the open water.

The third zonation pattern is found in Lough Truska near Errisbeg, in the middle of transect I. Probably due to exposure, a rocky substratum is found on the eastern shore (see fig. 10c). Blanket bog overlying rock forms the western shore. Production in these poor lakes is very low, but there are still differences. A few Phragmites australis and Cladium mariscus plants still can be found on the western shore, together with some floating plants like Nymphaea alba and Potamogeton natans. A thick mat of Eriocaulon septangulare and Lobelia dortmanna covers the lake bottom. A similar community, but more sparse, is found on the other shore, followed by thinly scattered fragments of the Samolo-Littorelletum on bare rock. A Myrica gale and Molinia caerulea fringe acting as a transition to Oxycocco-Sphagnetea type of vegetation is lacking.

The fourth example is the last lake in transect I, Lough Suffrauncam (see fig. 10d). Completely surrounded by blanket bog vegetation, its shores and lake bottom are built up by peat.

Differences between eastern and western shores are less pronounced. The slope of the western shore is usually more gentle, whereas the eastern shores tend to have steep sides due to wind action. The major difference is that, due this more gentle slope, Scheuchzerietea vegetation can develop between the Myrica gale fringe and lake bottom vegetation of Eriocaulon septangulare and Lobelia dortmanna. This lake bottom vegetation moreover is somewhat more closed and contains somewhat more isolated tall reed plants, like Schoenoplectus lacustris, than are found on the opposite side.

In general, the zonation pattern is better developed on western shores than on eastern ones. On western shores a greater number of broader zones are often found and sometimes different vegetation types contribute to these zones within the same lake. When there is no major difference between types, usually the poorer variants with low cover values are found on the eastern shores. The reason for these differences is the circulation of the water driven by the south-western winds. This causes a back current along the lake bottom, concentrating silt, organic material and nutrients on the western shore. As expected, there are marked differences between coast and inland, but these differences will be discussed in more detail in the next section.

The question remains: can the observed zonation be in any way related to succession? In other words: is the spatial pattern repeated in time so that the observed sequence from wet to dry also represents a proces in time. For this purpose we made two comparisons, using two different time-scales.

First of all we used a table prepared by dr. D. Teunissen and drs. H. Teunissen-van Oorschot, which is based on pollen counts from a profile from the blanket bog in the Dolan area (See also Teunissen and Teunissen-van Oorschot 1978). Some 13000 years of time-span are covered by the analysis and, although the data cannot be related to one particular spot in the area, they give more or less quantitative information on the vegetation history. It will be clear from this table, when looking at the first four groups (the "wet" vegetation) that eutrophic open water was found in the beginning (Potamogeton natans, Nymphaea alba and Myriophyllum alterniflorum). This was followed by rich fen and reedswamp (not present anymore in the blanket bog area today). Species indicative of rich fen are Scorpidium scorpioides and Campylium stellatum. The main reedswamp species present in the sample was Phragmites australis, with some Typha latifolia and Eleocharis palustris. Probably at this stage the "Verlandung" really started, not only via reedswamp and rich fen, but also and more importantly, via blanket bog formation.

It is not surprising that this zonation in time over 13000 years cannot be found as a zonation in space in one particular lake, but when considering a somewhat larger scale in space, the sequence outlined above can be found again when going from the coast to inland areas. Eutrophic open water, fens and reedswamps are now restricted to the coastal strip after a probably much wider distribution in former times. Blanket bog in contrast, now covers almost every other square meter in Western Connemara.

When using a much shorter time interval, it becomes possible to relate the changes in time to a particular zonation in space. For this purpose we compared the contours of the lakes as drawn on our vegetation maps, with Ordnance Survey maps made at the end of the last century. This comparison gives an exact idea of what did change in a particular place, but it gives no qualitative information as to which vegetation caused the changes. The most obvious changes all occurred in coastal lakes. Lough Aillebrack North and Lough Aillebrack South formerly were connected. The NW lobe of Lough Truska contained more open water, occupying a part of what in this investigation is called Truska mire. Lough Antony is drawn connected with a smaller lake to the north. Lough Antony hardly can be called a lake anymore. In the Aillebrack lakes blowing sand probably caused the separation; in the other two lakes autogenic succession did take place. The vegetation types that form the bulk of these (partly) filled in lakes, are sedge communities from the Scorpidio-Caricetum lepidocarpae (Truska mire) or the Anagallido-Caricetum diandrae both indicating ecotone habitat. These vegetation types or closely related ones, are also found in belt-like zones in the same lakes and shores that show little or no "Verlandung" (See the vegetation maps of the lakes concerned). This suggests a proces of filling in, where at a certain stage the ecotone zone can expand into a larger area.
A complete reconstruction of the process is not possible with the little information available. It seems however, that "Verlandung" is not a universal process. It is probably of no importance in bog lakes with their very low productivity and exposed conditions. Here the main accumulation of organic matter takes place in the form of blanket bog formation. Under coastal conditions the filling in may take place, given some favourable conditions like shores being not too steep and rocky, not too exposed, not with too deep water and probably not too well drained (nutrient sink). When compared with blanket bog formation, the biomass productions seems much lower. This could be due to a greater decomposition rate near the coast.

In general there have been major changes in time, more or less parallel to the major climatic changes since the last ice age. Due to leaching under the very wet conditions in western Ireland, the situation seems to have changed from eutrophic, with much open water into oligotrophic waterlogged blanket bog. These changes in time are more or less reflected in space going from the coast inland. On a smaller scale, when filling in occurs, it can possibly be reconstructed from the zonation pattern elsewhere in the same lake. It is not claimed however that every zonation actually reflects a "Verlandungs" series. This seems unlikely for bog lakes but also for some of the richer coastal lakes with unfavourable conditions for filling in.

5.5.4. Evaluation of the lake transects

As already explained in 3.7.2., the relative area of main vegetation types in each lake has been measured (see fig. 11). This was done to enable an adequate comparison of the lakes within the transects to be made and to analyse differences between transects. Before discussing some general trends, some remarks to elucidate this table have to be made.

It was not possible to measure all the smallest vegetation units (variants), therefore only the area of vegetation units of a rather high level, the same as used in the vegetation maps A, were measured. The shading of this table agrees with that of te vegetation maps. This is also true for the sub-division of the units. Therefore the legends of the vegetation maps should be used (see fig. 13).

The last two vegetation types in fig. 11 contribute slighty to the vegetation of some lakes, but we dit not make relevés in those communities, so they are not accompanied with vegetation tables.
Concerning the Alnetea glutinosae, the association concerned is the Osmundo-Salicetum atrocinereae. The Nardo-Callunetea stand is of the association Ericetum-Caricetum binervis. Communities of the Oxycocco-Sphagnetea are absent in this table, they do not occur in the investigated lakes.

Every column represents the vegetation of one lake. The total area of the vegetation and the relative proportion of the different vegetation units is indicated in fig. 11. One error might be hidden in these figures, especially in lakes with much open water. Certain vegetation types (Potametea, Isoeto-Lobelietum) might be underestimated during the vegetation mapping and as a result of this, other vegetation types will be overestimated. Where these errors might be involved, will be discussed below.

Below fig. 11 the % "Verlandung" in every lake is indicated. To calculate this percentage, the total area of the whole lake is fixed as 100%. The area of Potametea, Isoeto-Lobelietea and open water, expressed as a percentage of the whole lake, is subtracted and the resulting figures are regarded as percentage of "Verlandung". These figures are not completely correct, for they also include communities such as Samolo-Littorelletum which do not have much to do with "Verlandung". These figures must be seen as an indication of the productivity of the lakes.

Fig. 12 presents mean values per lake of pH, Ca^{++} and Cl^{-} as measured by the water analysis. Calcium and magnesium have been determined together (see 3.5 and 5.2.3). In this way changes of the value along the transects are made clear. It is the overall trends that are important for standard deviations (not indicated) can be rather high. Especially in coastal lakes the standard deviations vary from small values to more than 50% of the mean values. They decrease for lakes further inland. The phosphate values are not included, because only very few water samples contained detectable amounts of this ion. This will be discussed later on.

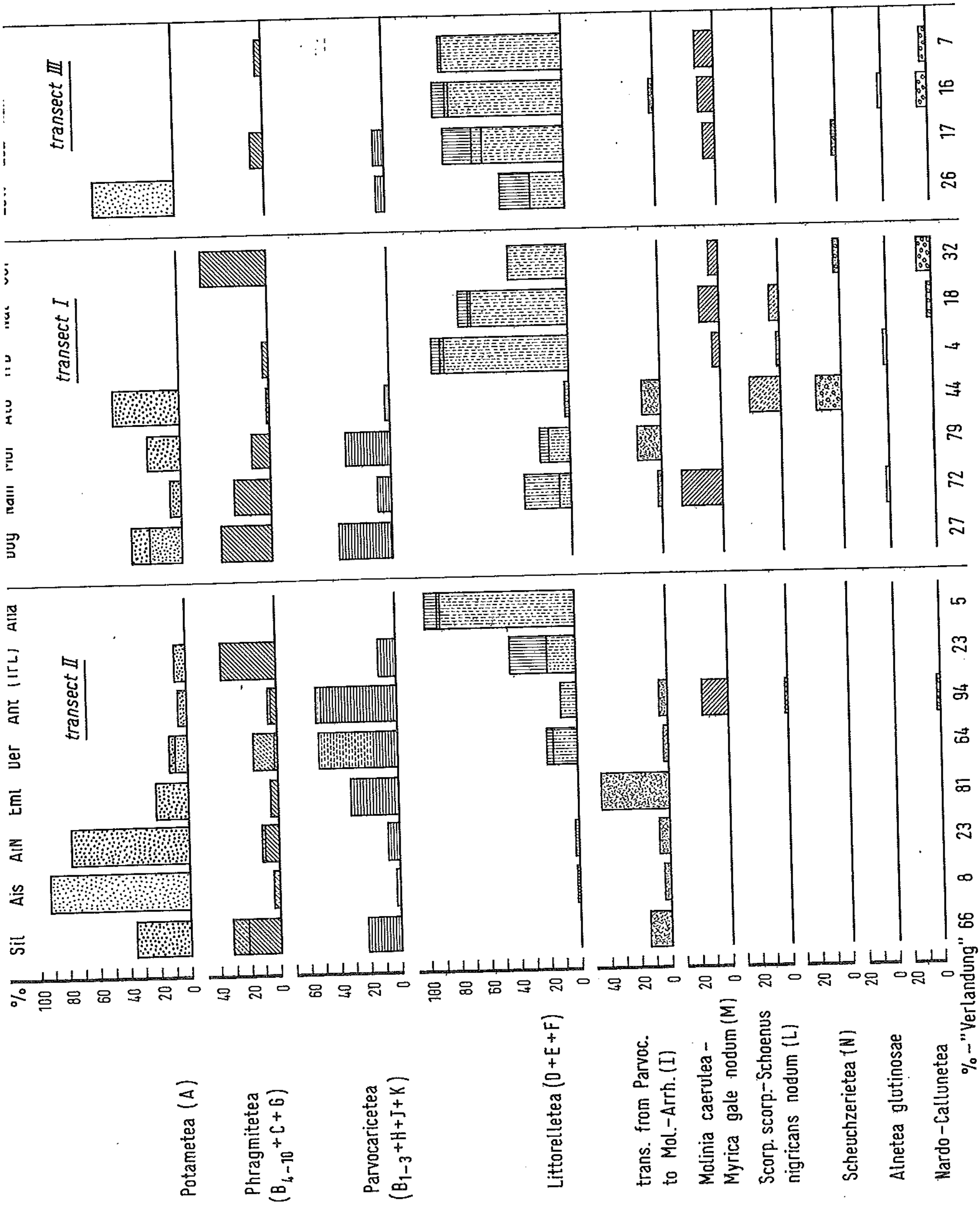


FIG. 11 CONTRIBUTION OF MAIN VEGETATION TYPES TO THE OVERALL VEGETATION COVER IN THE LAKES

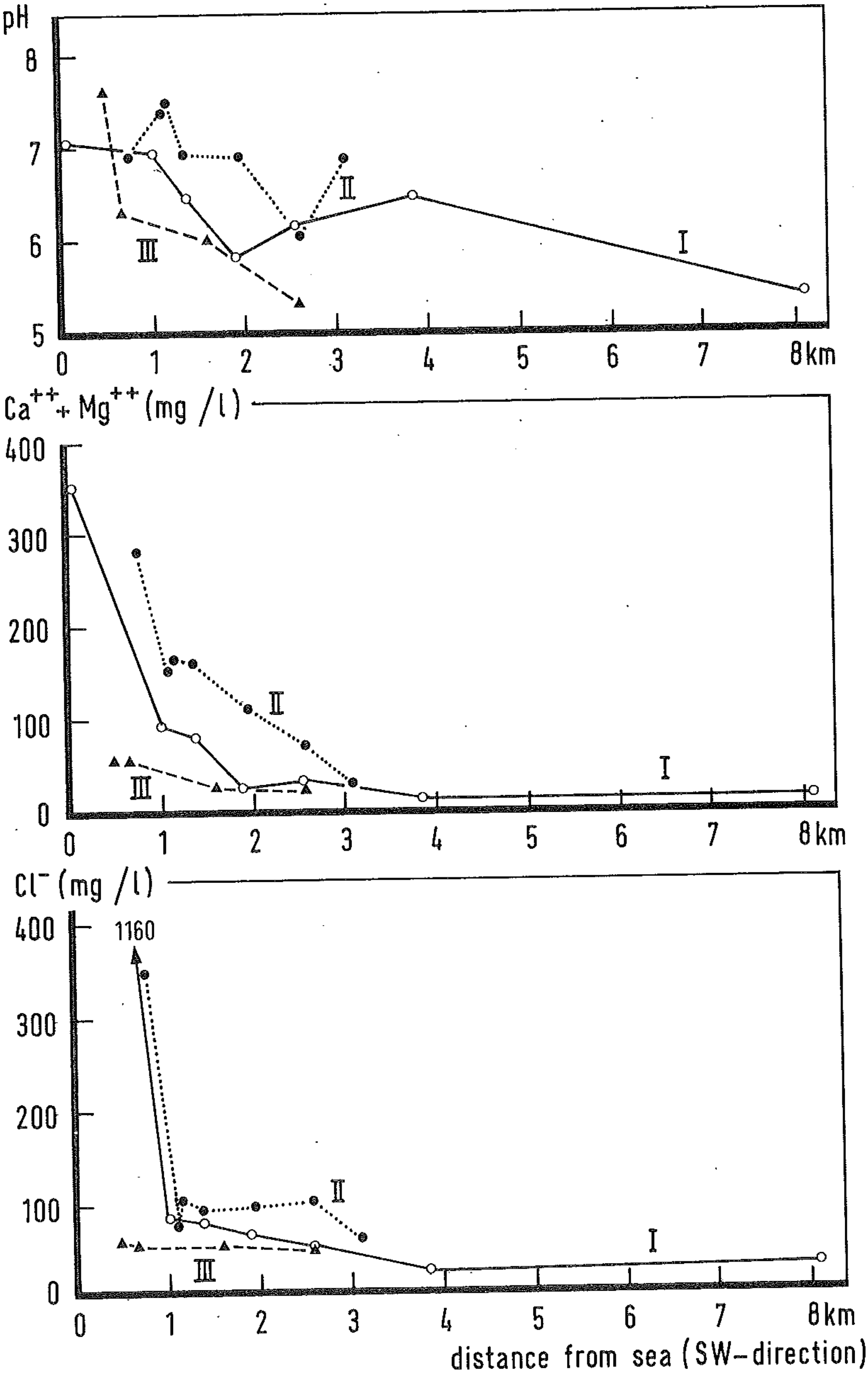


FIG. 12 MEAN pH, CL and Cd^{++} + Mg^{++} VALUES OF THE LAKES OF TRANSECT I, II and III AS A FUNCTION OF THE DISTANCE OF THESE LAKES TO THE OCEAN

Transect III

Transect III will be described first, because it is the least complicated one. It starts on a rocky shore and can be regarded as a control for transect I and II, that start on calcareous beaches (see also 3.1.1).

Although "rain catcher" results of this transect do not show a gradual decrease of nutrient supply by the ocean, the vegetation does show differences. Within this transect, communities of the Littorelletea are the dominant vegetation type. From coast to inland a gradual increase of the Isoeto-Lobelietum is attended by a gradual decrease of the Samolo-Littorelletum. This last phenomenon may be connected with the surroundings of these lakes. They are nearly completely surrounded by blanket bog vegetation, which can completely overgrow the stony shores and thus occupy the appropriate milieu for the Samolo-Littorelletum.
The increase of the Isoeto-Lobelietum can be stipulated by the surroundings, in that sense that relatively acid water is carried off from the blanket bog into the lakes. However, in the first two lakes of the transect (LeW and LeE) that lie very close to the ocean, the Isoeto-Lobelietum still is a dominant vegetation type.

The Potametea vegetation is relatively important in the first lake, but the occurring type is restricted to this lake and described as a "nutrient-poor variant" which shows transitions to the subassociation of Myriophyllum alterniflorum of the Isoeto-Lobelietum. The stands of the Isoeto-Lobelietum in this lake also belong to this subassociation and the same holds for the second lake (LeE), even though the stands belong to an other variant. The last two lakes of the transect contain the typical subassociation of the Isoeto-Lobelietum (sub-association Inops). So going inland, there is a gradual increase of the area of the Littorelletea (especially Isoeto-Lobelietum), which is accompanied by a change in the type of the latter association.

Communities of Phragmitetea and Parvocaricetea are nearly absent in this transect. Probably because the lakes are too big and too dynamic for "Verlandung". It is true that much bigger lakes may fill up completely, but then such lakes are situated in more sheltered positions.

The percentages of "Verlandung" area are low in this transect, even when stands of the Samolo-Littorelletum are included in these figures.

When considering the water analyses (see fig. 12), the very high mean values of pH for the first lake and the sharp decrease along the transect are striking. Cl^- values are not much different in transect III; the same is true for the results of the "rain catchers" (see 5.2.2). Mean Ca^{++} values in both coastal lakes are twice as big as the values of the bog lakes, which would not be expected in view of the "rain catcher" results. This may have to do with characteristics of the Ca^{++} ion (positive: absorption), or with perhaps antropogenic Ca^{++} sources. The high pH values of the coastal lakes are probably directly connected with the vegetation type, notably a Potametea vegetation. In assimilation processes, CO_2 becomes assimilated from the water, bringing about shifts in the carbonate equilibrium and thus causing an increase of pH (Ringelberg, 1976). The submerged communities of the bog lakes are less productive, besides, humic acids from the surroundings provide compensation.

Conclusion:

In this transect "rain catcher" results do not give a decisive answer about the influences the ocean has on the vegetation within the transect. The observed differences in the vegetation cannot be explained sufficiently by the water analyses (change of pH seems inherent to the vegetation). In this transect, the primary cause of the differences in the vegetation of the lakes going from the coast inland (i.e. the influence of the sea on the vegetation in our hypothesis) cannot be confirmed by the techniques used.

Transect I

Transect I is more complicated than the third transect, having more lakes and more vegetation types. Fig. 11 shows, that halfway across this transect, the character of the lakes suddenly changes. The last three lakes, Truska near Errisbeg (TrB), Nalawney and Suffrauncam are almost similar to the last two lakes of transect III. Also the Isoeto-Lobelietum vegetation which is dominating in these three lakes, largely belongs to the same subassociation Inops as in the third transect.

The coastal lakes have a complete different character. The Isoeto-Lobelietum is nearly absent. Of the Littorelletea only the Eleocharetum multicaulis is of importance where it concerns variants which show transitions to the Parvocaricetea. The main vegetation types of the coastal lakes belong to the Potametea, Phragmitetea and Parvocaricetea. Also transitions to the Molinio-Arrhenatheretea are restricted to these coastal lakes.

Although clear differences between coastal and "bog" lakes are found, still a gradual alteration of the vegetation types can be observed within the coastal area. With regard to the Potametea, in Dog's Bay the saltish variant of the Potametum graminei (with Ruppia maritima) as well as the Potameto-Nupharetum occur; in Namanawaun the Potameto-Nupharetum and the Sparganio-Nymphaeetum are found and, in Murvey and Aturtaun, only the Sparganio-Nymphaeetum. From the preceding descriptions of the vegetation (see also 5.3.3) it will be clear that these three communities form a sequence from nutrient-rich to nutrient-poor. This evidently is connected with the distance of the lakes concerned and their vegetation from the ocean.

Something similar also holds for communities of the Parvocaricetea. In Dog's Bay, which lies very close to the ocean, the Parvocaricetea are only represented by a sociation of Juncus subnodulosus (a Caricion davallianae species). In Namanawaun the Anagallido-Caricetum diandrae and the Carex nigra-Juncus articulatus association are to be found. Murvey only contains the latter association (an association with a relatively great Littorellion element) and in Aturtaun only the sociation of Menyanthes trifoliata (a species to be found in the Scheuchzerietea and in the Parvocaricetea) is present. Again a gradual shifting appears of eutraphent communities near the coast to oligotraphent communities further inland (eutraphent" and "oligotraphent in the sense of Westhoff & den Held, 1969).

Communities of the Phragmitetea in this transect embrace the species-poor polycorm communities, mainly Cladium mariscus and Schoenoplectus lacustris. The great amount of Phragmitetea in Suffrauncam consists of a species-poor polycorm vegetation of Schoenoplectus lacustris which could not be investigated. The undergrowth very probably consists of a well developed Isoeto-Lobelietum. In this case the vegetation type should be reckoned to the Littorelletea instead of to the Phragmitetea and would thus increase the relatively small area of the Isoeto-Lobelietum in this lake.

The stated difference in transect I between coastal lakes and lakes more inland seems to be connected with the surroundings of the lakes. L. Aturtaun lies on the border of the coastal cultivated land and the blanket bog area. The last three lakes of this transect are nearly completely surrounded by blanket bog. Although Aturtaun is found in a transitional situation, the vegetation strongly differs from the coastal lakes as well from the bog lakes. Besides Potametea vegetation, the accent lies on communities of the Scheuchzerietea and the Schoenus nigricans-Scorpidium scorpioides nodum (the "Verlandungs" vegetation of this lake).

Still one may think of a logical transition, in such a way that the trophic level of the water is just high enough to bring about "Verlandung", but low enough for more oligotraphent "Verlandungs" communities than in coastal lakes.

"Rain catcher" results from this transect show a very gradual decrease of "air-borne nutrients". This agrees with the differences found in the vegetation, certainly in the coastal area, but not with the relatively sudden change-over halfway along the transect.

Also, water analyses show a parallel gradual decrease. One may think of factors that directly or indirectly become limiting at a certain level. Below a certain input of nutrients, communities of Parvocaricetea, Phragmitetea and Potametea just cannot flourish. Or the effect may be indirect: below a certain input, which (dependant on the extent of shelter) will be reached at a definite distance from the coast, ombrotrophic peat growth is only possible and this may have an influence upon the water vegetation at that place. In the last case, there is a self-consolidating process by which the alteration halfway along the transect becomes accentuated.

Conclusion:

Although gradual vegetation shifts within the coastal lakes of transect I have been observed, there are still extremely different characteristics in coastal lakes and "bog" lakes. Also as evidenced by the high percentages of "Verlandung", the coastal lakes have a much more productive character than the "bog" lakes of this transect. How far human activities (greatest close to the ocean) are responsible for this, cannot be traced with certainty. Nevertheless, the input of ions (of "sea-borne" origin) shows a clear decline from the coast more inland. A primary, natural cause is therefore well conceivable.

Transect II

Regarding transect II in fig. 11, it becomes clear that in contrast with transect I, the vegetation of the lakes changes more gradually going further from the coast. Although the last lake, L. Anaserd, has the same character as the last lakes of transect I, there is hardly question of a sudden change in vegetation. This is also valid for the surroundings of the lakes. On the peninsula no blanket bog is to be found and L. Anaserd actually is not a bog lake. However its surroundings consist mainly of acid heather communities, which may have the same influence as peaty surroundings.

Within the transect the situation of the first lake, Silverhill, is remarkable because it lies close to the ocean while its vegetation corresponds with that of Emlagharan L., which is situated further from the ocean. The results of the "rain catchers" elucidate the question. Because of its sheltered position, the first "rain catcher" in transect II (S6) caught less than would be expected on the ground of its distance to the ocean. This is extremely important for Silverhill, which lies a little west of "rain catcher" S6, in the shelter of a hill ridge along the west shore. This may have two important effects on the vegetation of the lake: first, less "air-borne" input of nutrients and secondly, calm conditions because of its sheltered position. In fact Aillebrack South, in this transect, should perhaps be regarded as the lake most exposed to the ocean.

Along the transect, communities of the Potametea gradually decrease in relative area occupation and also the type of vegetation changes. In Aillebrack South the Potametum graminei is present (the same association as in coastal lakes of transect III). Aillebrack North, Emlagharan and Derreen mainly contain the Potameto-Nupharetum, in Antony only the oligotraphent community of the class, the Sparganio-Nymphaeetum is to be found (the same association as in the coastal lakes of the less extreme transect I). Like the first transect, transect II shows a shift from eutraphent to more oligotraphent communities when going inland.

Communities of the Parvocaricetea have a clear optimum, about halfway along the transect. In those lakes the character is highly determined by these vegetation types.
The relatively big area occupied by the Scorpidio-Caricetum lepidocarpae (Caricion davallianae) in L. Derreen is striking, although the typical subassociation is not present. It concerns transitions to the Molinia caerulea-Myrica gale nodum and the Eleocharetum multicaulis; the last association is widely occurring. However, an explanation of the presence of the Caricion davallianae element in L. Derreen as yet cannot be given.

L. Antony is distinguished with regard to the Parvocaricetea vegetation, as the only place where the subassociation of Sphagnum concortum of the Anagallido-Caricetum diandrae is found, which is the most oligotraphent community of the class in Connemara. So again, those vegetation types that point to a nutrient-poor milieu are found farthest from the coast.

Also communities of the Phragmitetea have an important share in the vegetation of lakes in transect II. Well developed Phragmitetea communities (table C), are restricted to the coastal lakes Silverhill, Aillebrack South and Aillebrack North.
Polycorms (table B) are present in all lakes and transitions from Phragmitetea to Parvocaricetea (table G) appear especially halfway, where communities of the Parvocaricetea are optimally present.

Communities of the Littorelletea show a clear course along the transect. In coastal lakes these communities are almost absent. In the middle part, the Eleocharetum multicaulis is the most important representative of the class and in the lakes farthest from the ocean, communities of the Isoeto-Lobelietum are dominating. The Eleocharetum multicaulis, like the Parvocaricetea, is limited to the middle part of the transect, so they mostly appear together. This is also true for transect I and additionally underlines the relation between the Eleocharetum multicaulis and the Parvocaricetea as put forward in the description of the communities (5.3.3).
Like in transect I, transitions to the Molinio-Arrhenatheretea can form an important part of the vegetation of coastal lakes.

The "rain catcher" results show a gradual decrease of "air-borne" nutrients along the transect. Also water analyses of the lakes, especially Ca^{++} + Mg^{++} values, show a gradual decrease away from the coast.

Conclusion:

Along transect II, lakes and their vegetation show a gradual change of character with distance from the ocean and accompanying it , change in the state of nutrients. Also the concentration of ions in "rain catchers" tends to decline in SW-NE direction, thus supporting the hypothesis.

Roughly, three types of lakes can be distinguished:

- Type 1, are lakes far from the ocean, with low productivity and dominated by a Isoeto-Lobelietum vegetation.
- Type 2, are lakes that lie closer to the ocean, with high productivity (much "Verlandung") and dominated by communities of Phragmitetea, Parvocarictea and the Eleocharetum multicaulis.
- Type 3, are dynamic, coastal lakes with dominance of Potametea vegetation.

Comparing the three transects, the following can be stated:
The lakes farthest from the ocean (type 1) are notably: in transect I: Truska near Errisbeg (TrB), Nalawney and Suffrauncam; in transect II: Anaserd and possibly Truska L. and in transect III: Kankoge and Nacorrussaunbeg. These are highly similar, both in type of vegetation (Isoeto-Lobelietum) as in the amount of "air-borne" nutrient input. The lowest values of "rain catchers" were always found in the neighbourhood of these lakes. The surroundings have an acid character (mostly blanket bog) which can be determinative for the type of water-vegetation in these lakes. The fact that these very oligotrophic lakes in transect III are situated much closer to the ocean than in transect I and those again closer to the ocean than type 1 lakes in transect II, is a clear indication in itself that affirms the hypothesis of blowing in of lime-rich material.

Also the lakes of the second type (dominated by communities of Phragmitetea, Parvocaricetea and Eleocharetum multicaulis) are rather identical in transect I (Dog's Bay, Namanawaun and Murvey) and transect II (Emlagharan, Derreen and Antony). The "air-borne" nutrient input in the surroundings is never extremely high or low in comparison with other places in the area. Water analyses show mean Ca^{++} + Mg^{++} values in these lakes between 75 and 150 mg/l. In transect I these values are reached at a shorter distance from the ocean than in transect II.

Lakes of type 2 are not present in transect III, which is in accordance with the low "rain catcher" values and low Ca^{++} + Mg^{++} values of the lakes in this transect.

Lakes of the third type (dominated by communities of the Potametea) only show up in transect II, very close to the ocean (Aillebrack South and Aillebrack North). On these places, the highest amount of "air-borne" nutrient input was measured and Ca^{++} + Mg^{++} values and pH belong to the highest measured values in the area (the values of "rain catcher" S1 of transect I in fact are higher, but S1 lies closer to the ocean than the first lake of transect II).
This does not mean that these are the most determining factors. The factor turbulence can be essential in Aillebrack South and Aillebrack North. Both lakes are bordering a calcareous dune area and also because of the soil type of the bottom of the lakes, it is admissible that during winter storms, great amounts of lime-rich material are blown in.

Once again must be pointed to the "rain catcher" results, that made clear that the measured Ca^{++} + Mg^{++} values, for the greater part originated from the coast, yet not from the beaches itself but from the seawater.

That this lime-rich beach or dune material does influence the vegetation, is apart from the Aillibrack lakes clearly shown by Truska Mire. "Rain catcher" results have average values but the Ca^{++} + Mg^{++} values of the mire water appeared to be very high and the vegetation of this mire almost completely belongs to the lime-indicating Caricion davallianae. The blowing in of calcareous material from the adjacent dune area seems highly determinative.

Summarizing it can be stated, that the character of the lakes and with that their vegetation, in the first place is connected with the type of shore behind which these lakes are situated and secondly, with the distance to the coast.

This means we noticed a clearly observable enrichment, originating from the coast. The enrichment is greatest in transect II, surrounded by the sea and calcareous dunes and beaches, less in transect I (that starts on not such an extreme calcareous beach) and hardly provable in transect III, which starts on a rocky shore.

Considering this, one may not forget that man always exerts a certain influence on his environment and this will also be so in the investigated area. Whether human influences exceed the influence on the ocean in the area, is not easy to establish. It is nor simply clear if the intensity of human activities in the surroundings of the transects differs. This could mean that differences between the transects have a "natural" origin.

Within the transects there is an obvious difference between human activity in the coastal strip and the land that is laying behind. An extreme effect of human activity on the vegetation would, as is pointed out in previous chapters, be recognizable because of sharp boundaries or sudden changes in the vegetation along the transects. However, on the somewhat denser populated Bunowen peninsula (transect II), where human activity can be thought very high, no sudden or extreme change-over of vegetation along the transect is to be shown.

An other way to find out about this, is by way of determining phosphate concentrations of the lake-water, which way in the already strongly polluted Netherlands provides a good indication for extensive human activities. From the about 350 water analyses (280 from lakes, 70 from blanket bog), it appeared that the phosphate concentration of 26 samples from blanket bog and only 36 from lakes, was above the detection limit of 1Pbb. For the blanket bog samples this is not very surprising, for the solubility of phosphates in acid milieus is excellent. The low number of "positive" samples in the lakes however is remarkable, and at any rate no indication for extensive human activities.

An other argument to fortify the opinion that not man but the ocean in the first instance is responsible for the differences in the vegetation of coastal strip and hinterland, is the fact that at present no human settlement can be found in the blanket bog. It is very unlikely that man would settle in such an infertile area. Man generally chooses the naturally fertile places and the coastal strip probably still fulfils the criterion (see also 2.6, fig. 4). This does make a primary natural cause of the observed differences more acceptable.

In the landscape of South-west Connemara, cultural influences do not seem to dominate yet. This means a situation on which Dutch nature conservancy would be extremely jealous, a situation we can hardly imagine as once being reality in the Netherlands. In short, a situation of balance wherein man at best has an enriching effect on the landscape.

If however, the necessary measures are not taken in time, it will be inevitable that the increasing human activities, like intensive peat cutting (certainly mechanically) and reafforestation, an intensive use of fertilizers and an increasing recreation pressure will disturb the balance for ever within the near future.

VI GENERAL METHODOLOGICAL DISCUSSION

Now the final conclusions are reached, this may be the right place to reconsider the methods we used, their efficiency and their reliability, given the restrictions (no laboratory, no electricity) outlined above.

To detect the influence of the sea, the use of transects proved to be satisfactory. The placing of them however could have been better. This is best demonstrated by the short middle transect (transect III). Moreover, to separate influence from the sea from the influence of human activities, not only the type of coast is important, but also the degree of those human activities. Unfortunately these two elements, nutrient-rich beaches and human activities, go hand in hand, so that only a more careful placing of these transects could have given clearer answers than the hypothesis outlined in the previous section.

As a basis for comparison, the swamp vegetation was chosen. Vegetation in general is a good synthetic indicator of environmental conditions. This is even more true for swamp vegetation, of which the environment can be influenced directly and easily. The detail however, with which maps were drawn, relevés were classified and subsequently redrawn, was unnecessary to answer the question.

During the synthesis, mapping and classifying became goals in themselves and generated results quite independently from the central questions. This is not uncommon in this type of investigation and partly due to the impossibility to define in any precise way, beforehand, the level of detail necessary for answering the question. It would however be interesting to try to partly separate classifying in an ecological sense from classifying for purely syntaxonomical purposes. Moreover, the results of the classification are of restricted syntaxonomical use, because of the restricted area of investigation and the imbalances between the classes of vegetation represented in our samples.

The intensity of sampling the vegetation could also not be defined beforehand (see above). As a matter of precaution it has therefore likely been too detailed. The number of samples is high and complete species lists are time consuming. Especially one can ask if a solid period of three months, identifying mosses by four people, was worth the effort, maybe with the exception of Sphagna.

The coupling of these data with the environmental data had to be crude. The level of detail in these environmental data is by far not as precise as the vegetational data. Type of soil has been estimated rather superficially. A good typification for organic soils and their degree of decomposition would have been very welcome.

The water samples, collected from the vegetation, only give a rough indication of the conditions in the soil. First of all they are sensitive to rainfall and subsequent dilution. Secondly, only directly available ions are measured and not at all any potential of the soil on the long run. What is more, ions present are not necessarily available to plants. Only four ions were measured, only one of them is a major nutrient, namely phosphate. The pH gives an overall indication and the others could indicate influence from the sea (Cl^-) or influence from the sea and/or substratum (Ca^{++} and Mg^{++}). Phosphate was present in subdetectable quantities and therefore lost its usefulness as an indicator of human activities. One can ask furthermore if a concentration of phosphate without an indication of cycling rate, has any value at all. To measure other or more chemical data was under the given circumstances impossible. Notwithstanding all the restrictions mentioned above, some general trends did emerge.

There have also been attempts to measure the influence of the sea directly. As to the "rain catchers" used for this purpose, there are several points of criticism. The main criticism is, that the measurements were done in the wrong period. The bulk of the "air-borne" nutrients is blown in during wintertime. The heights of the pots have been chosen rather arbitrarily. Maybe a combination of a high and a low pot to catch blowing sand would have given a better idea of the effect of wind and sea. A good standardisation of the technique will doubtlessly improve the results. Lastly when placing the "rain catchers", any sheltering should be avoided. The method, however crudely can generate the wanted results.

The second main question regarded the influence of the substratum. Here transects were clearly not the best method. Carefully chosen, more or less similar situations of different substrata were compared. Here, unnecessary detail was avoided, but our limited knowledge of the geology of the area led to the wrong choice of sites.

Benglenisky cannot be regarded as a "zero" situation, when compared with Errisbeg. The presence of glacial deposits disturbed the comparison. Moreover, there was a slight difference in "air-borne" influences from the sea, notwithstanding the sheltered position of both localities. Therefore it was impossible to split the influence of the parent material completely from the effects of watermovement.

Summarising one can say that the techniques used in this survey yielded many more or less plausible hypotheses but little or no direct proof. More detailed investigations will possibly give the answers hinted at.

VII SUMMARY

From the 20th of May until the 10th of October 1975, synecological and geobotanical fieldwork was carried out in South-west Connemara, Ireland, to answer questions based on two remarkable features in the landscape:

- differences between the vegetation of the coastal strip and the " hinterland " ;
- differences between the vegetation on the slopes of the mountain Errisbeg and the surrounding blanket bog.

Firstly it was tried to describe these differences. Secondly, to explain the differences it was tried to trace the nature, origin and effects of factors that might cause the observed differences. Three main factors were postulated: The influence of the ocean; the effect of the (agricultural) activities of man and lastly the type of the underlying parent material. Furthermore it was assumed that any effect would show up best in wet places i.e. lakes, wetlands and bogs.

Stand choice, the making of relevés, their arranging (by hand and by computer) and the classification and description of vegetation units have been done according to techniques of the French-Swiss School.

Three transects were chosen in S.W. direction, to investigate the influence of the ocean (e.g. sea-spray, in-blow of beach material) and the influence of human settlement. Within the transects, 21 lakes and their associated wetlands were surveyed, mapped and described. The description of the vegetation types has been restricted to the syntaxonomical classes of Potametea, Phragmitetea, Parvocaricetea, Littorelletea, Scheuchzerietea, Oxycocco-Sphagnetea and sometimes also transitions to Molinio-Arrhenatheretea and Nardo-Callunetea.

Soil-water samples were taken and chemically analysed; type of soil was determined and depth of soil measured.

With the aid of the vegetation maps of the lakes, surface measurements have been carried out and the relative proportions of the vegetation units were quantified, to enable a comparison within and between the transects; also percentages of "Verlandung" have been indicated. Along the transects "rain catchers" were placed, to collect rainwater samples, which would give an idea of "air-borne" nutrient supply.

Results of this part of the investigation show that the vegetation types found in western Connemara can by no means easily be fitted in a more continentally based system. Most of the syntaxonomical difficulties that arose, may come down to shifts in the ecological amplitudes of the species present, compared with the continent. Some of the units described may represent typical Irish (eu-atlantic) vegetation types. All units are presented in detail and discussed as to their synecology and their probable syntaxonomical position. Moreover, the results are summarised on a

more general level and broad comparisons are made. For this purpose a so-called "synoptic table of all vegetation units" has been made, containing the environmental data as well. This table shows a dominant moisture gradient and superimposed on this an equally important nutrient gradient.

Roughly, three types of lakes could be distinguished based on typical vegetation zonations on the lake shores. This tripartition is confirmed by the results of the analyses of lake water and rain water samples. Obviously the zonation is dependant upon the nutrient status of the lake.

As for an explanation for these gradients it could be stated that the influence of the ocean and not of man, in the first place has been responsible for the differences between the vegetation of the coastal strip and the hinterland and that type of shore and distance to the coast had great influence on this phenomenon.

With the aid of the "rain catchers" it was shown that the analysed ions mainly originated from the ocean. Moreover, the in-blow of lime-rich beach or dune material appeared to influence the vegetation of some coastal lakes and wetlands.

The zonation in space (from the coast more inland) appeared to be comparable with a successional sequence in time, in the vegetation history over 13.000 years.

To investigate the second main problem, comparable spots were selected on the slopes of two mountains, Errisbeg and Ben Glenisky (one of the Twelve Bens), to see if there would be any differences in the vegetation types on these two places due to different rock types. Furthermore the vegetation of these mountain transects has been compared with the vegetation of "virgin" blanket bog in a flat area called Dolan, to analyse the influence of a slope with its typical water regime. Results show a significant influence of nutrient-rich parent material on the vegetation, caused by "seepage". Also "flow", the more or less rock type independant movement of surface water has an enriching effect on the vegetation. In some cases both effects were hardly to disentangle.

VIII ACKNOWLEDGEMENTS

We express sincere thanks to every person who shared his knowledge and experience to make our work possible.

The field work in Ireland was made possible through the financial help of the Beyerink Popping Fonds and the Stichting Nijmeegs Universitair Fonds. We have appreciated their cooperation.

We deeply appreciate the theoretical and practical help of our tutors, Prof. Dr. V. Westhoff (Department of Geobotany, Catholic University of Nijmegen) and Prof. J.J. Moore s.j. (Botany department University College of Dublin) both in Ireland as in the Netherlands. We are grateful for their constructive comments on the manuscript.

Furthermore we wish to thank Ing. H. van de Steeg, Mr. H. Butteling, Drs. L. Kempers and Drs. H. Helsper for their help during the field work preparations; Drs. J. Louppen for his advice and assistance with the data analysis, Dr. C.G. van Leeuwen for his interesting suggestions during our excursiontrips; Dr. D. Teunissen and Drs. H. Teunissen-van Oorschot for their geological and palynological information; Mr. J. Gerritsen and Mr. T. Oor for their patiently carried out design of maps and figures; Mrs. J. Westhoff-de Joncheere for all her kindness and the family Connolly for their friendly Irish hospitality and all other unnamed persons who contributed to the realization of this work.

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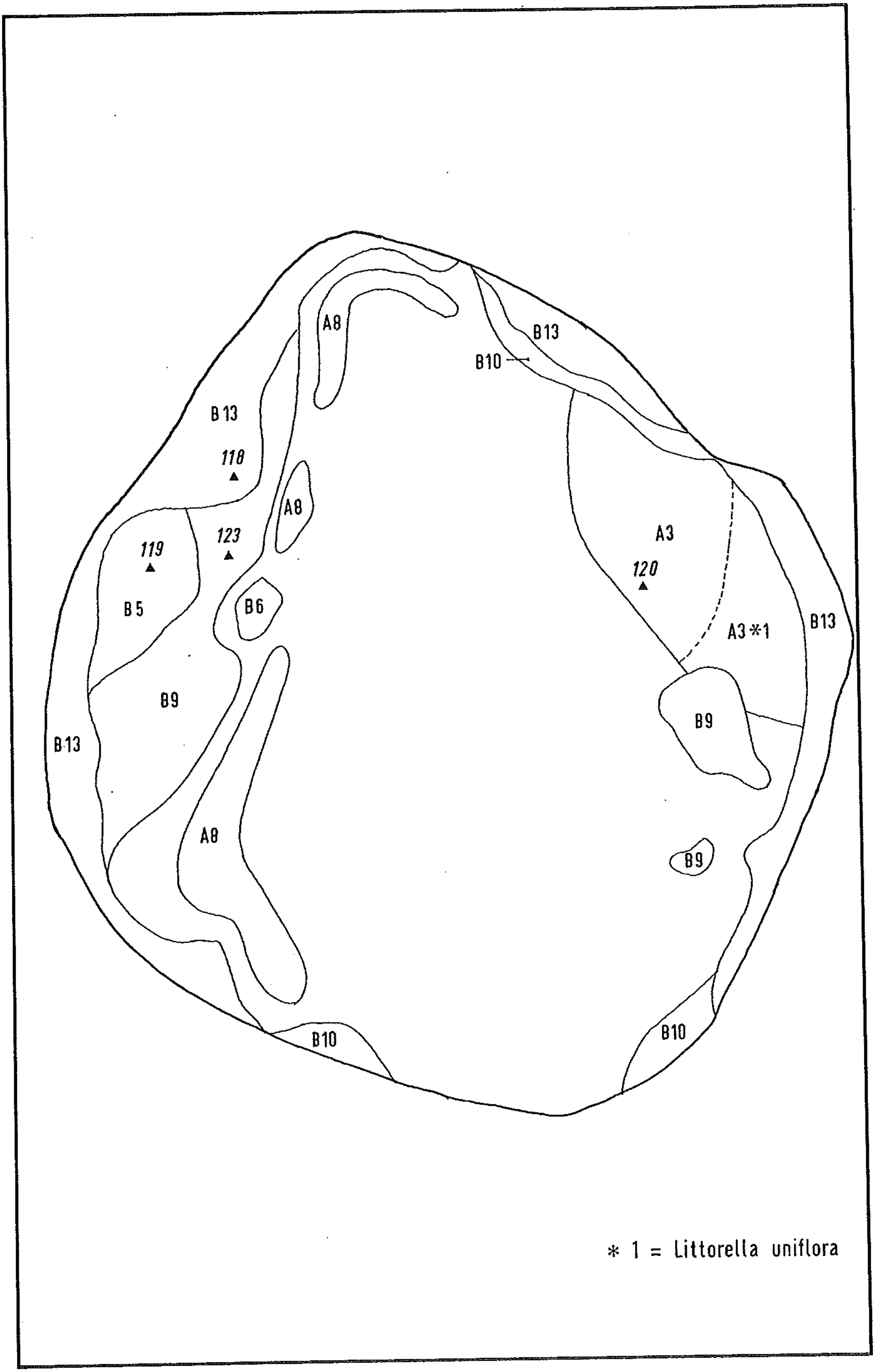
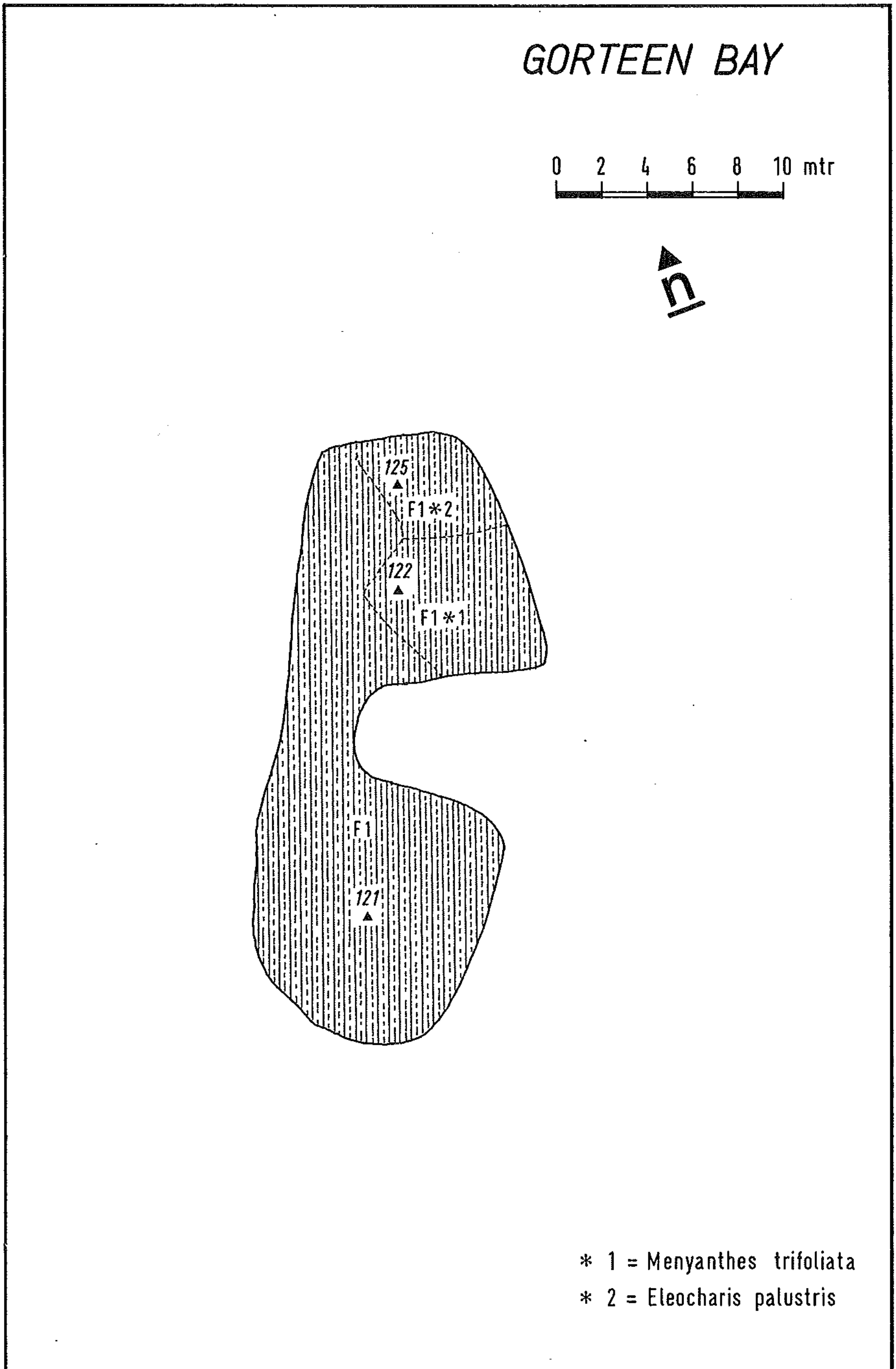
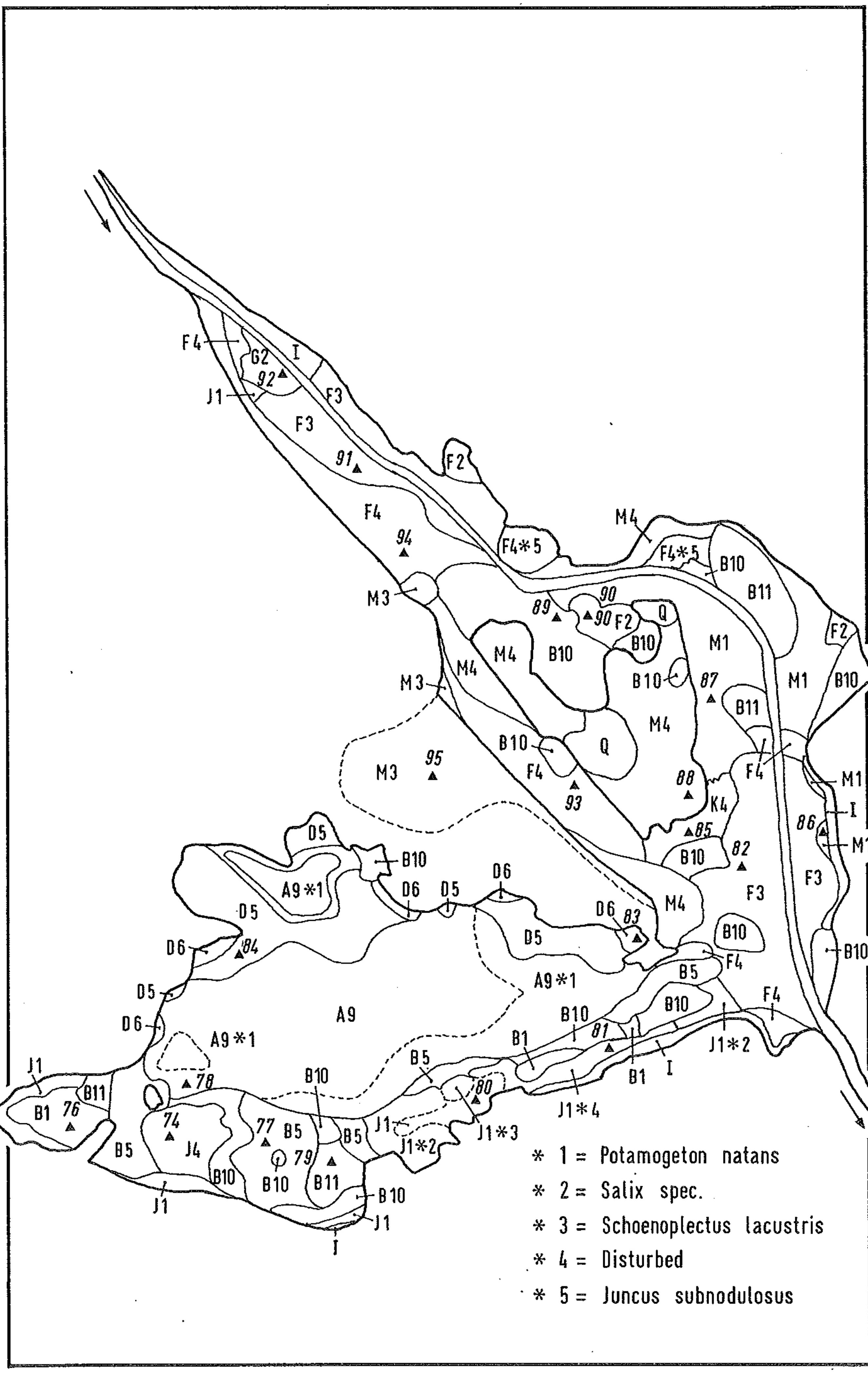
Wit, R. de, 1955. Het Caricetum lasiocarpae bij Kortenhoef, in verband met de verbreiding en de systematische plaats van de associatie. In: Kortenhoef: Een veldbiologische studie van een Hollands verlandingsgebied: 50-59. (see Meyer, W. & de Wit, R.J., 1955).

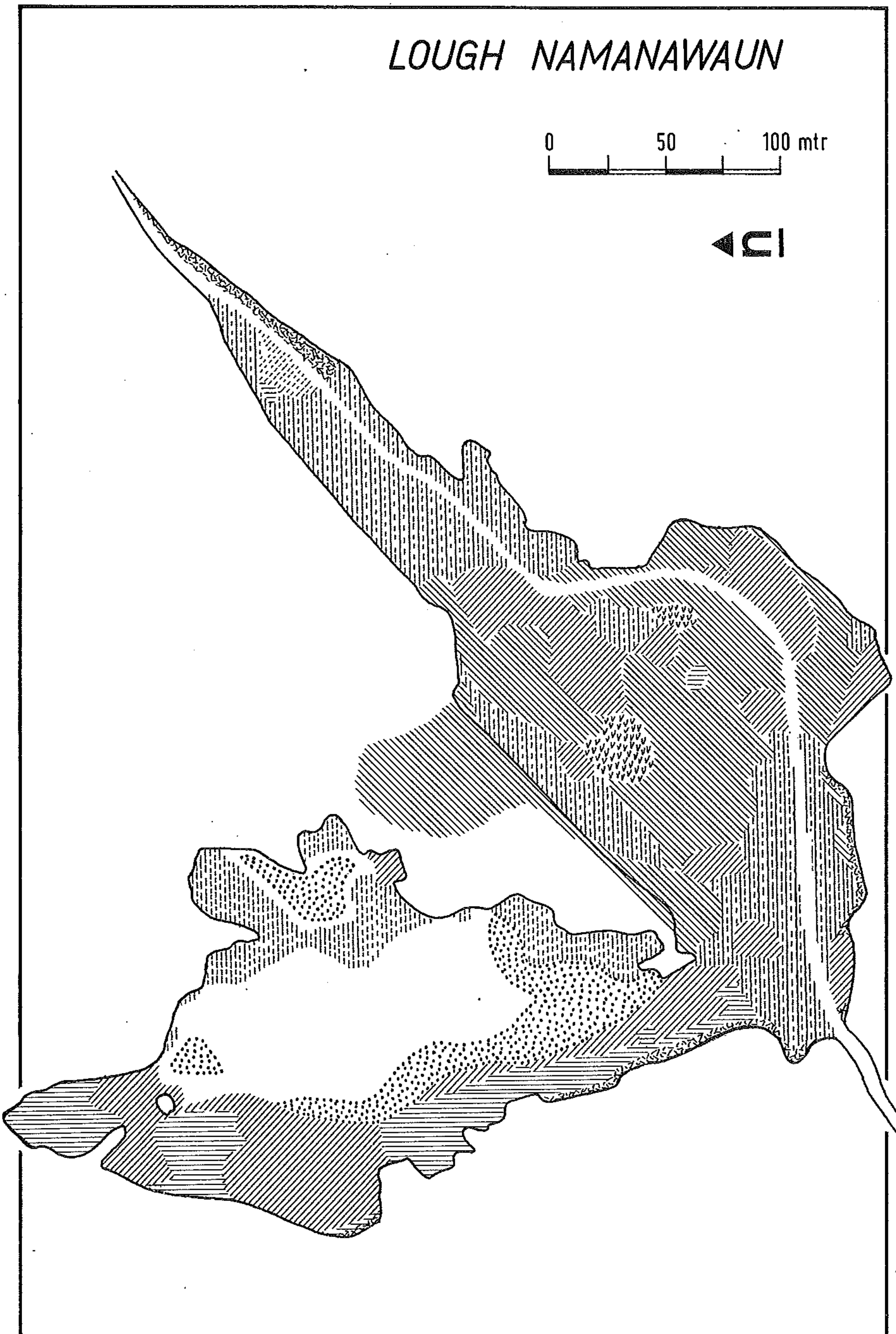
Zinderen Bakker, E.M. van, 1942. Het Naardermeer. De Lange, Amsterdam, 255 pp.

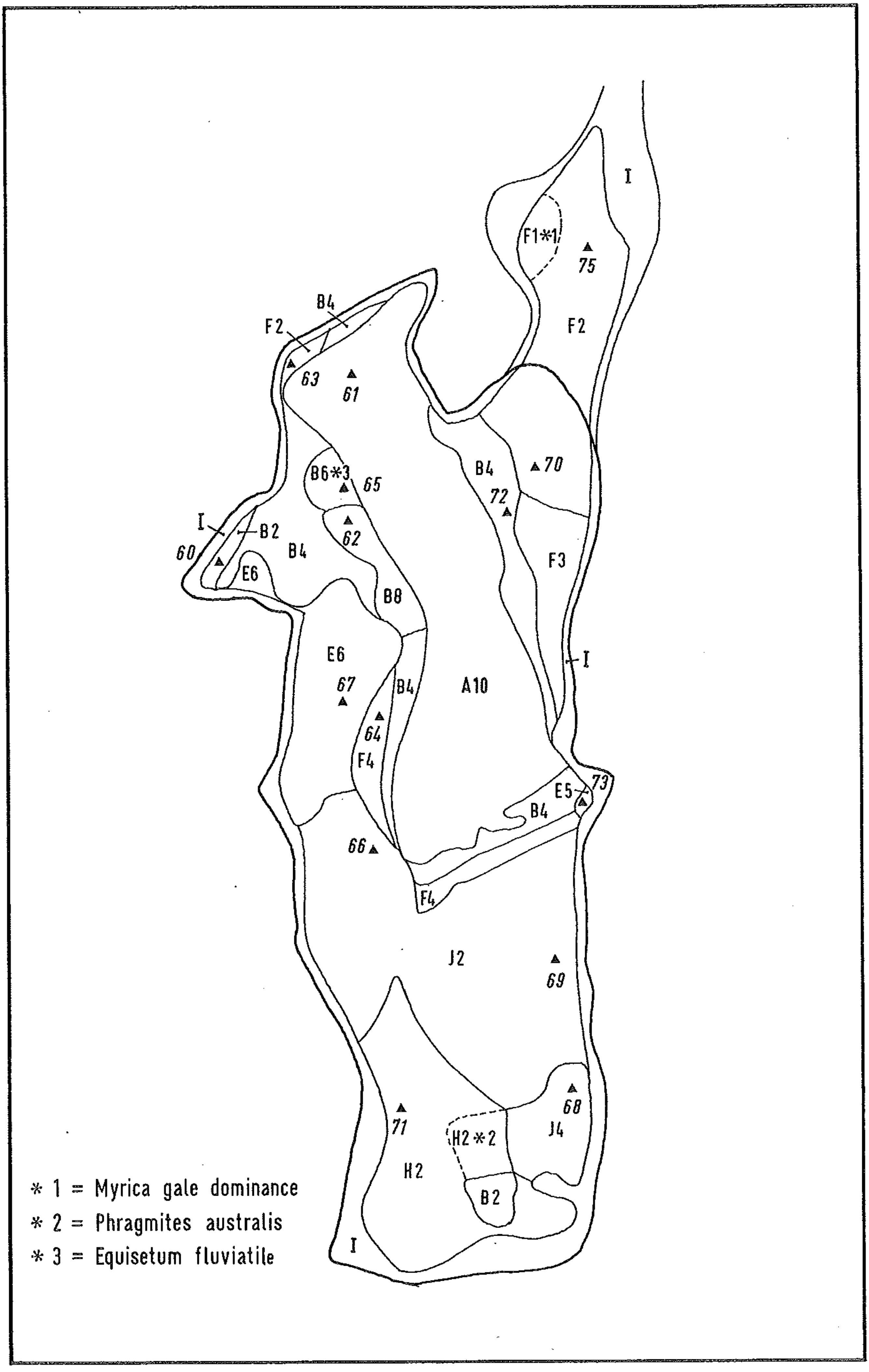

A8
B13
B10
B 13
118
A8
A3
123
119
120
B6
B 5
A3 *1
B13
B9
B9
B 13
A8
B9
B10
B10
* 1 = Littorella uniflora

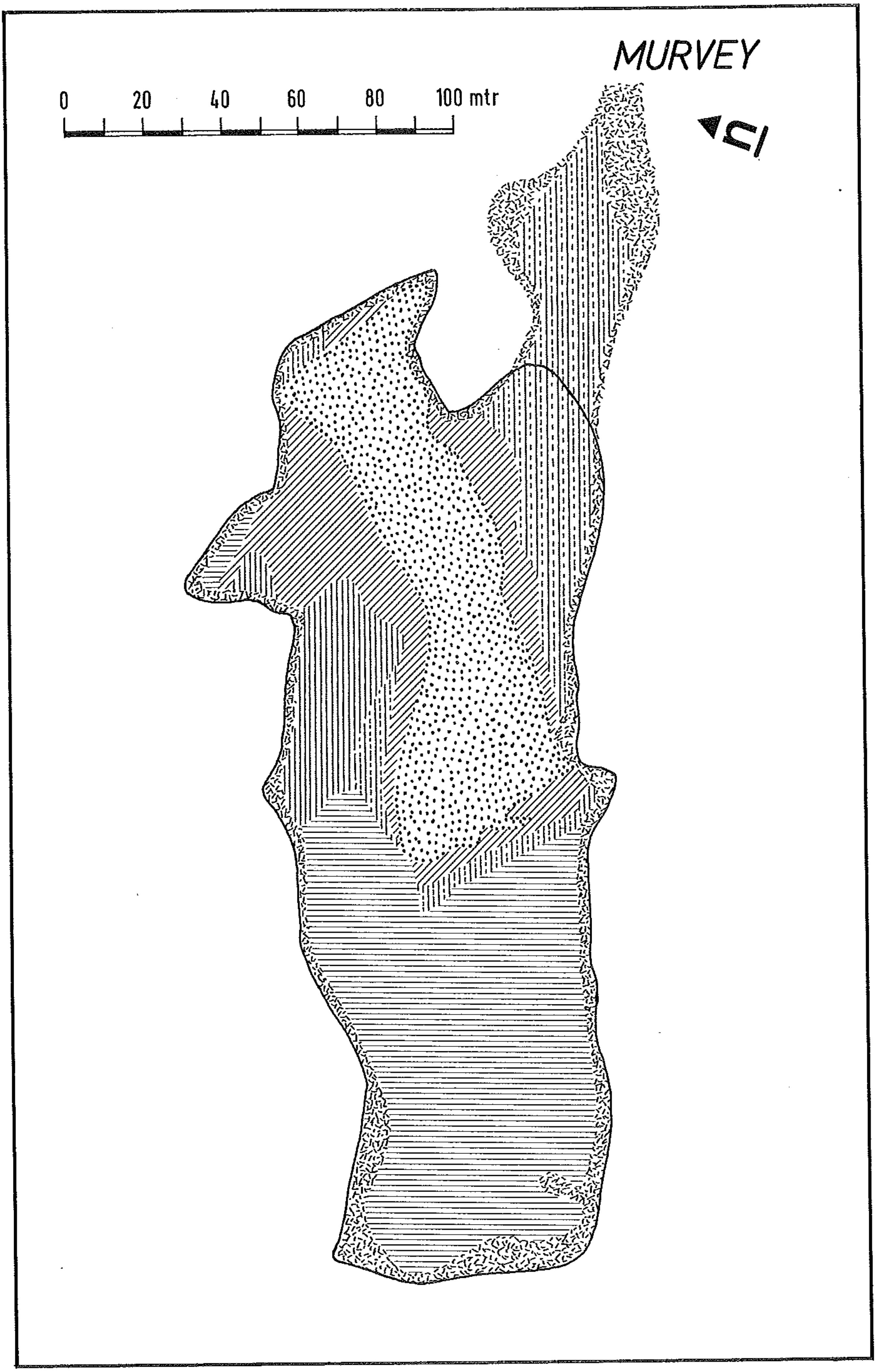

DOGS BAY
n
0
10
20
30
40
50 mtr


GORTEEN BAY
0 2 4 6 8 10 mtr
n
125
F1*2
122
F1*1
F1
121
* 1 = Menyanthes trifoliata
* 2 = Eleocharis palustris

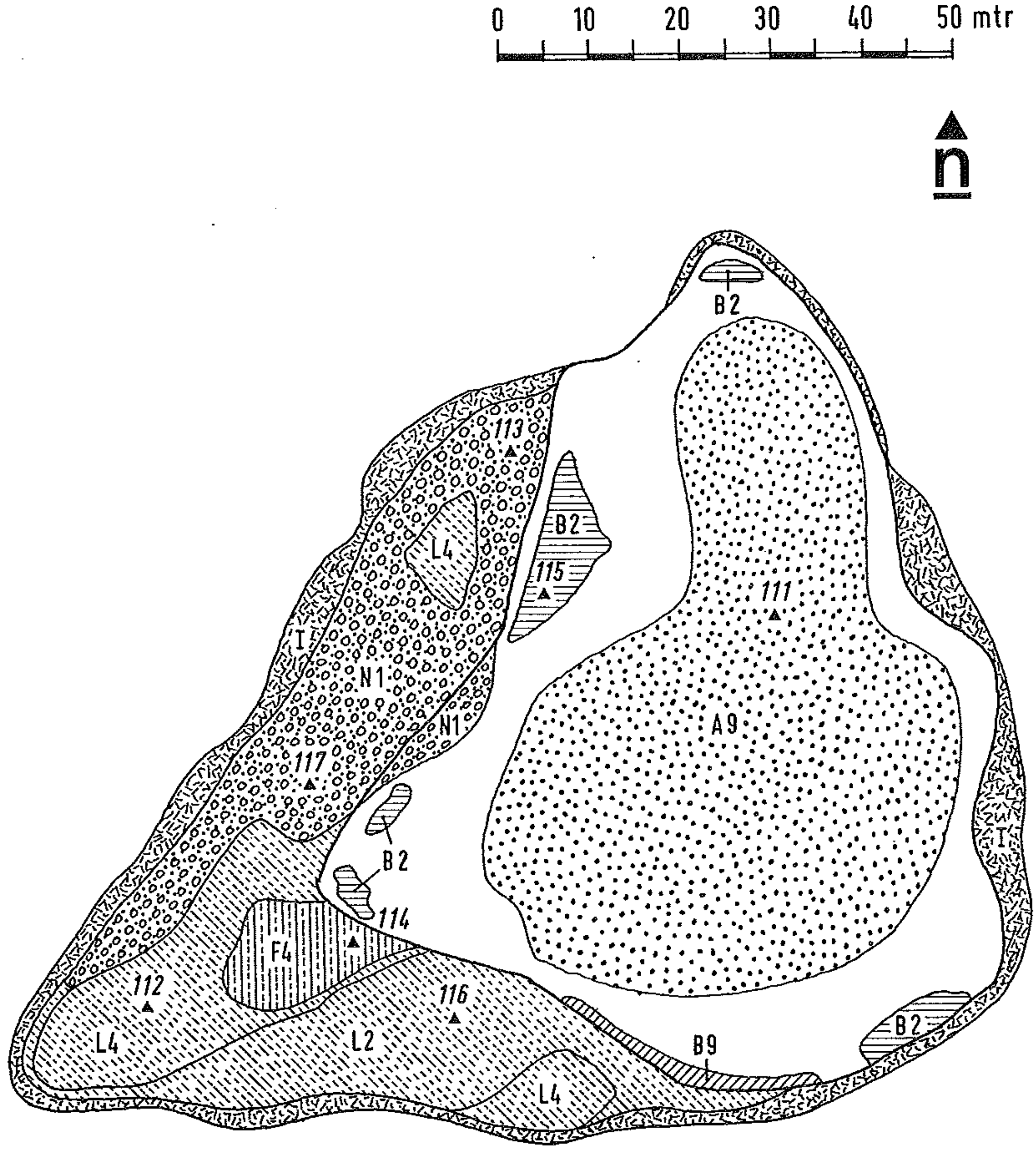

* 1 = Potamogeton natans
* 2 = Salix spec.
* 3 = Schoenoplectus lacustris
* 4 = Disturbed
* 5 = Juncus subnodulosus

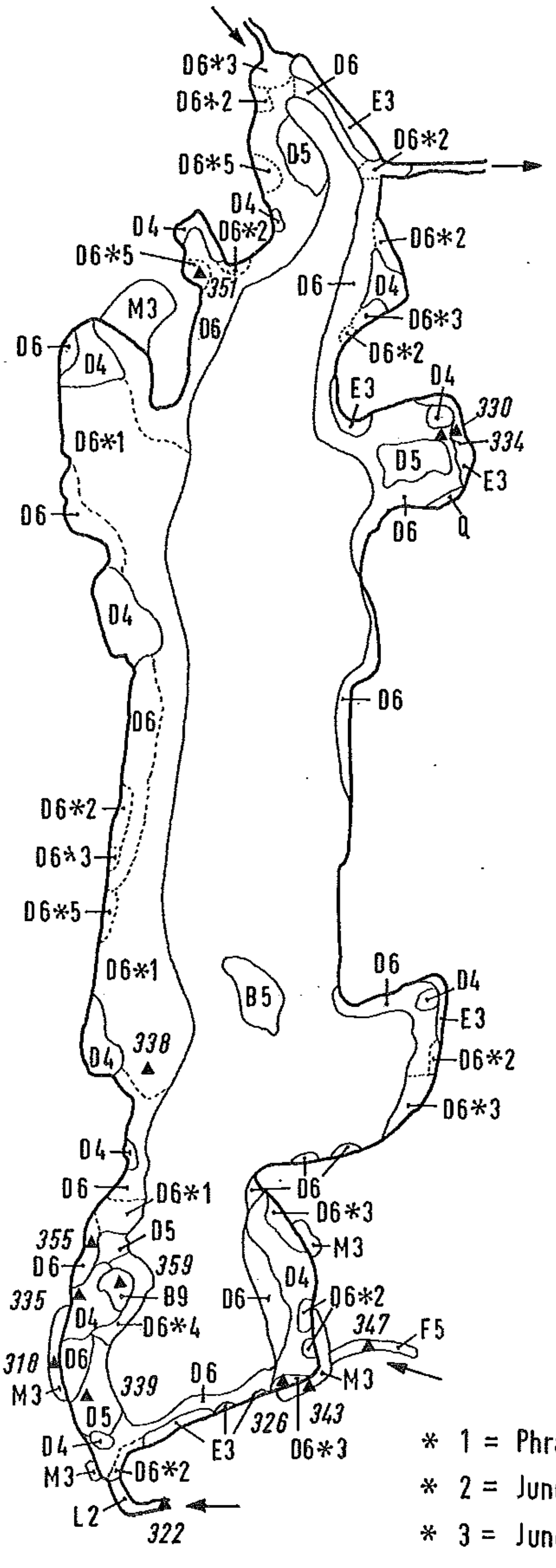

LOUGH NAMANAWAUN
0
50
100 mtr


I
F1*1
75
F2
B4
F2
63
61
B4
70
B6*3
65
72
I
B2
62
B4
60
E6
F3
B8
I
E6
A10
67
B4
64
F4
E5
73
B4
66
F4
J2
69
68
71
J4
H2*2
H2
B2
I
* 1 = Myrica gale dominance
* 2 = Phragmites australis
* 3 = Equisetum fluviatile


MURVEY
0 20 40 60 80 100 mtr

LOUGH ATURTAUN





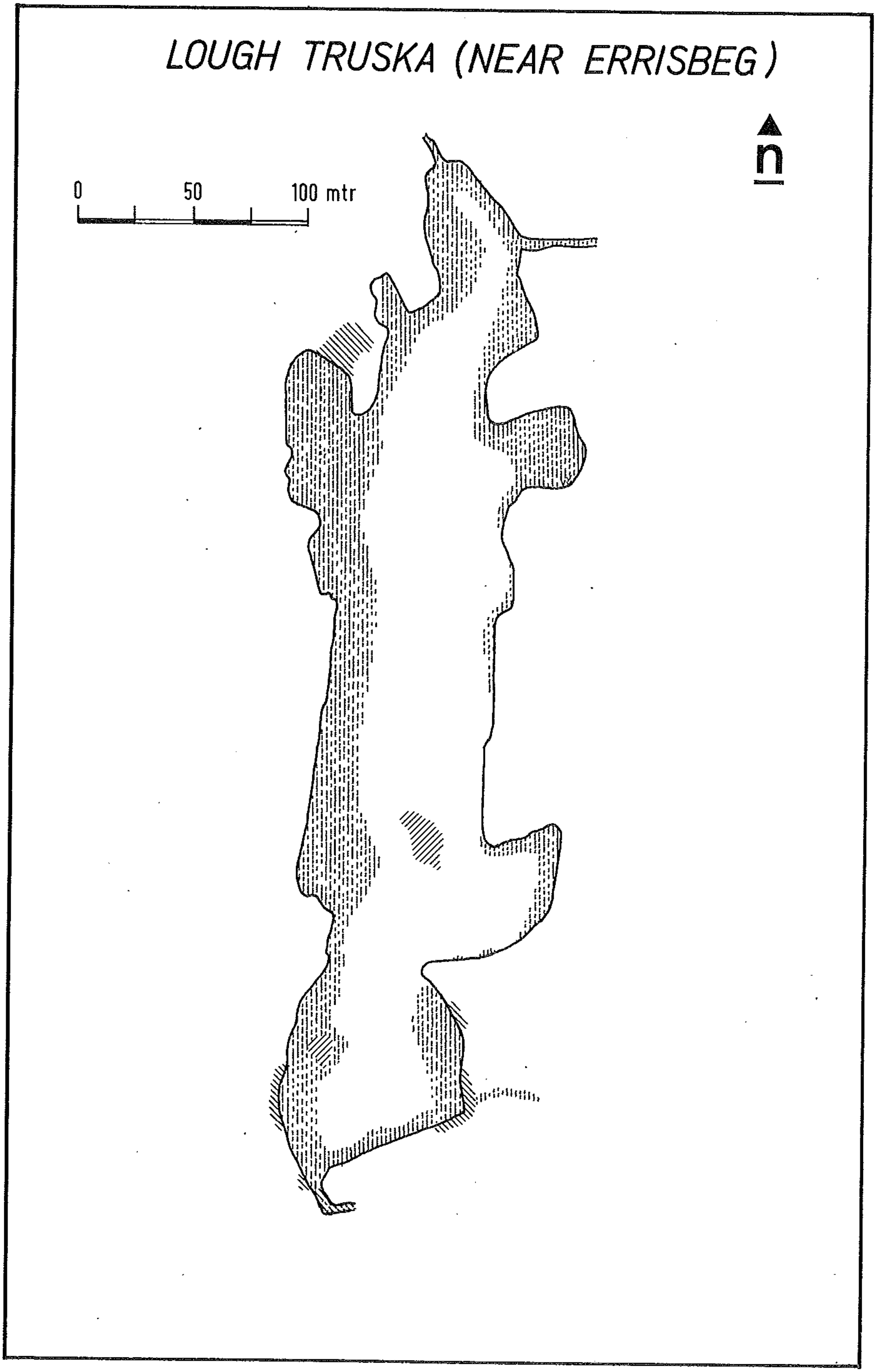
* 1 = Phragmites australis, loose

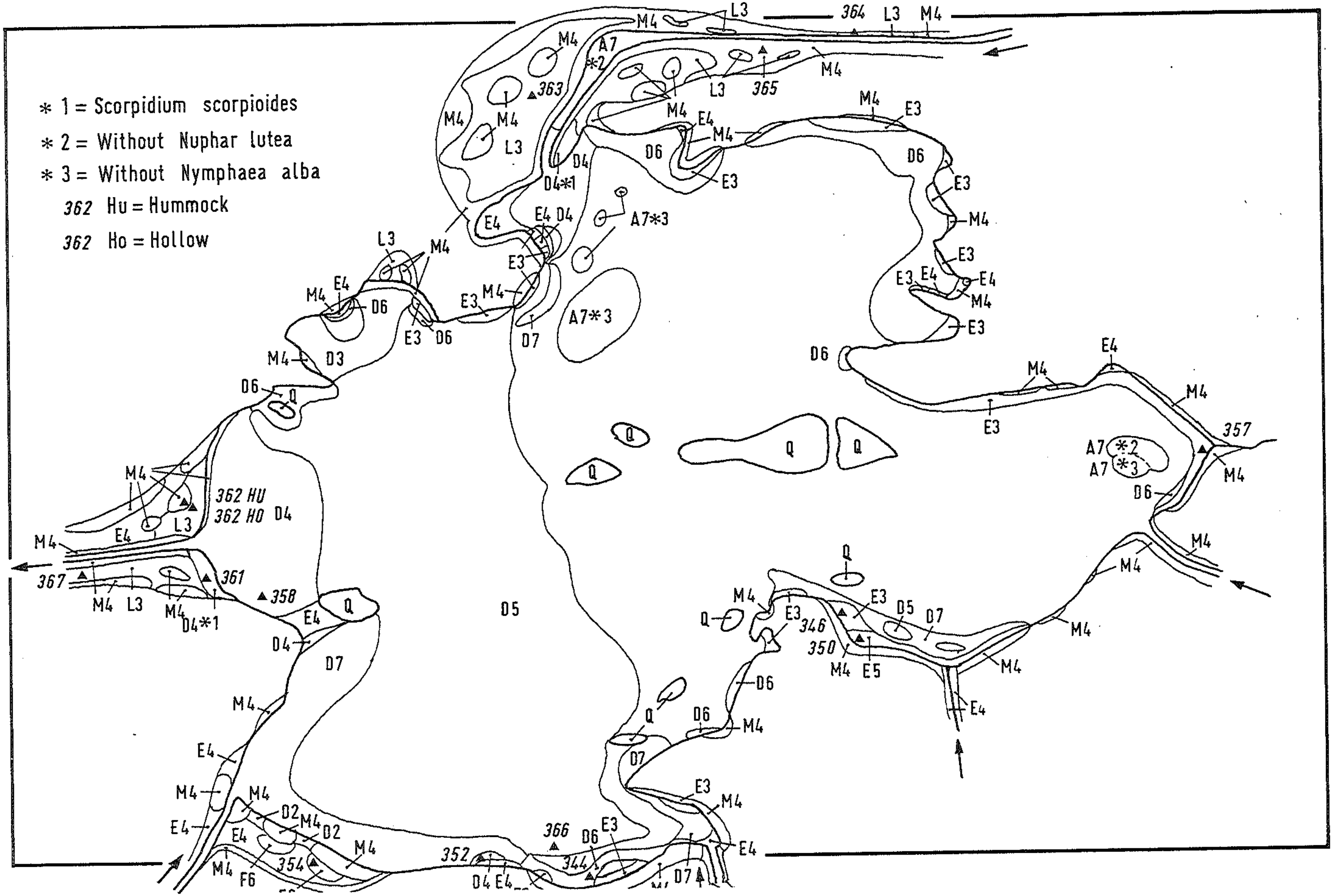
* 2 = Juncus subnodulosus

* 3 = Juncus subnodulosus + Cladium mariscus, loose

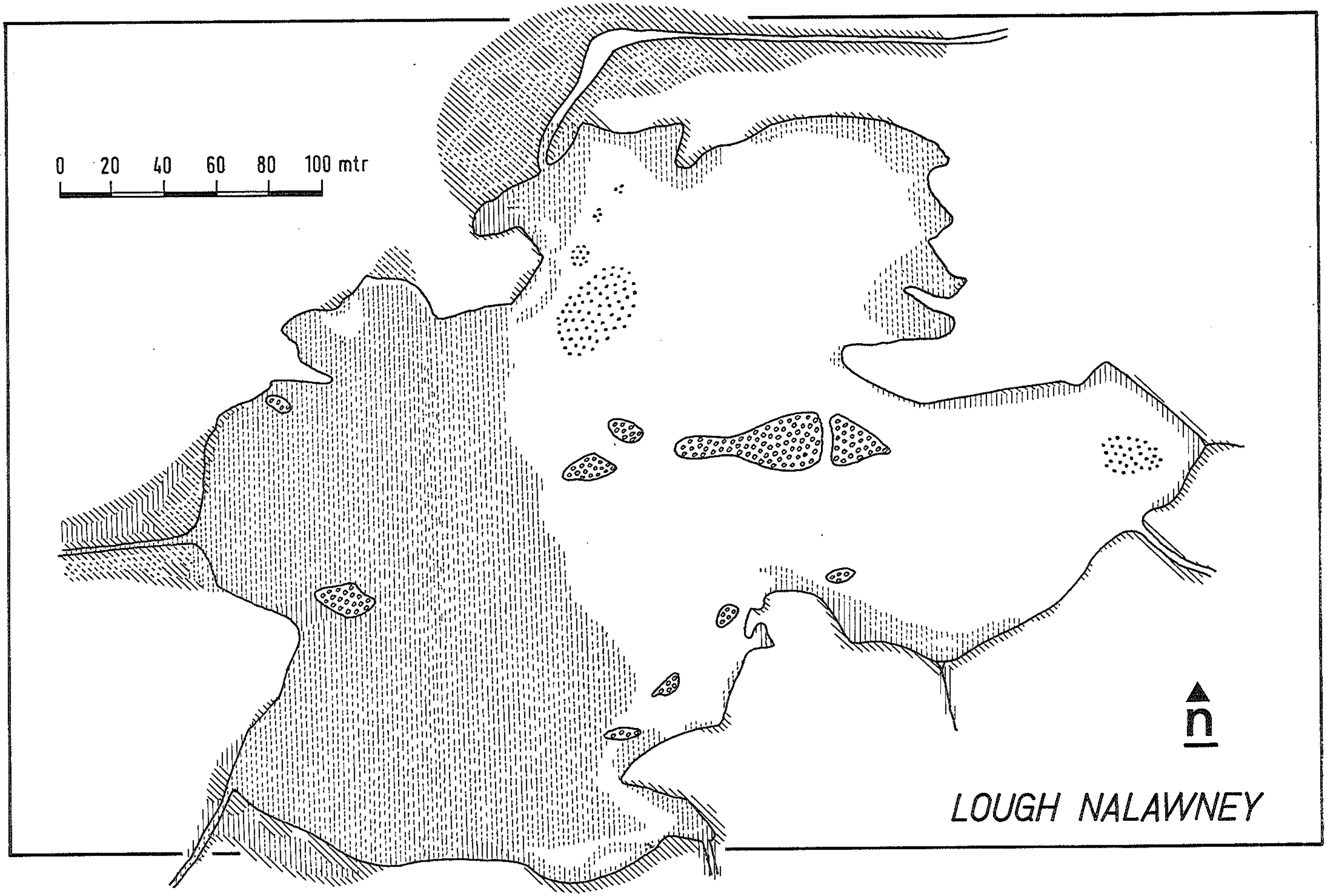
* 4 = Nymphaea alba

* 5 = Eleocharis multicaulis

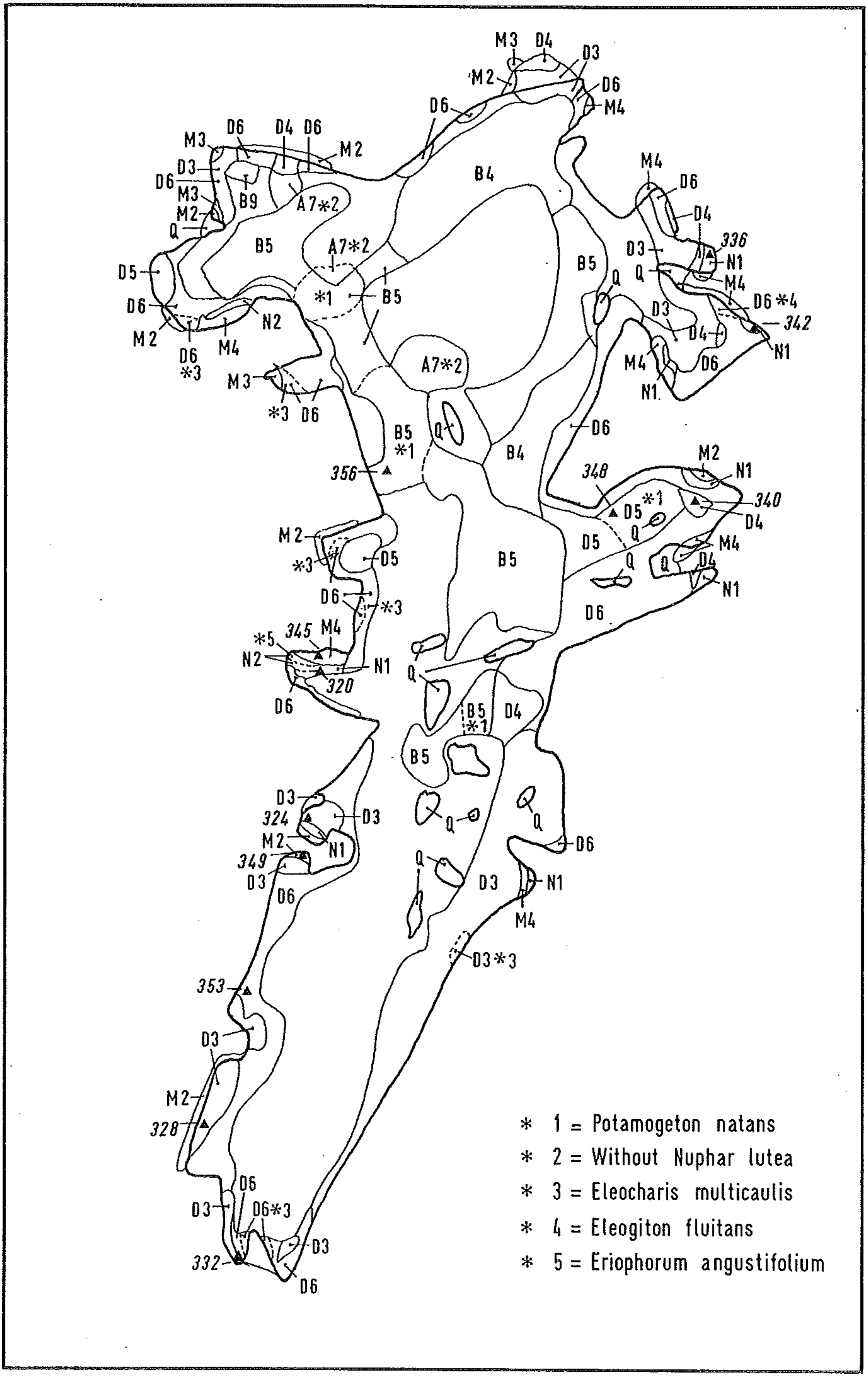

LOUGH TRUSKA (NEAR ERRISBEG)
n
0
50
100 mtr



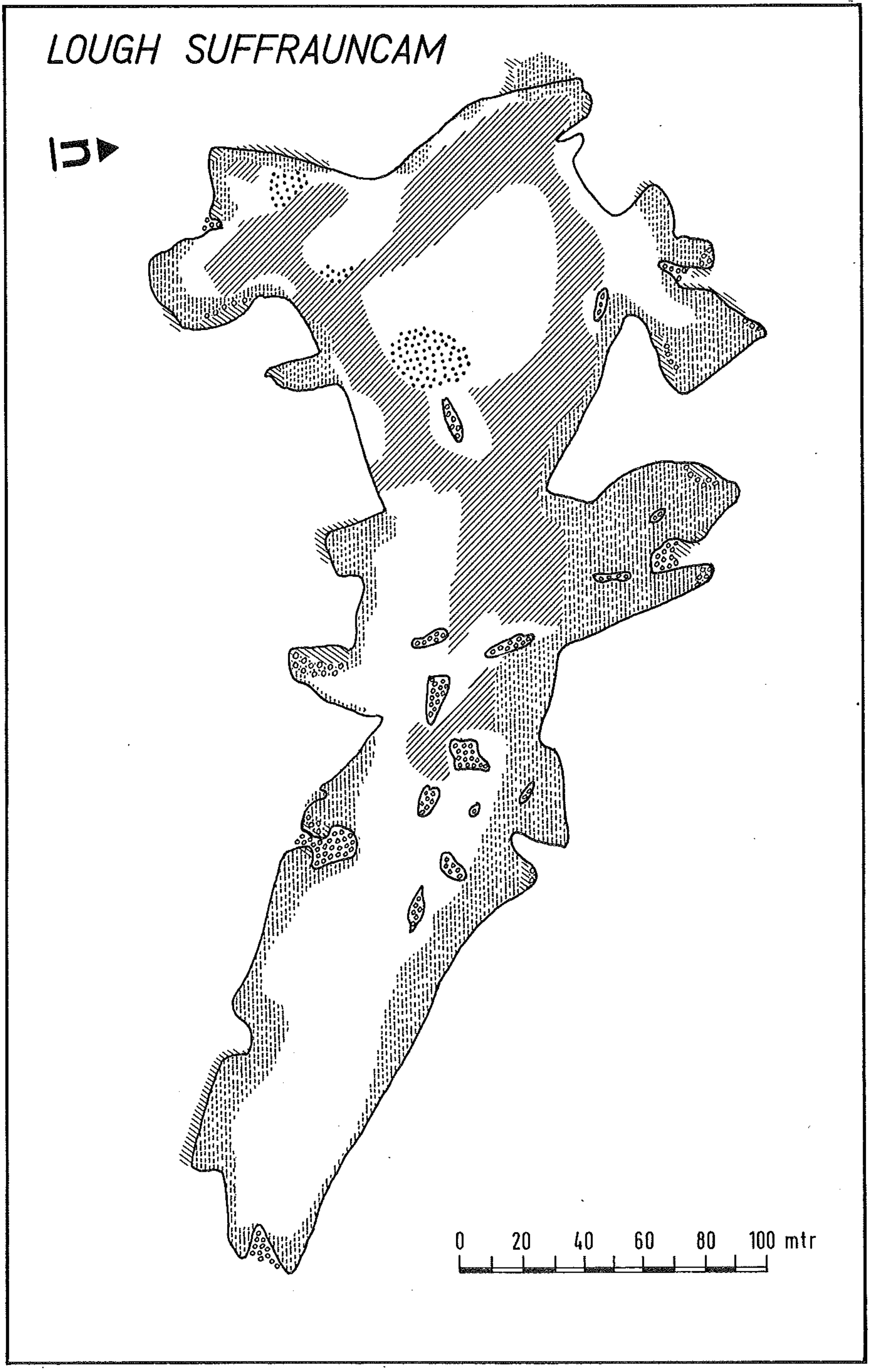
* 1 = Scorpidium scorpioides
* 2 = Without Nuphar lutea
* 3 = Without Nymphaea alba
362 Hu = Hummock
362 Ho = Hollow
364
365
363
357
346
350
362 HU
362 HO
361
358
367
366
344
352
354
D5
A7*3

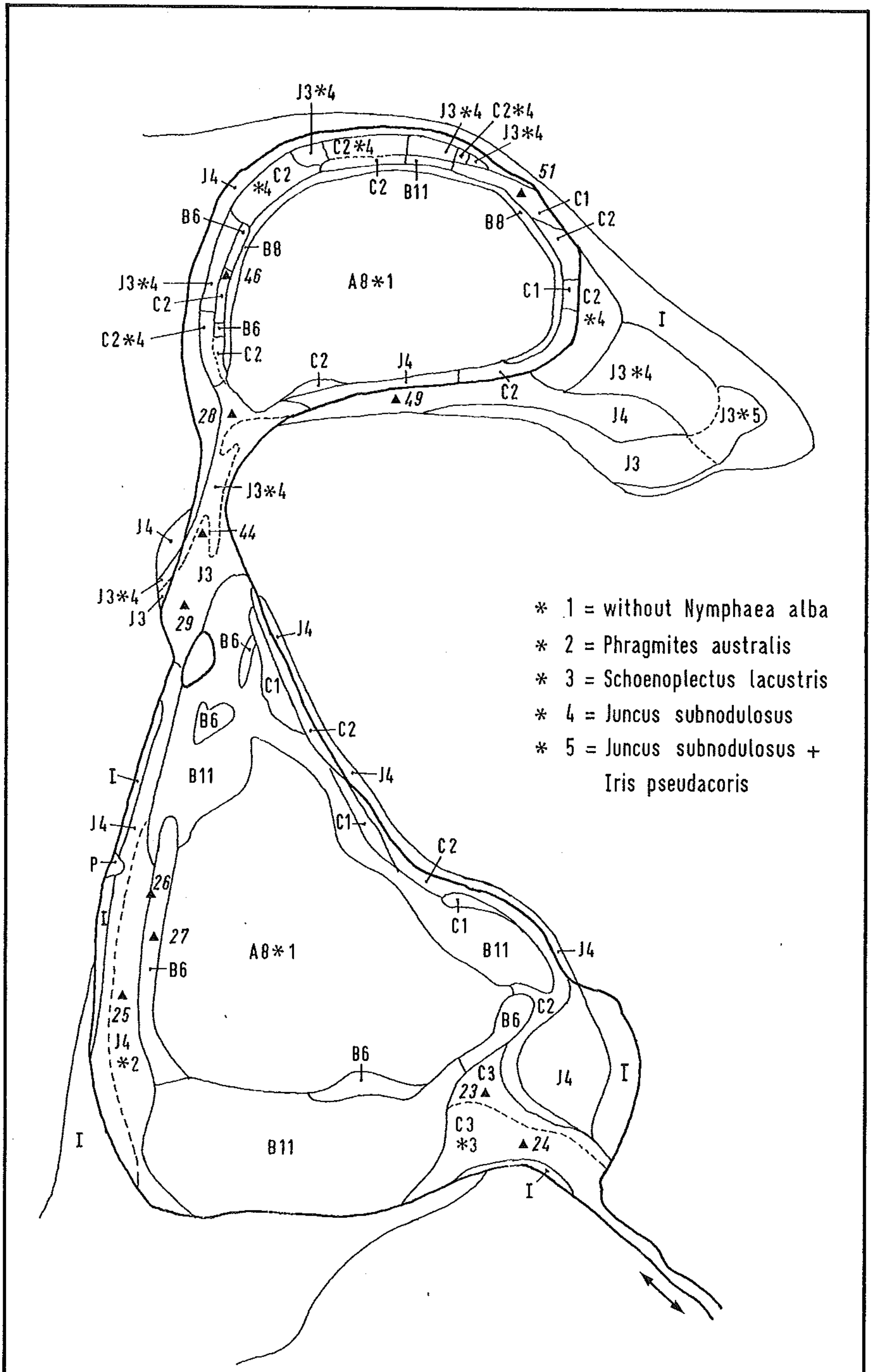


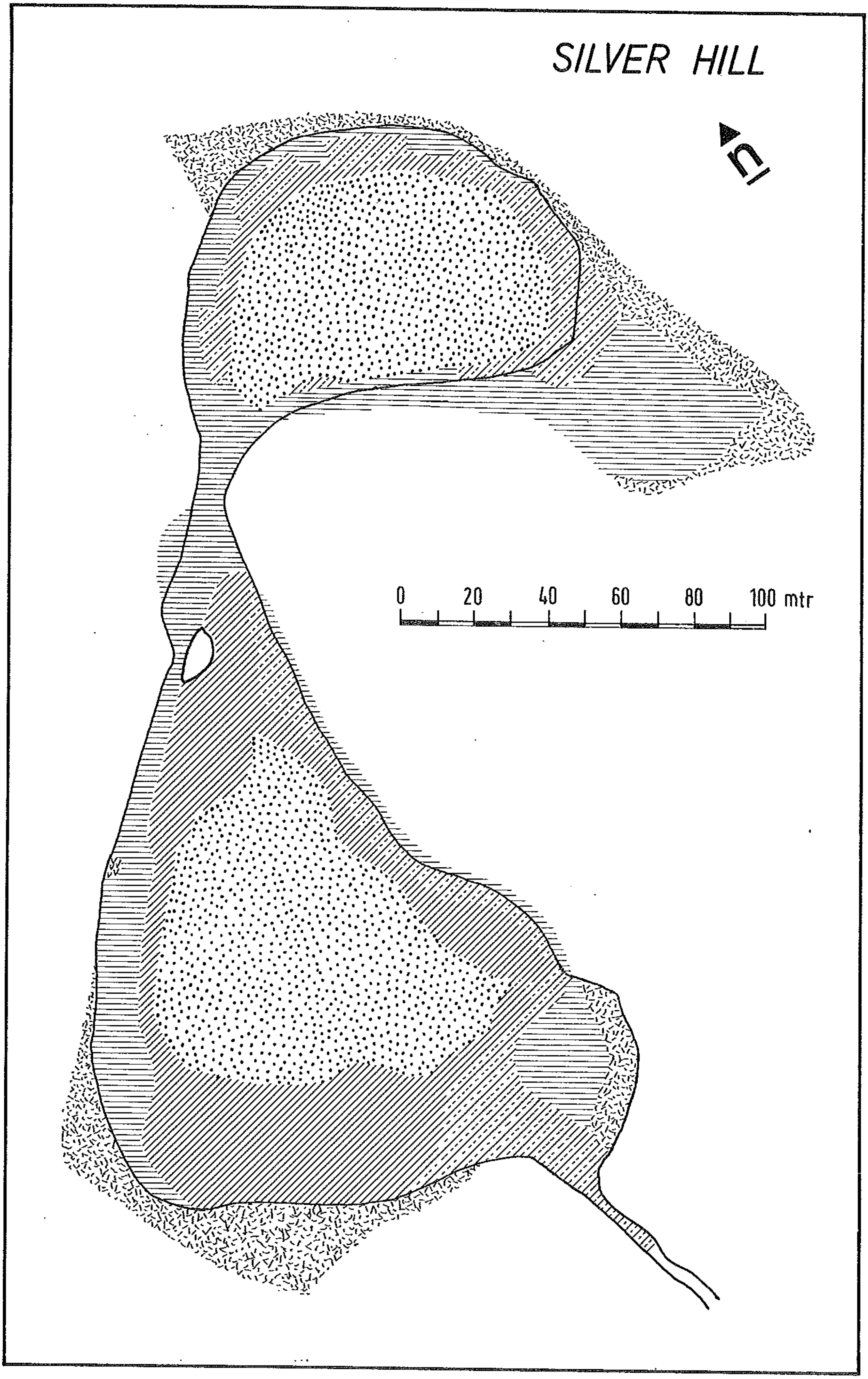
0 20 40 60 80 100 mtr
n
LOUGH NALAWNEY



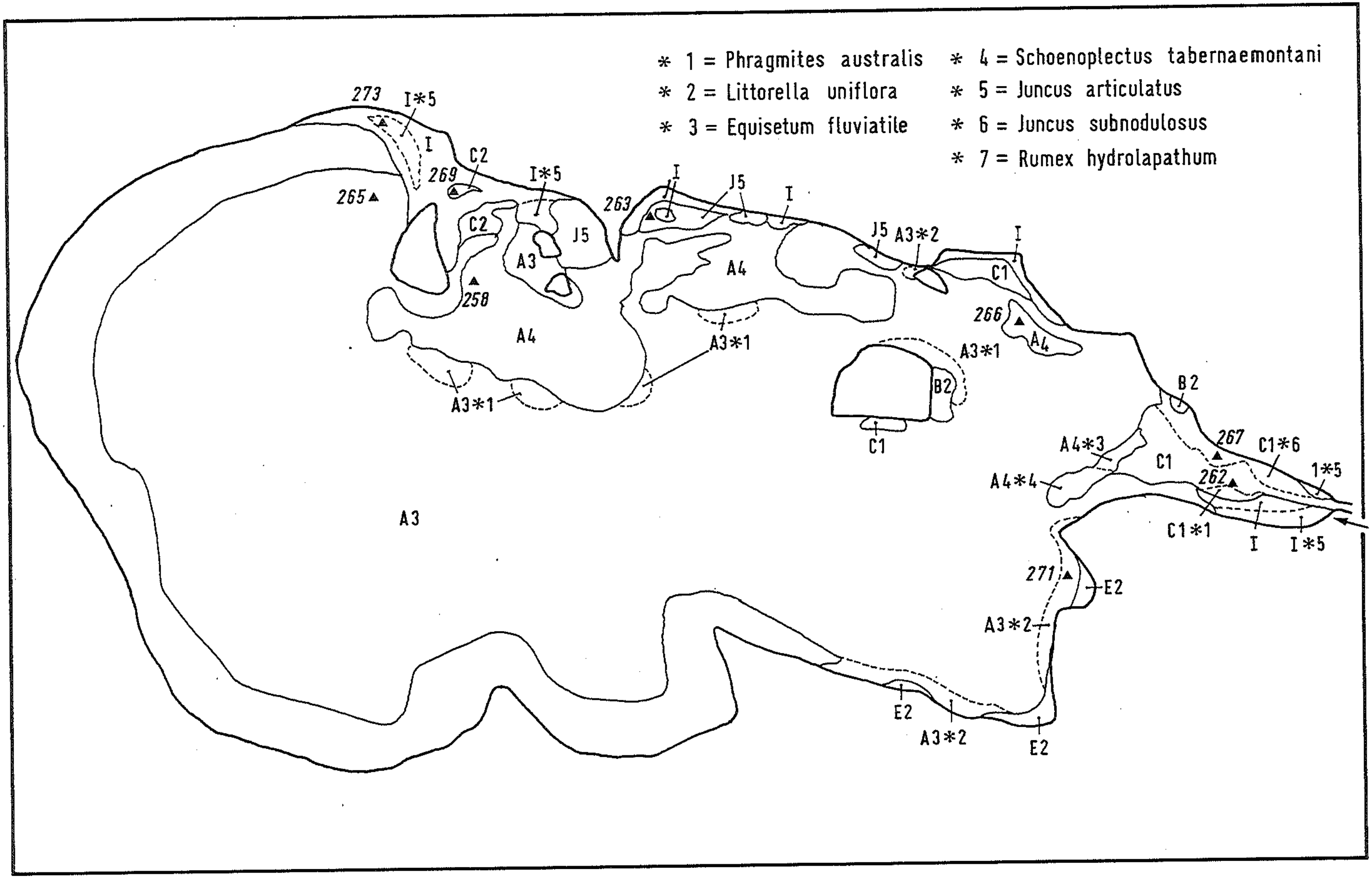
* 1 = Potamogeton natans
* 2 = Without Nuphar lutea
* 3 = Eleocharis multicaulis
* 4 = Eleogiton fluitans
* 5 = Eriophorum angustifolium


LOUGH SUFFRAUNCAM
0 20 40 60 80 100 mtr

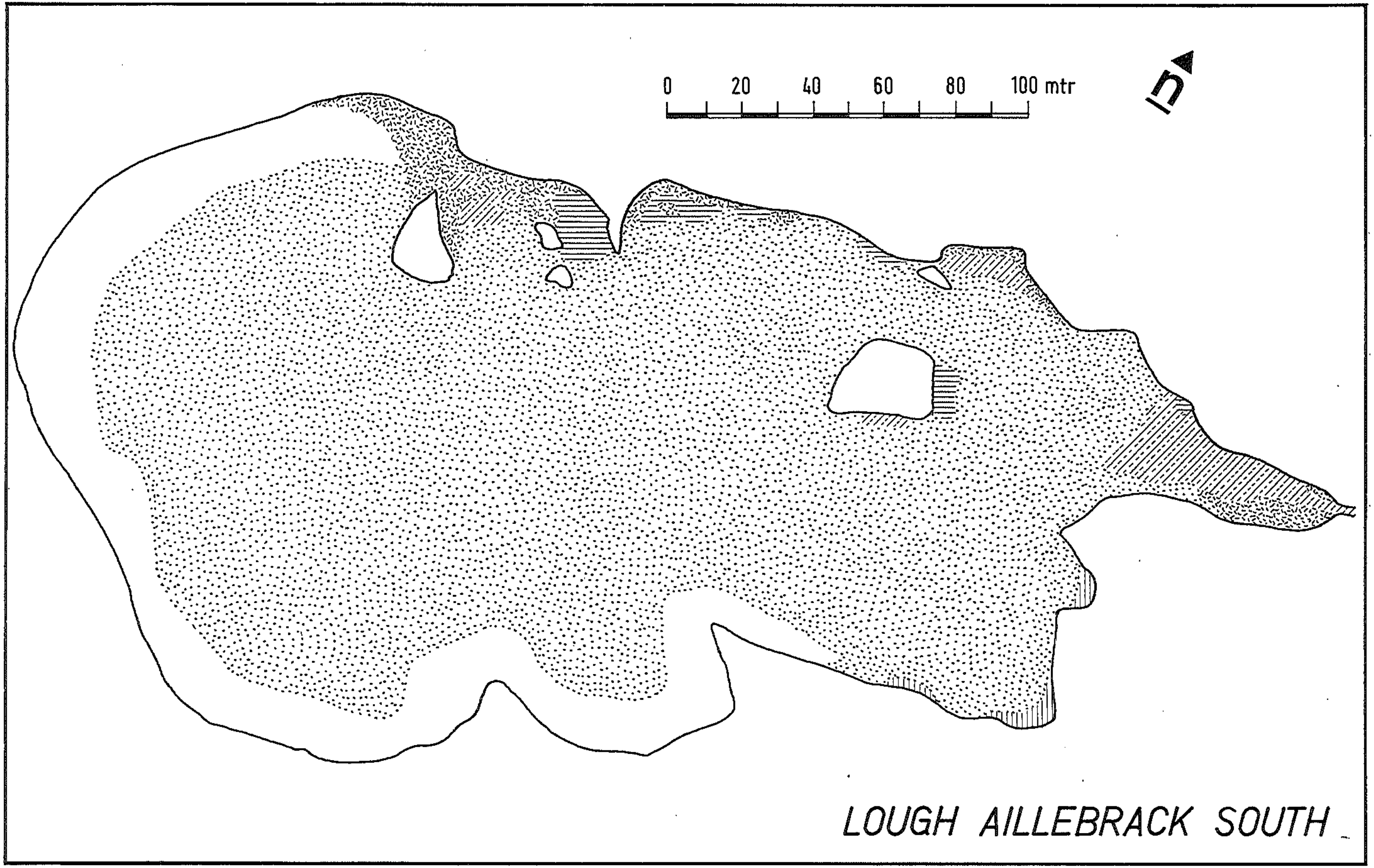

J3*4
J3*4 C2*4
J3*4
C2*4
J4
C2
*4
C2
B11
51
C1
B6
B8
C2
B8
46
A8*1
J3*4
C2
C1
C2
*4
I
C2*4
B6
C2
C2
J4
J3*4
C2
49
28
J4
J3*5
J3
J3*4
J4
44
J3
J3*4
J3
29
B6
J4
C1
B6
C2
I
B11
J4
J4
C1
P
C2
26
I
C1
27
A8*1
B11
J4
B6
25
B6
C2
J4
*2
B6
C3
J4
I
23
C3
*3
24
I
B11
I
* 1 = without Nymphaea alba
* 2 = Phragmites australis
* 3 = Schoenoplectus lacustris
* 4 = Juncus subnodulosus
* 5 = Juncus subnodulosus + Iris pseudacoris

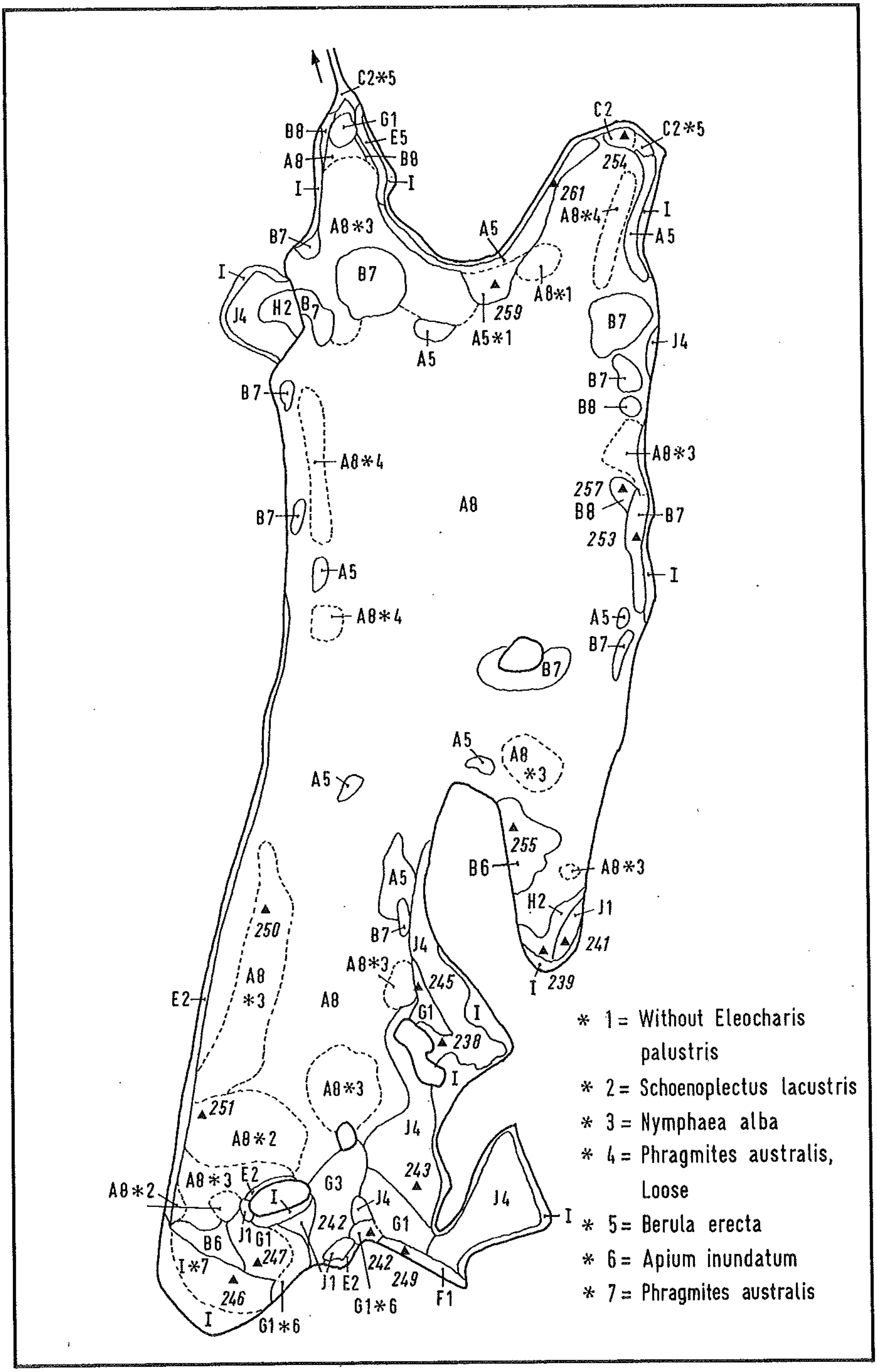


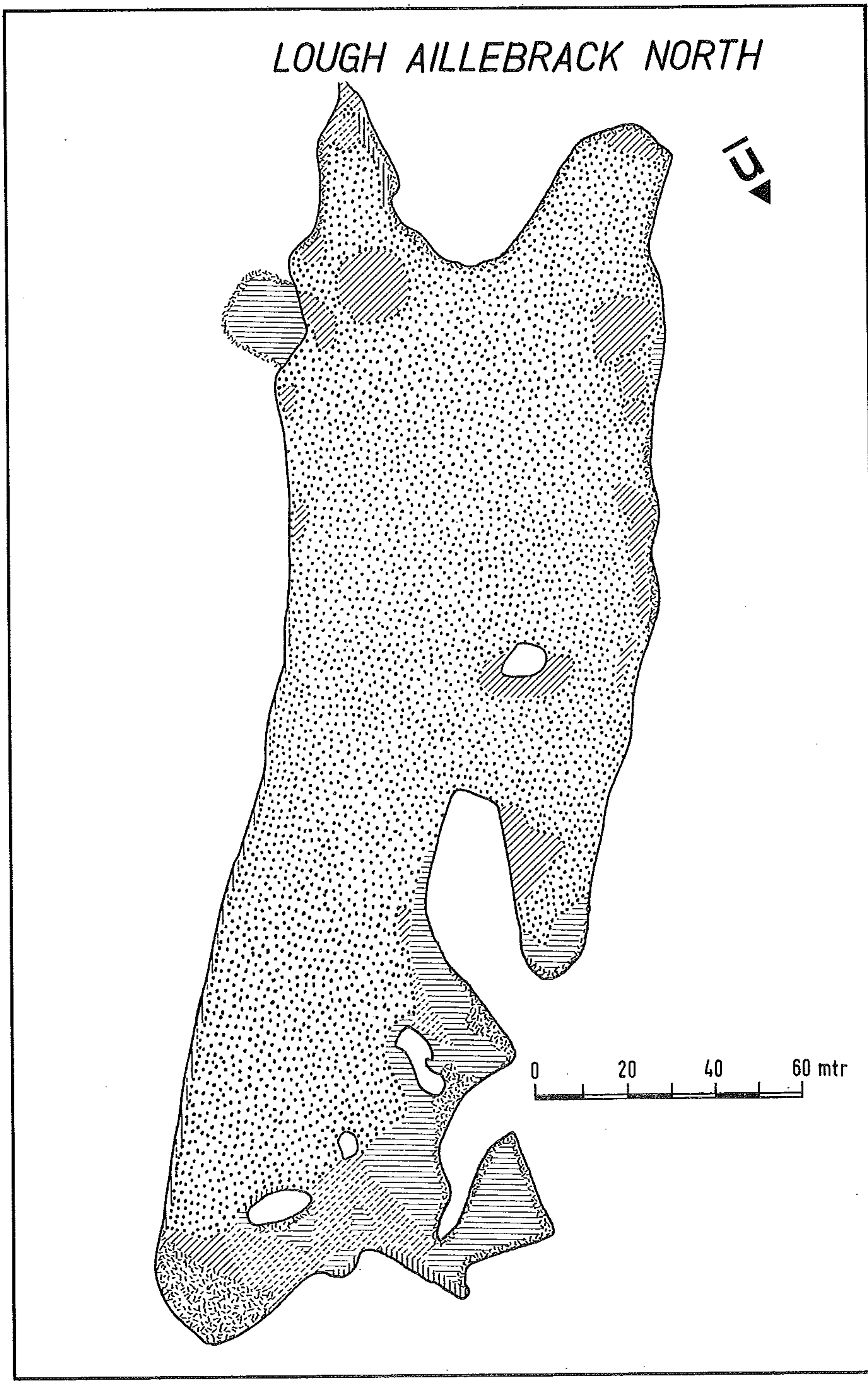
SILVER HILL
N
0
20
40
60
80
100 mtr



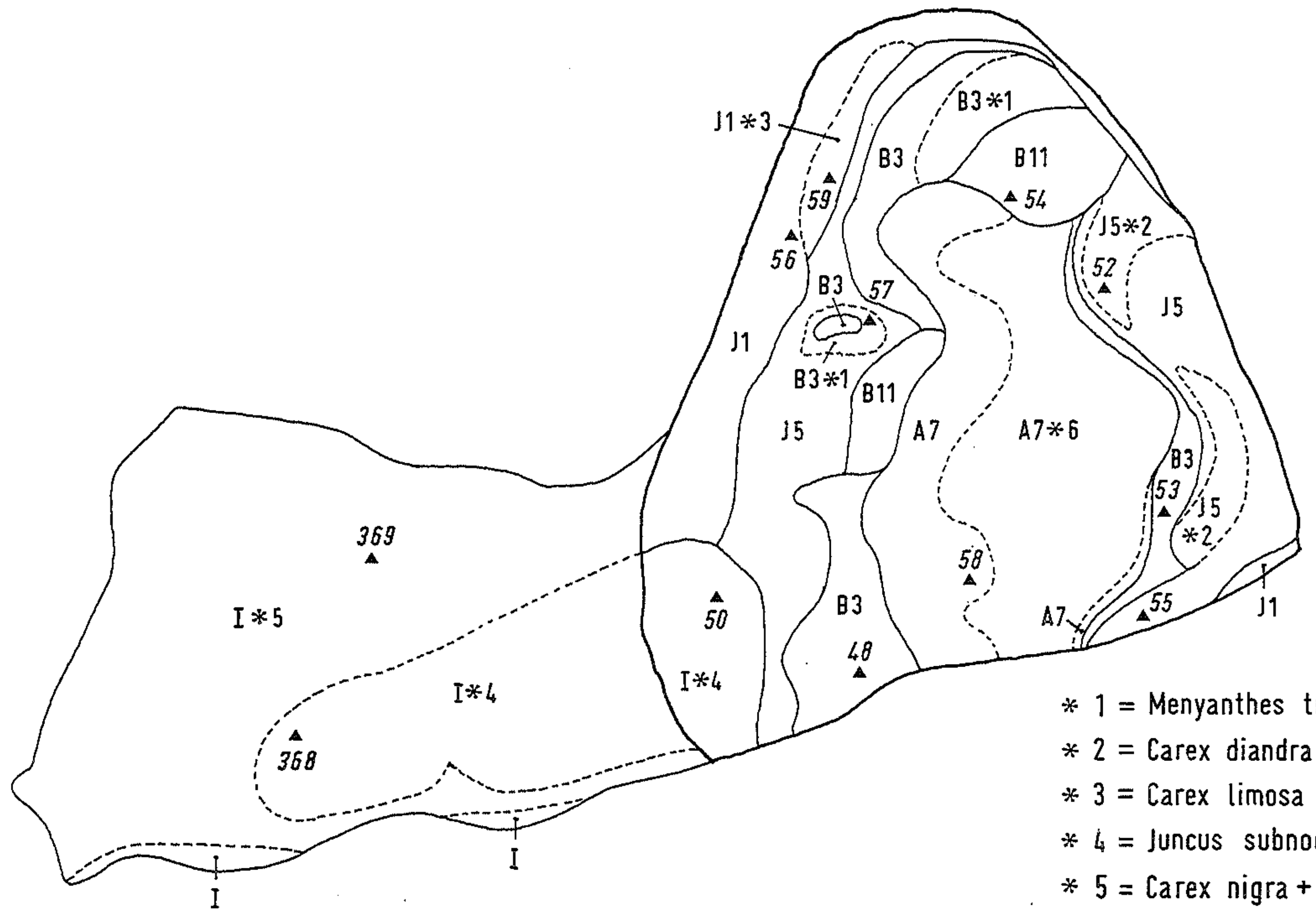
* 1 = Phragmites australis
* 2 = Littorella uniflora
* 3 = Equisetum fluviatile
* 4 = Schoenoplectus tabernaemontani
* 5 = Juncus articulatus
* 6 = Juncus subnodulosus
* 7 = Rumex hydrolapathum
273
I*5
I
C2
269
265
I*5
C2
J5
A3
258
263
I
J5
I
A4
J5
A3*2
I
C1
266
A4
A3*1
A3*1
B2
C1
A3*1
B2
A4*3
C1
267
C1*6
1*5
262
A4*4
C1*1
I
I*5
271
E2
A3*2
E2
A3*2
E2
A3


0
20
40
60
80
100 mtr
LOUGH AILLEBRACK SOUTH

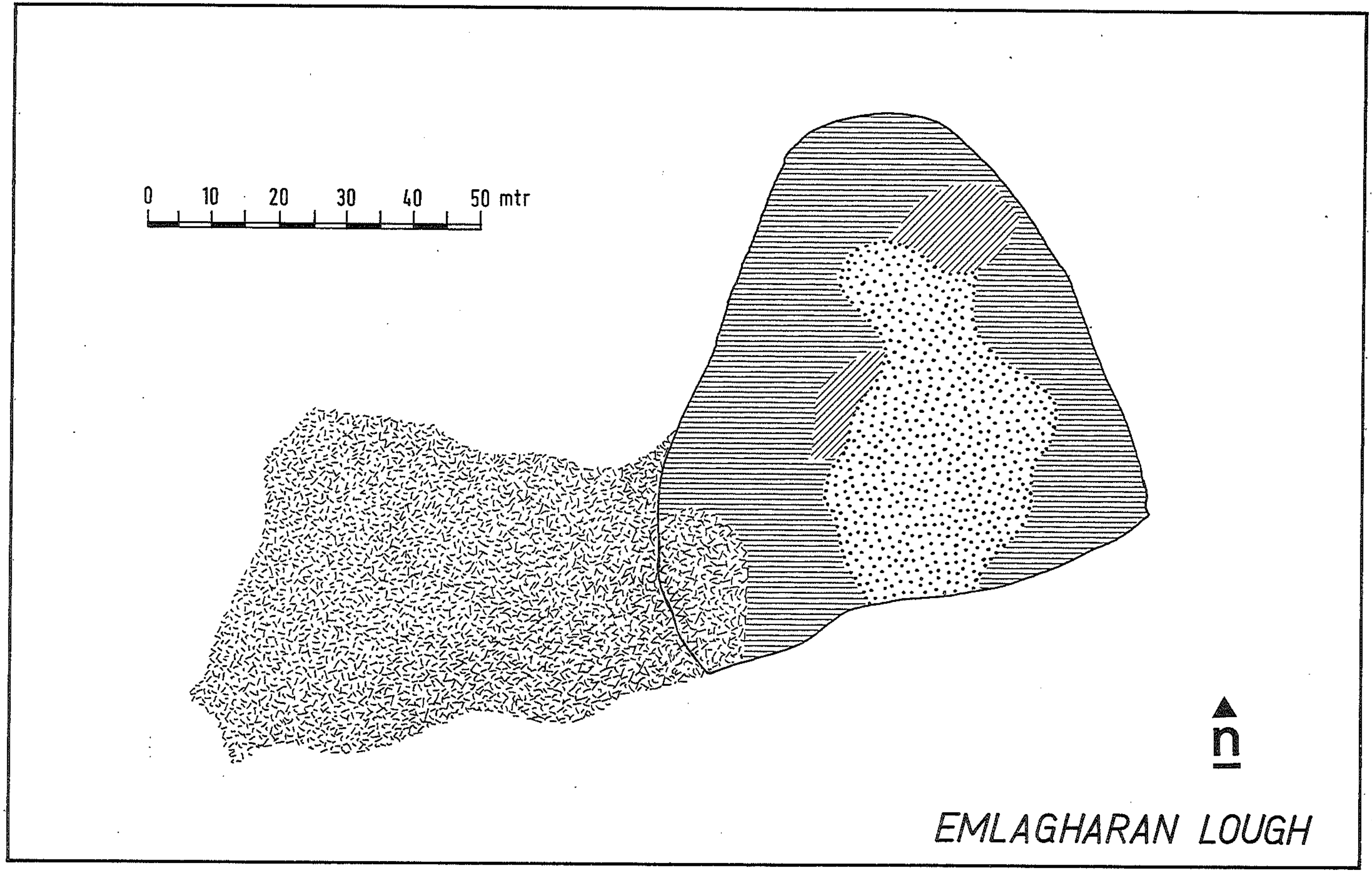

C2*5
G1
B8
E5
A8
B8
I
I
A8*3
B7
C2
C2*5
254
261
A8*4
I
A5
A5
A8*1
B7
I
J4
H2
B7
A5
A5*1
259
B7
J4
B7
B8
B7
A8*4
A8*3
A8
257
B8
B7
253
B7
I
A5
A8*4
A5
B7
B7
A5
A8
*3
A5
255
B6
A8*3
A5
H2
J1
B7
241
250
239
I
J4
A8*3
245
A8
*3
E2
A8
G1
I
238
I
A8*3
251
J4
A8*2
243
E2
A8*3
A8*2
G3
I
J4
J4
I
242
G1
B6
J1
G1
247
242
I*7
J1
E2
249
246
G1*6
F1
I
G1*6
* 1 = Without Eleocharis palustris
* 2 = Schoenoplectus lacustris
* 3 = Nymphaea alba
* 4 = Phragmites australis, Loose
* 5 = Berula erecta
* 6 = Apium inundatum
* 7 = Phragmites australis

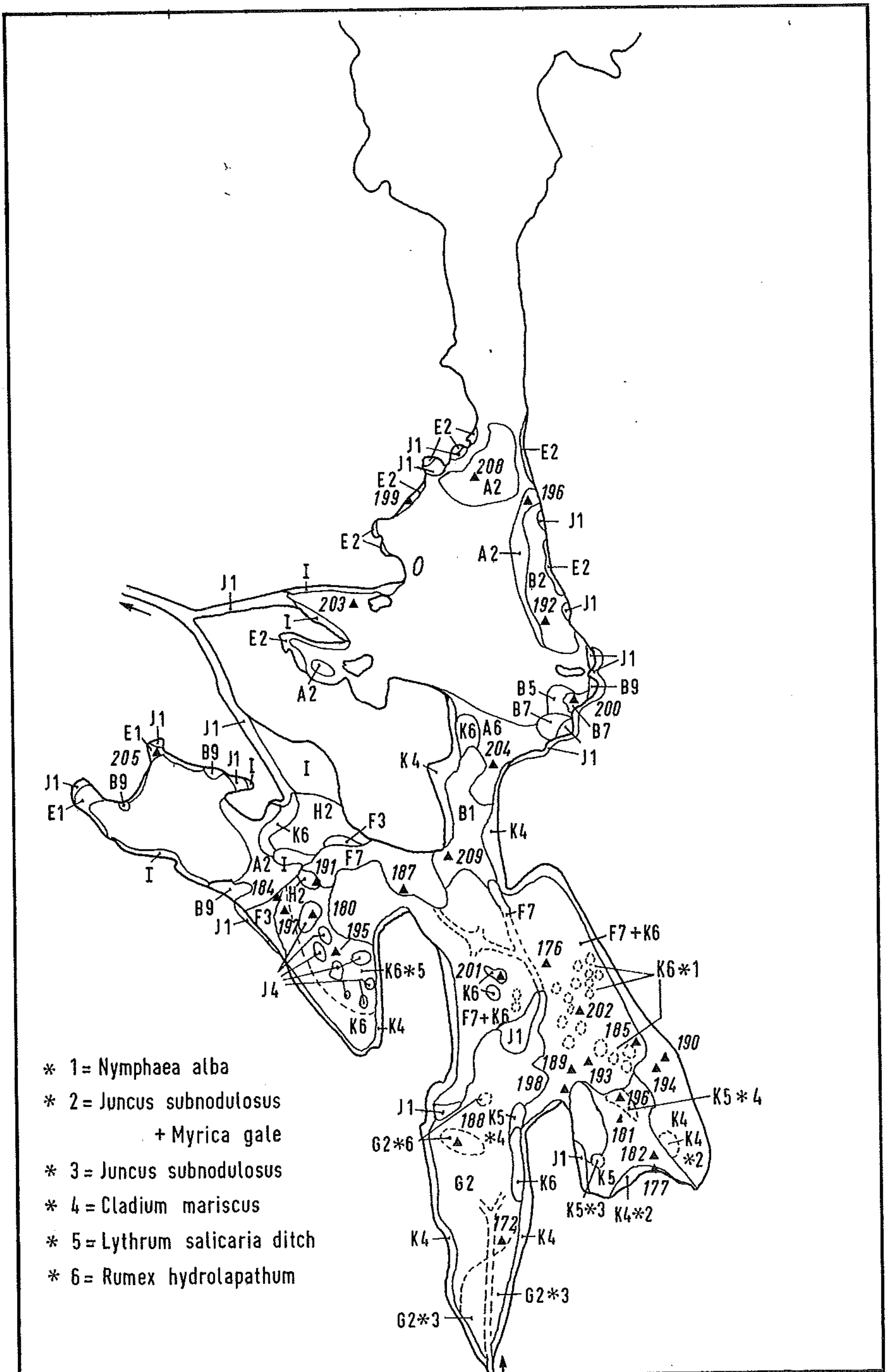


LOUGH AILLEBRACK NORTH
N
0
20
40
60 mtr

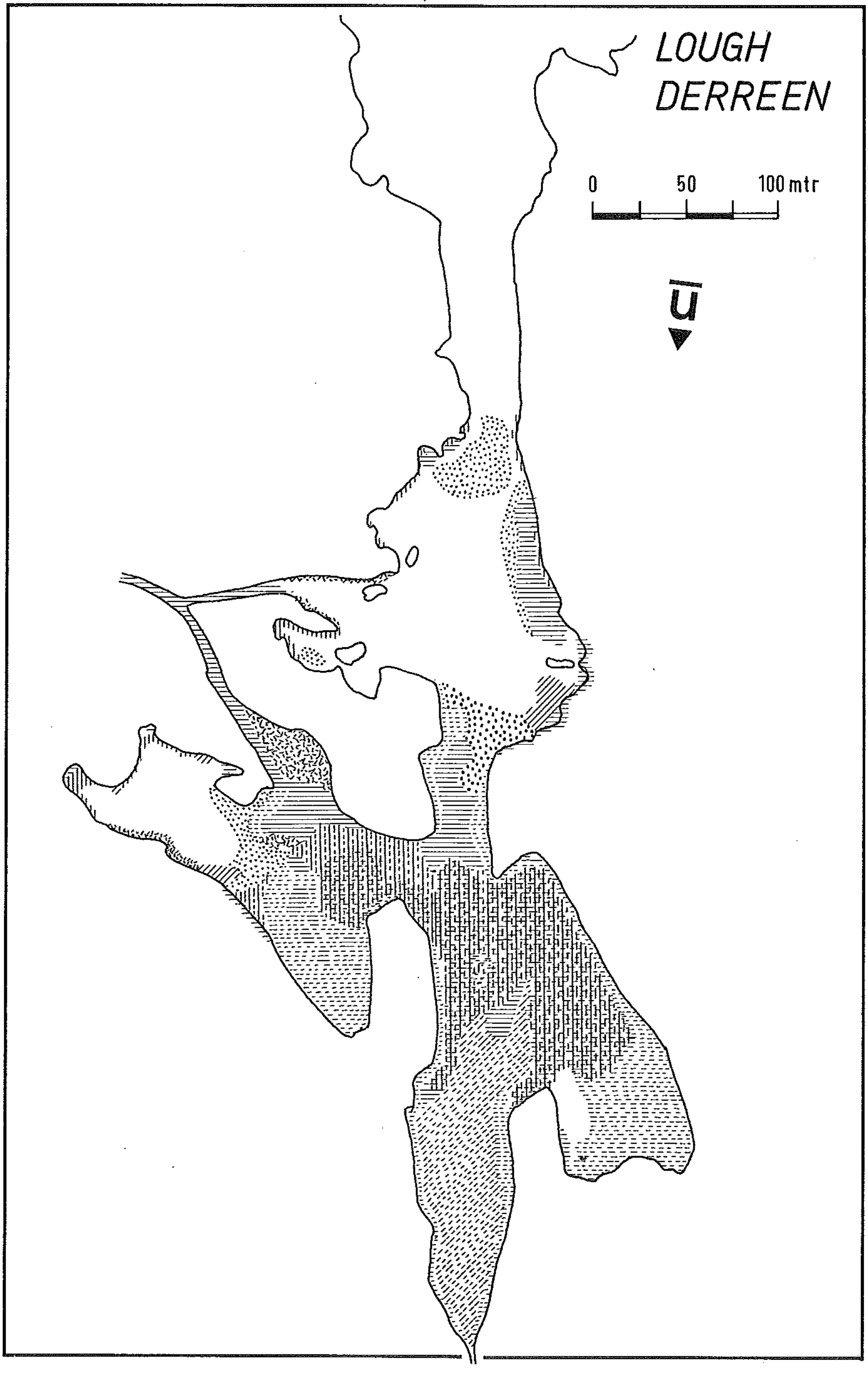


* 1 = Menyanthes trifoliata
* 2 = Carex diandra
* 3 = Carex limosa
* 4 = Juncus subnodulosus
* 5 = Carex nigra + Juncus articulatus
* 6 = without Nymphaea alba
  without Nuphar lutea

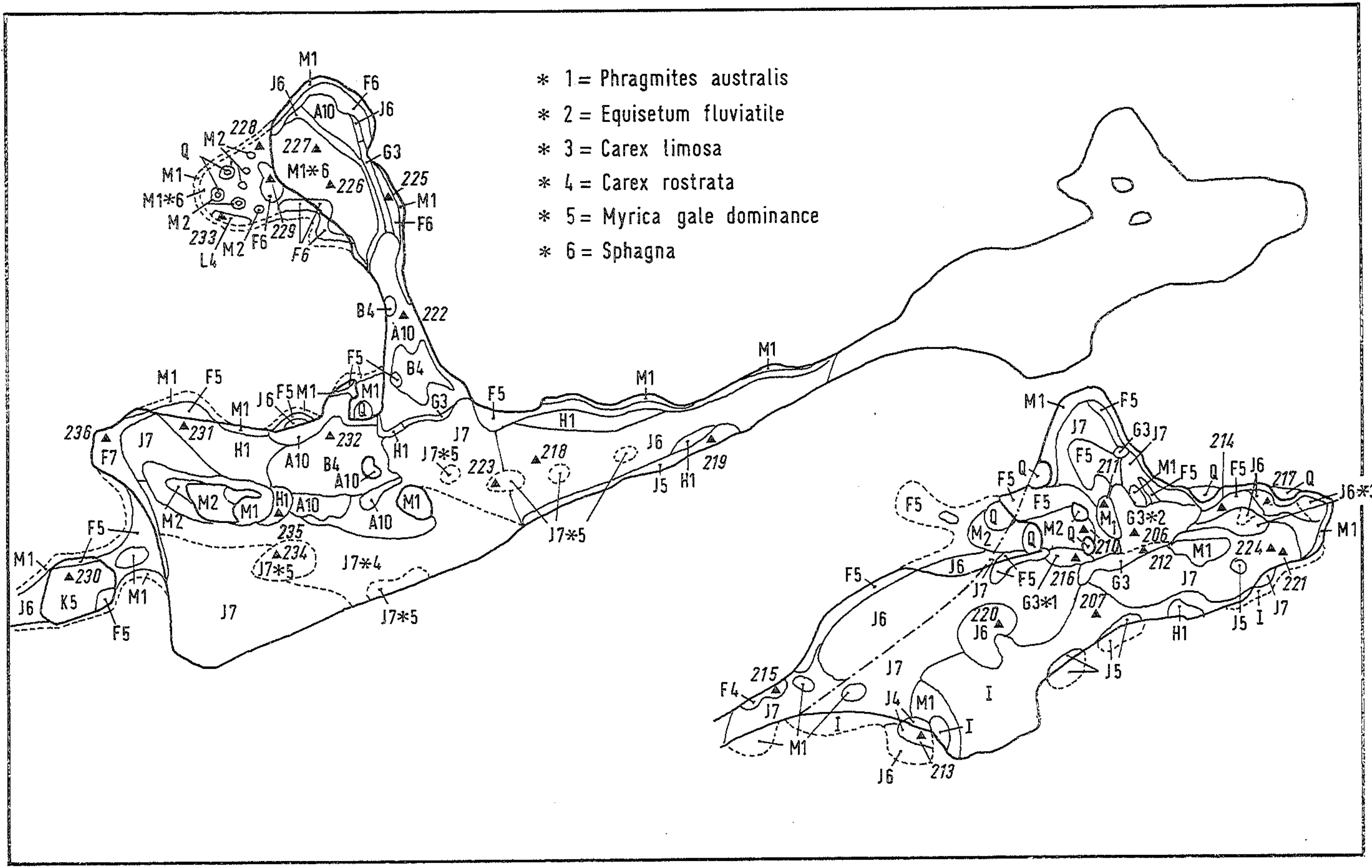

0
10
20
30
40
50 mtr
n
EMLAGHARAN LOUGH

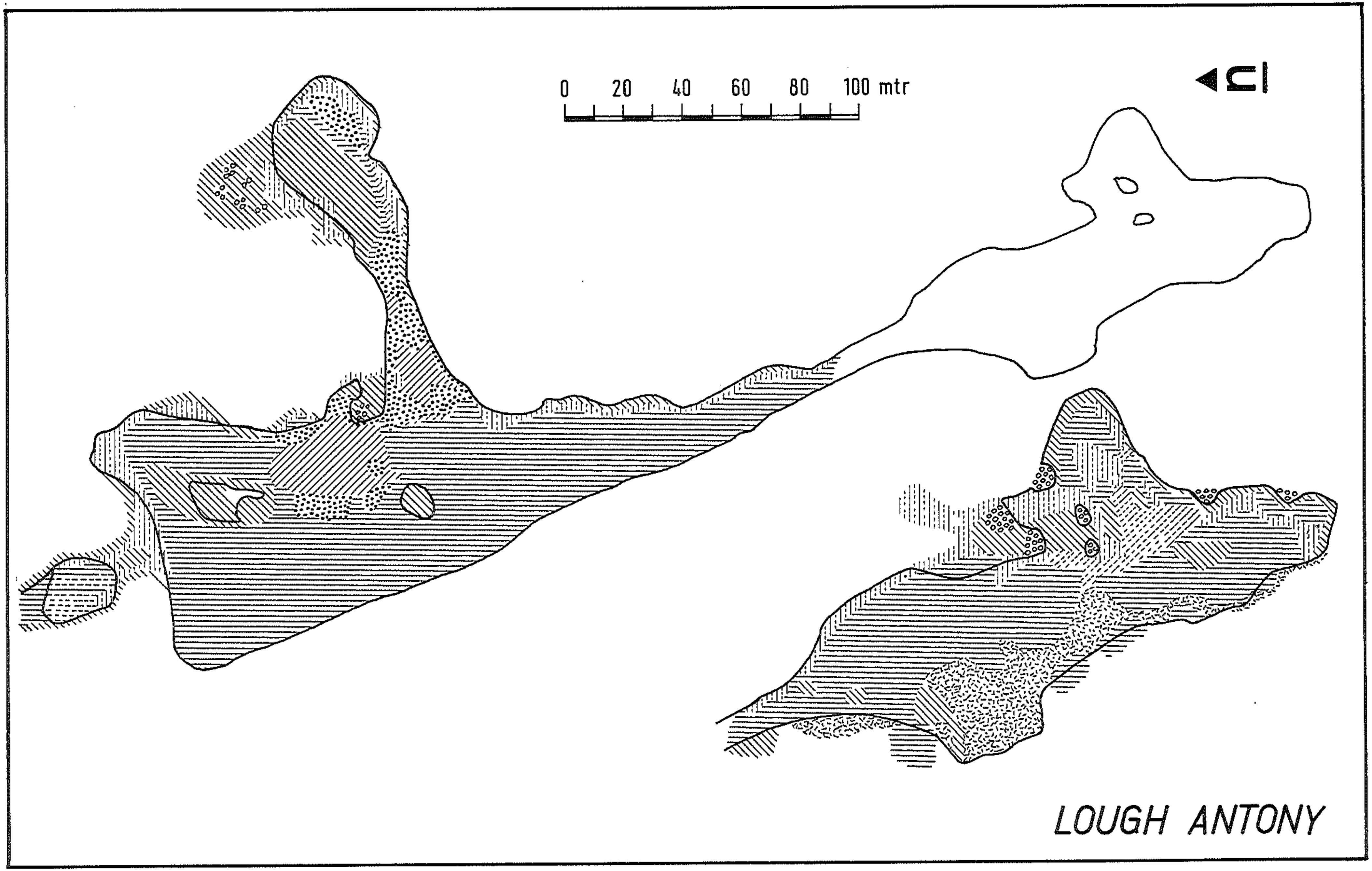


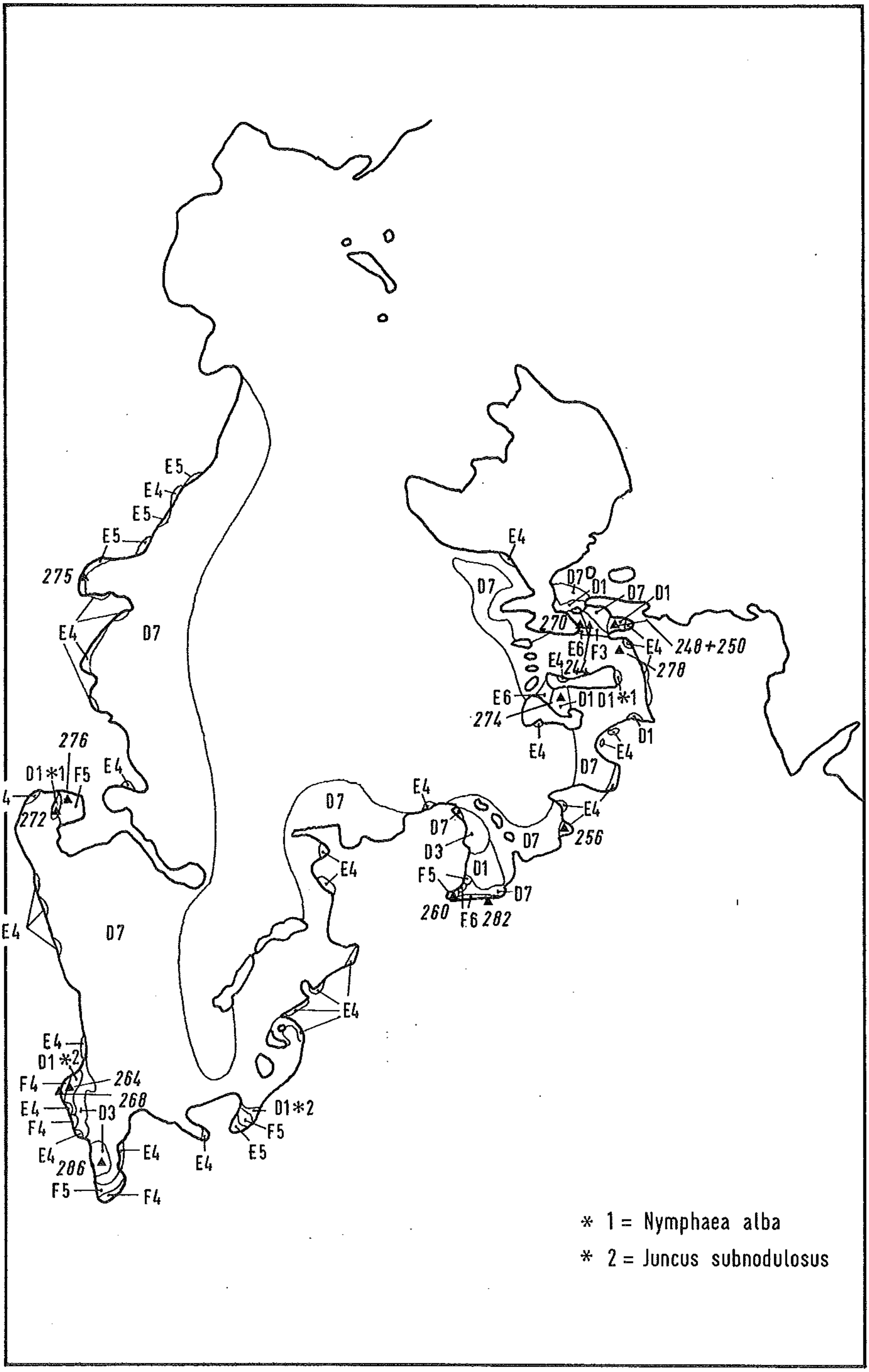
E2
J1
J1
208
A2
E2
199
196
J1
E2
A2
E2
O
B2
E2
J1
I
192
J1
203
I
E2
J1
A2
B5
B9
B7
200
B7
J1
E1
J1
205
J1
B9
J1
I
I
K6
A6
204
J1
K4
J1
E1
B9
H2
F3
B1
K4
K6
A2
I
F7
191
187
209
I
184
H2
B9
F3
197
180
F7
J1
195
176
F7 + K6
K6 * 5
201
K6 * 1
J4
K6
202
F7 + K6
K6
K4
J1
185
190
* 1 = Nymphaea alba
* 2 = Juncus subnodulosus
+ Myrica gale
* 3 = Juncus subnodulosus
* 4 = Cladium mariscus
* 5 = Lythrum salicaria ditch
* 6 = Rumex hydrolapathum
189
193
194
198
196
K5 * 4
J1
K5
101
K4
188
K4
G2 * 6
* 4
182
* 2
J1
K5
G2
K6
177
K5 * 3
K4 * 2
172
K4
K4
G2 * 3
G2 * 3



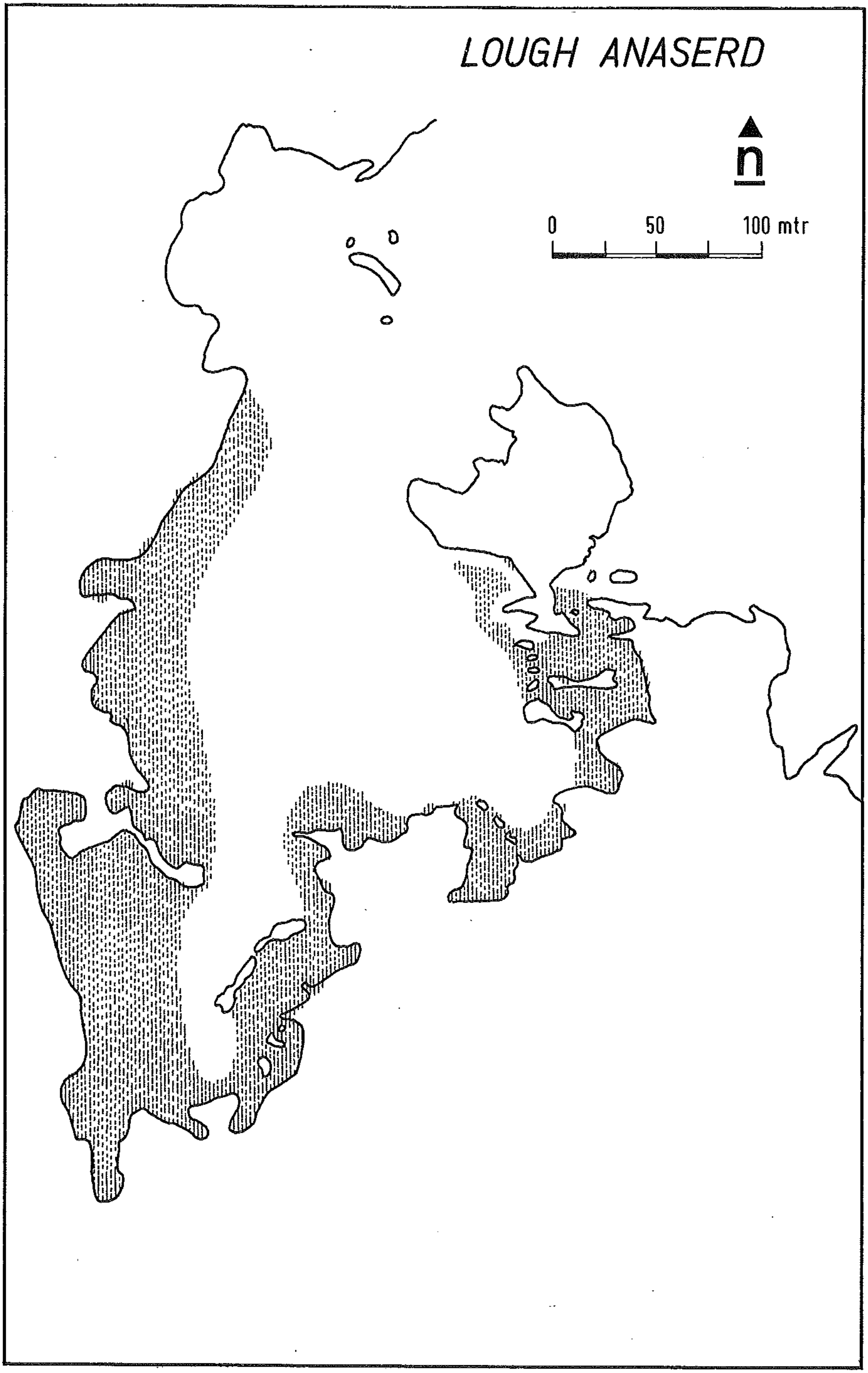
LOUGH
DERREEN
0
50
100 mtr

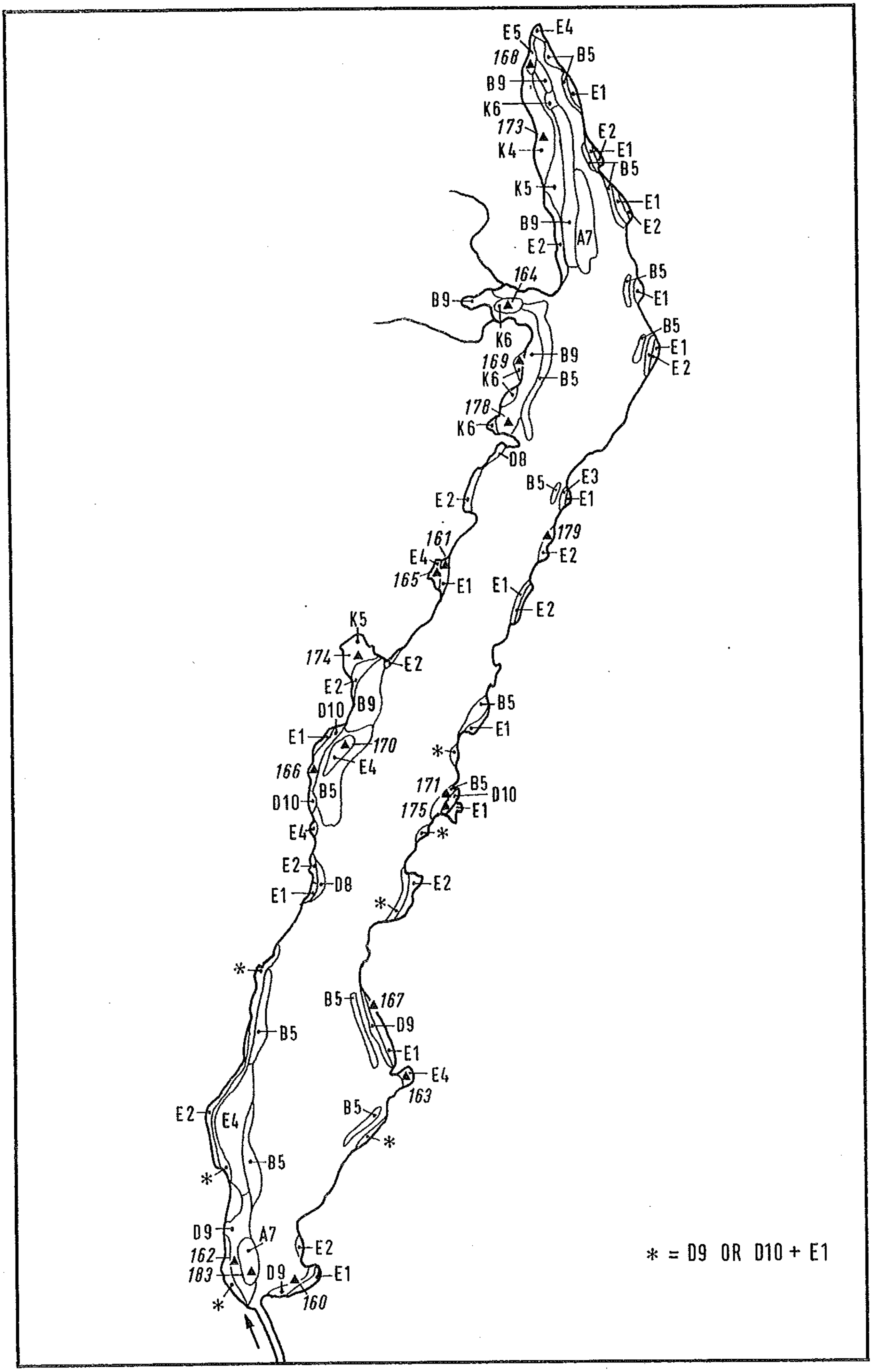

* 1 = Phragmites australis
* 2 = Equisetum fluviatile
* 3 = Carex limosa
* 4 = Carex rostrata
* 5 = Myrica gale dominance
* 6 = Sphagna


0 20 40 60 80 100 mtr
LOUGH ANTONY

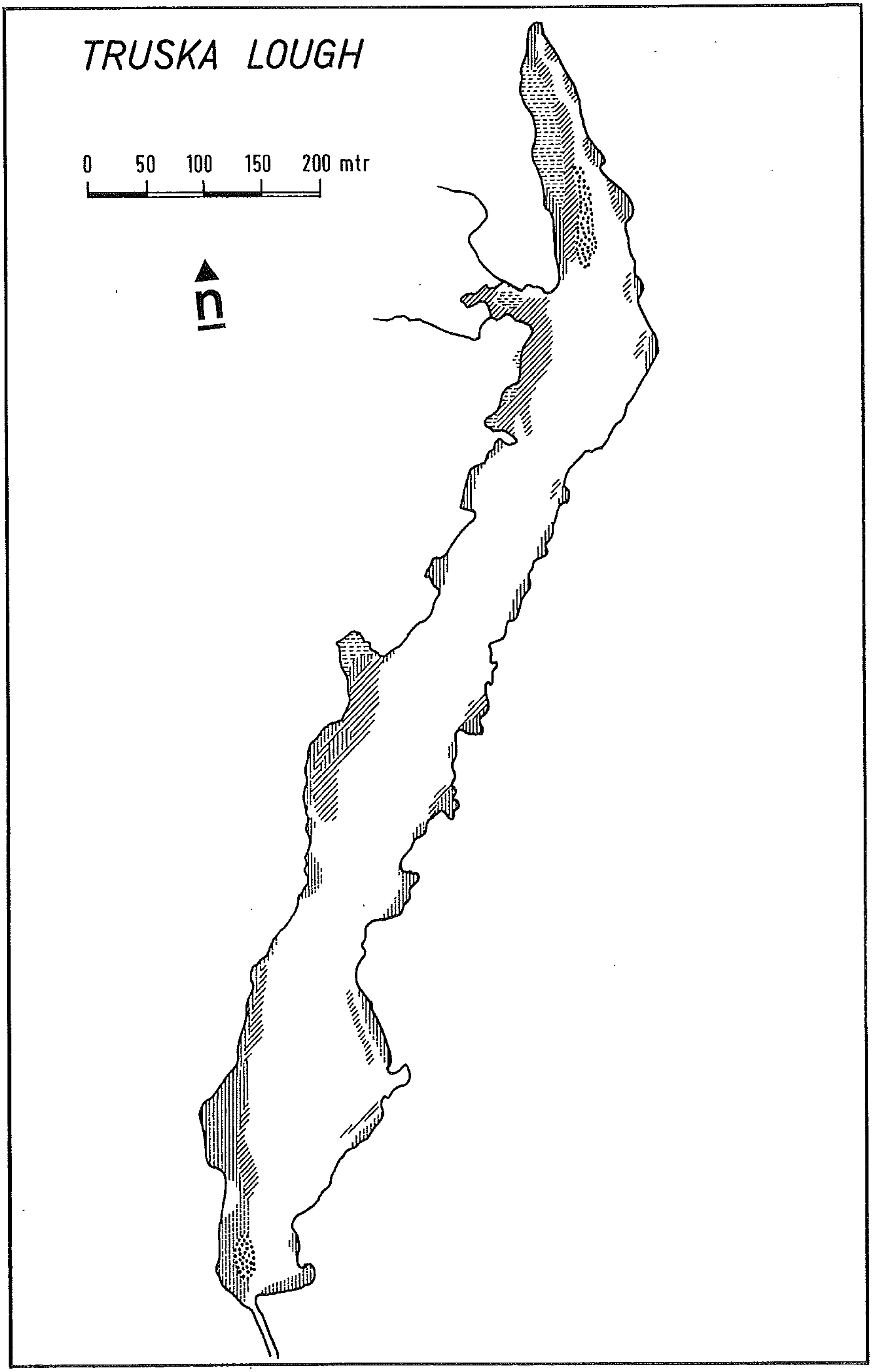


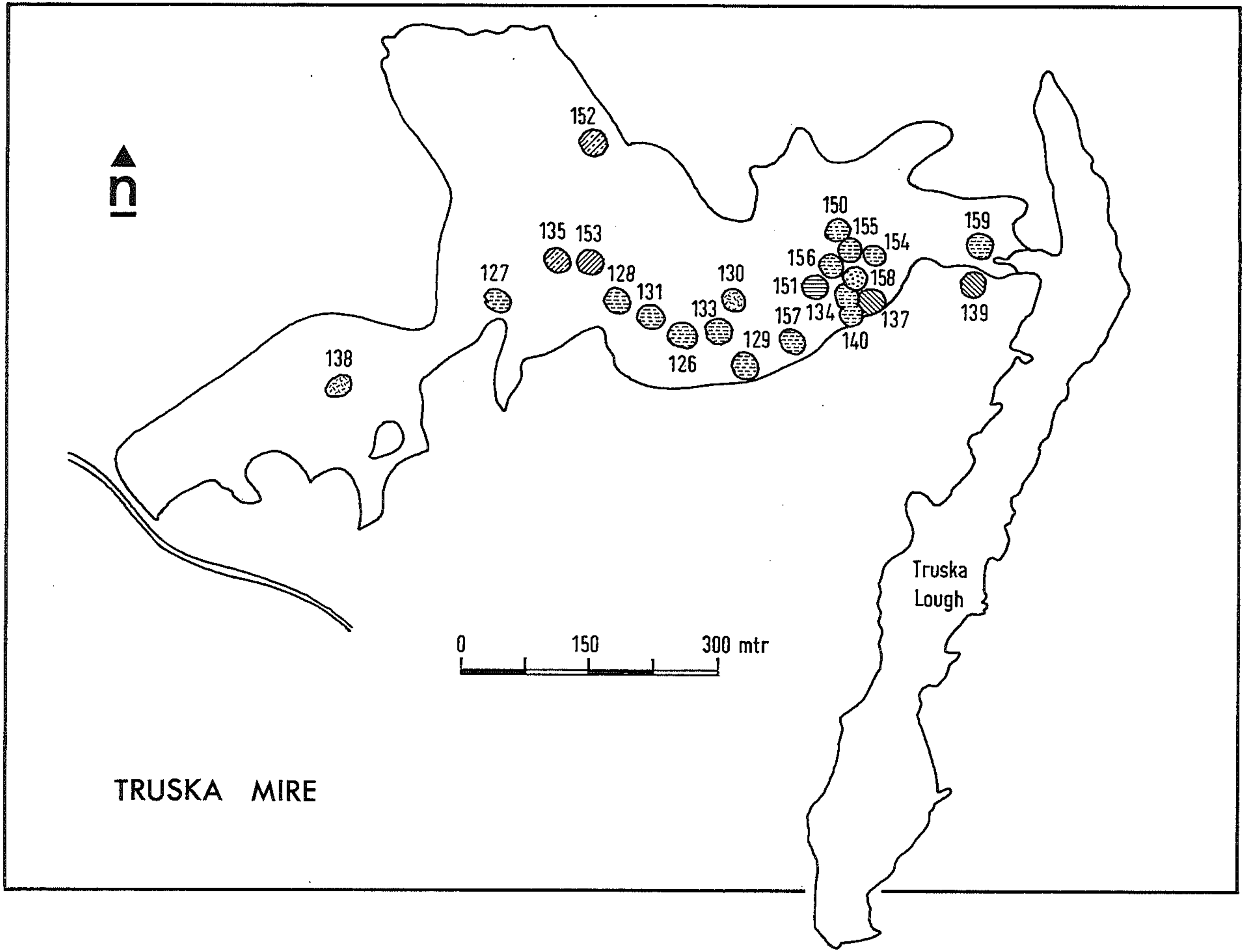
E5
E4
E5
E5
275
E4
D7
E4
276
D1 *1
F5
E4
E4
272
E4
D7
E4
D1 *2
F4
264
268
E4
F4
D3
E4
286
E4
F5
F4
E4
D1 *2
F5
E5
E4
D7
D7
D1
D7
D1
270
E6
F3
E4
248+250
278
E4
244
E6
D1
D1 *1
274
E4
D1
E4
D7
E4
D7
E4
256
D7
D3
D7
D1
F5
D7
260
F6
282
E4
E4
* 1 = Nymphaea alba
* 2 = Juncus subnodulosus


LOUGH ANASERD
n
0
50
100 mtr

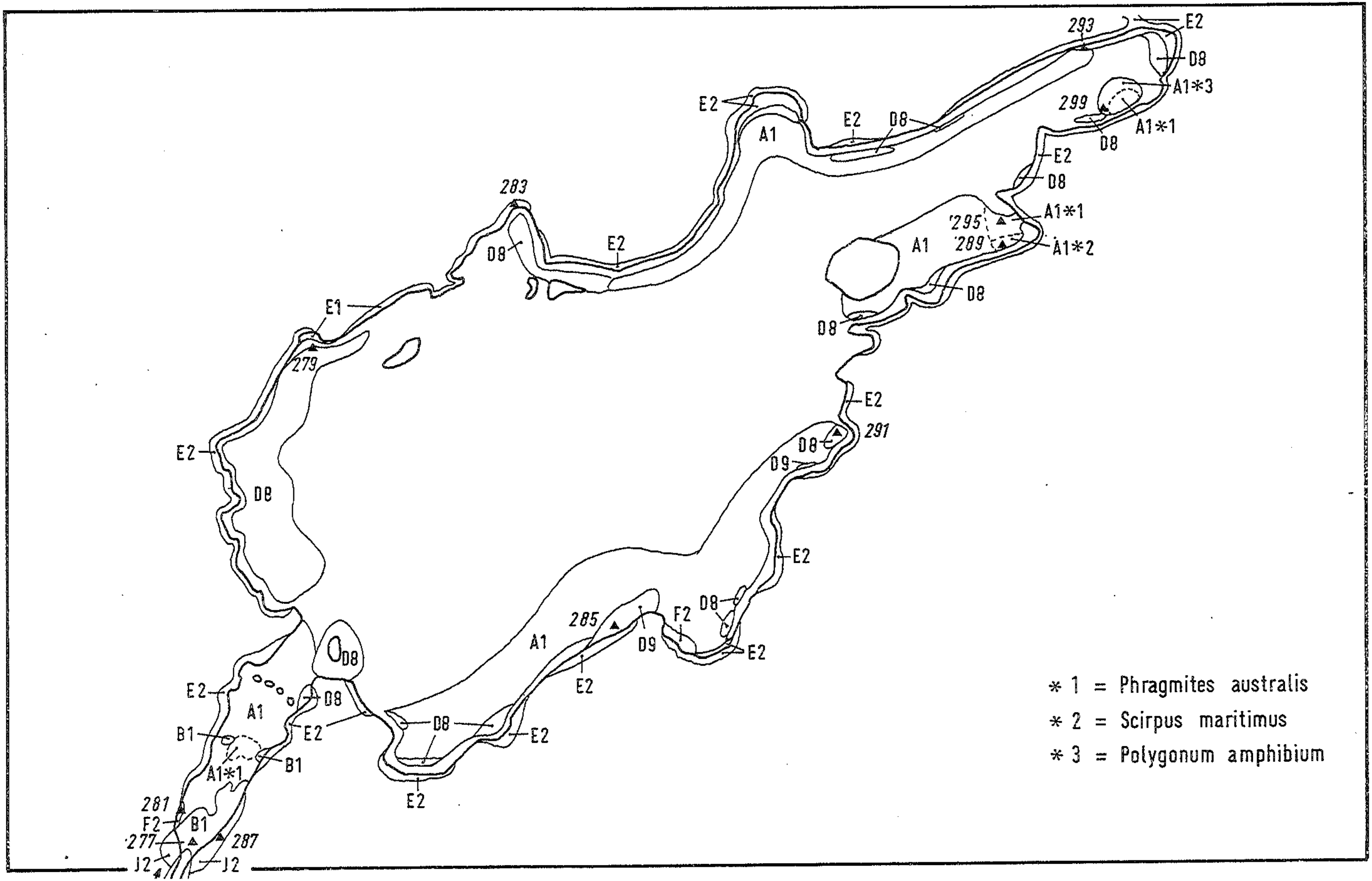


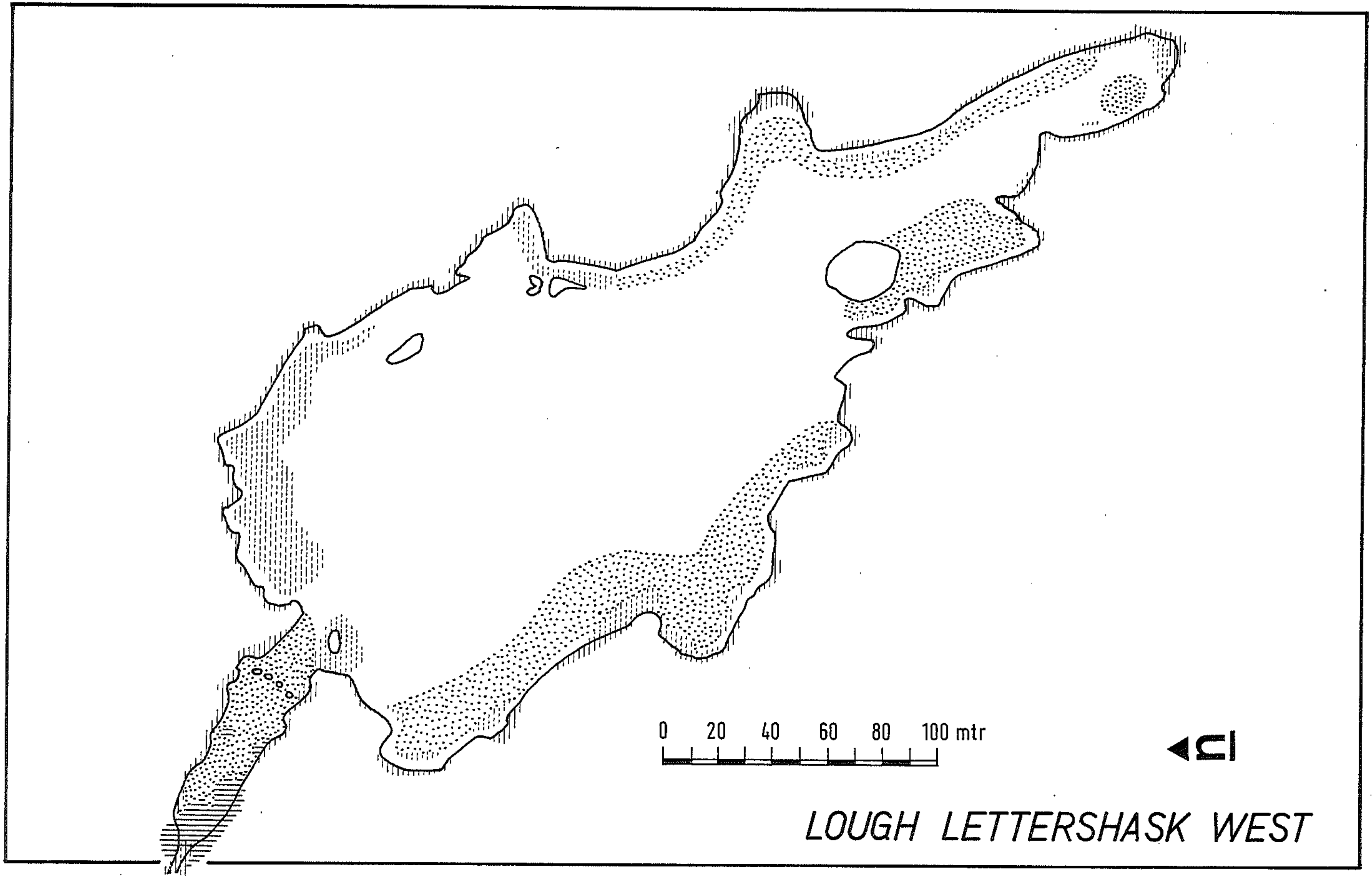
E5
E4
168
B5
B9
E1
K6
173
E2
K4
E1
B5
K5
E1
B9
E2
A7
E2
164
B5
B9
E1
K6
B5
E1
169
B9
E2
K6
B5
178
K6
D8
B5
E3
E2
E1
161
179
E4
E2
165
E1
E1
E2
K5
174
E2
E2
B9
B5
D10
E1
E1
170
*
E4
166
171
B5
D10
B5
175
E1
D10
E4
*
E2
E2
D8
E1
*
*
B5
167
B5
D9
E1
E4
163
B5
E2
E4
*
B5
*
D9
A7
E2
162
183
D9
E1
160
*
* = D9 OR D10 + E1


TRUSKA LOUGH
0 50 100 150 200 mtr
n

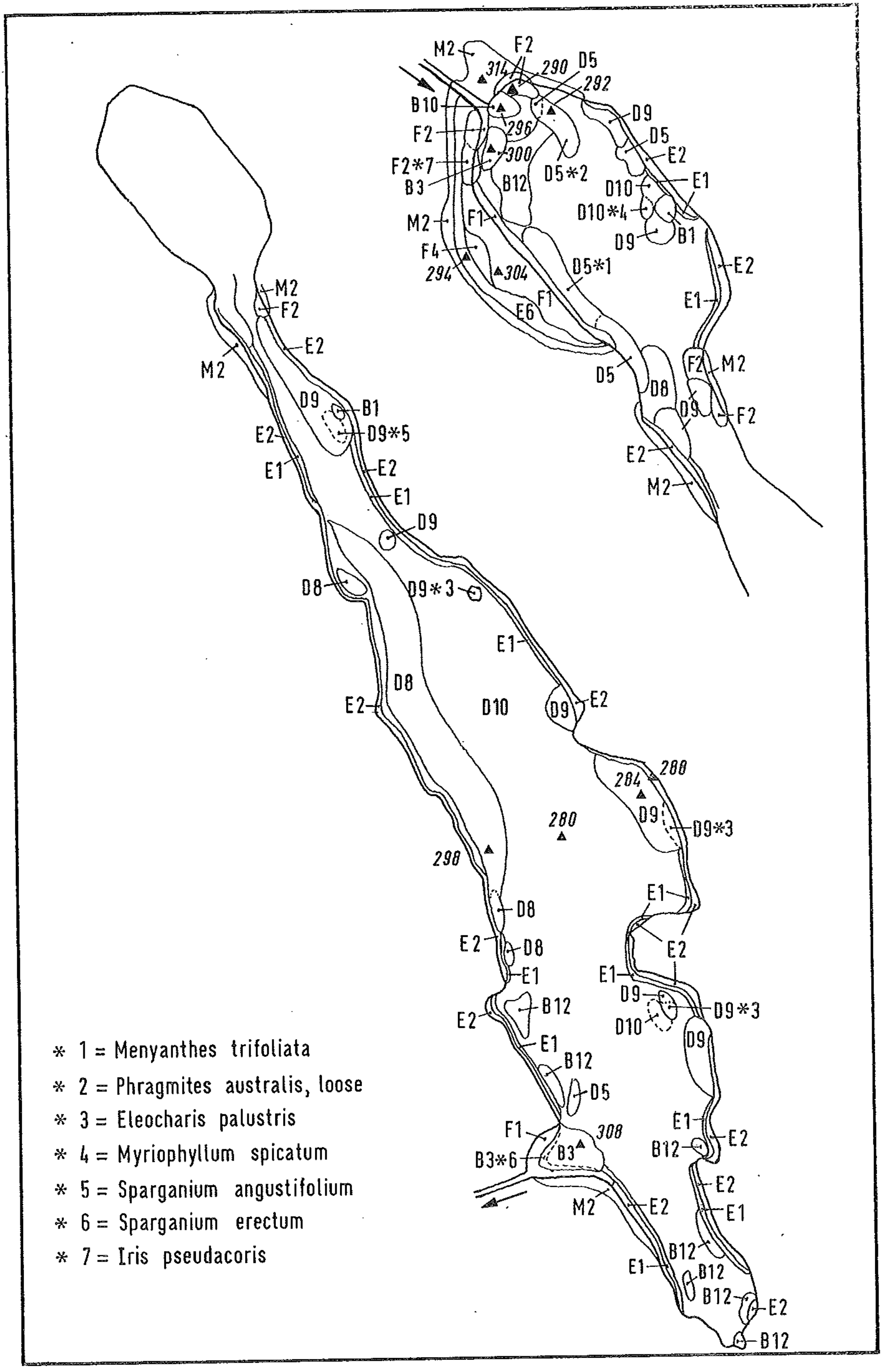


n
152
135
153
127
128
131
130
133
126
129
157
151
156
150
155
154
158
134
137
140
159
139
138
Truska
Lough
0
150
300 mtr
TRUSKA MIRE

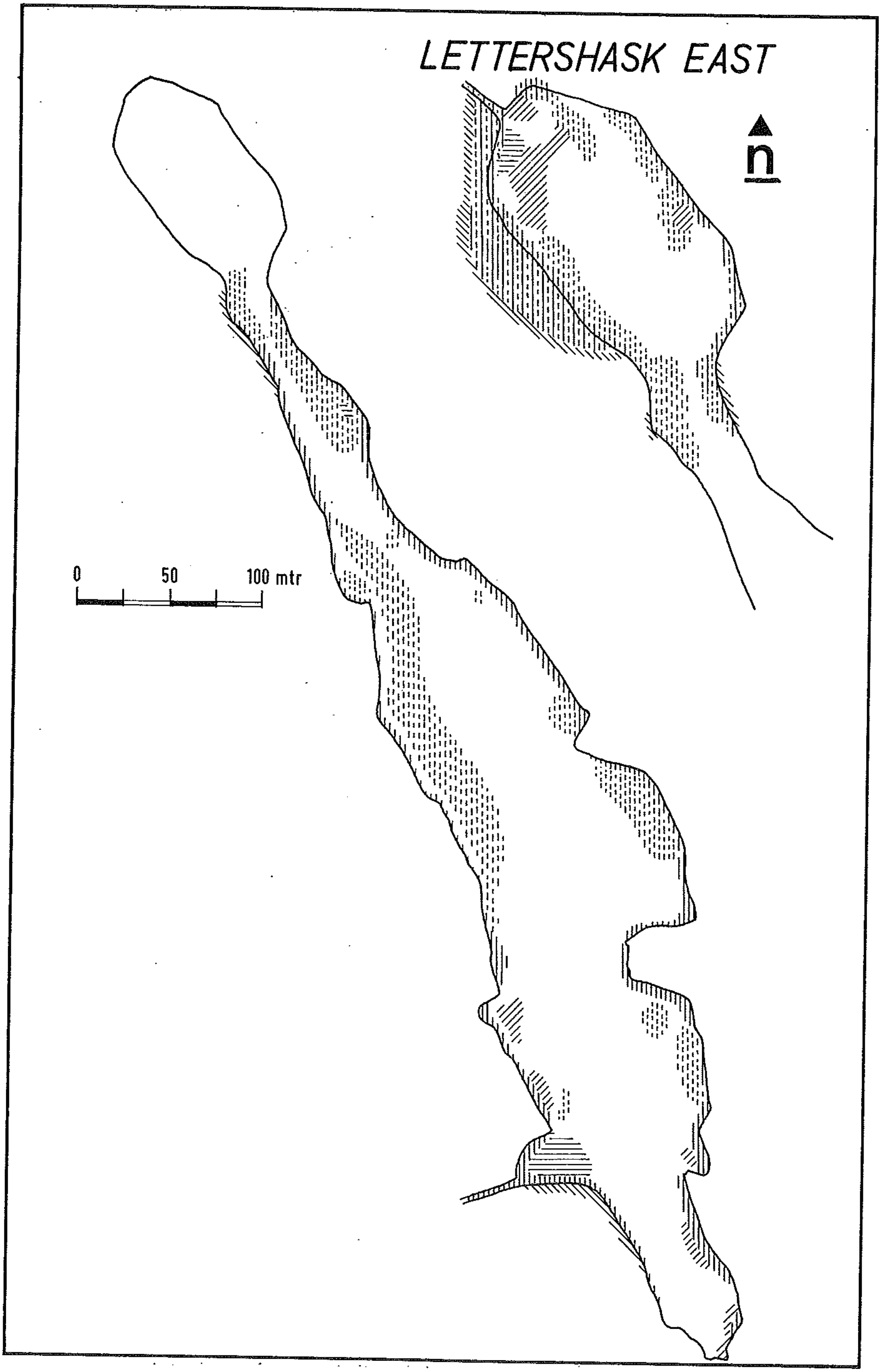

E2
D8
A1*3
A1*1
299
293
D8
E2
D8
A1*1
A1*2
295
289
A1
D8
283
E2
A1
E1
279
291
D9
E2
D8
F2
D9
285
A1
E2
D8
E2
D8
E2
B1
A1*1
B1
287
J2
281
F2
277
J2
* 1 = Phragmites australis
* 2 = Scirpus maritimus
* 3 = Polygonum amphibium

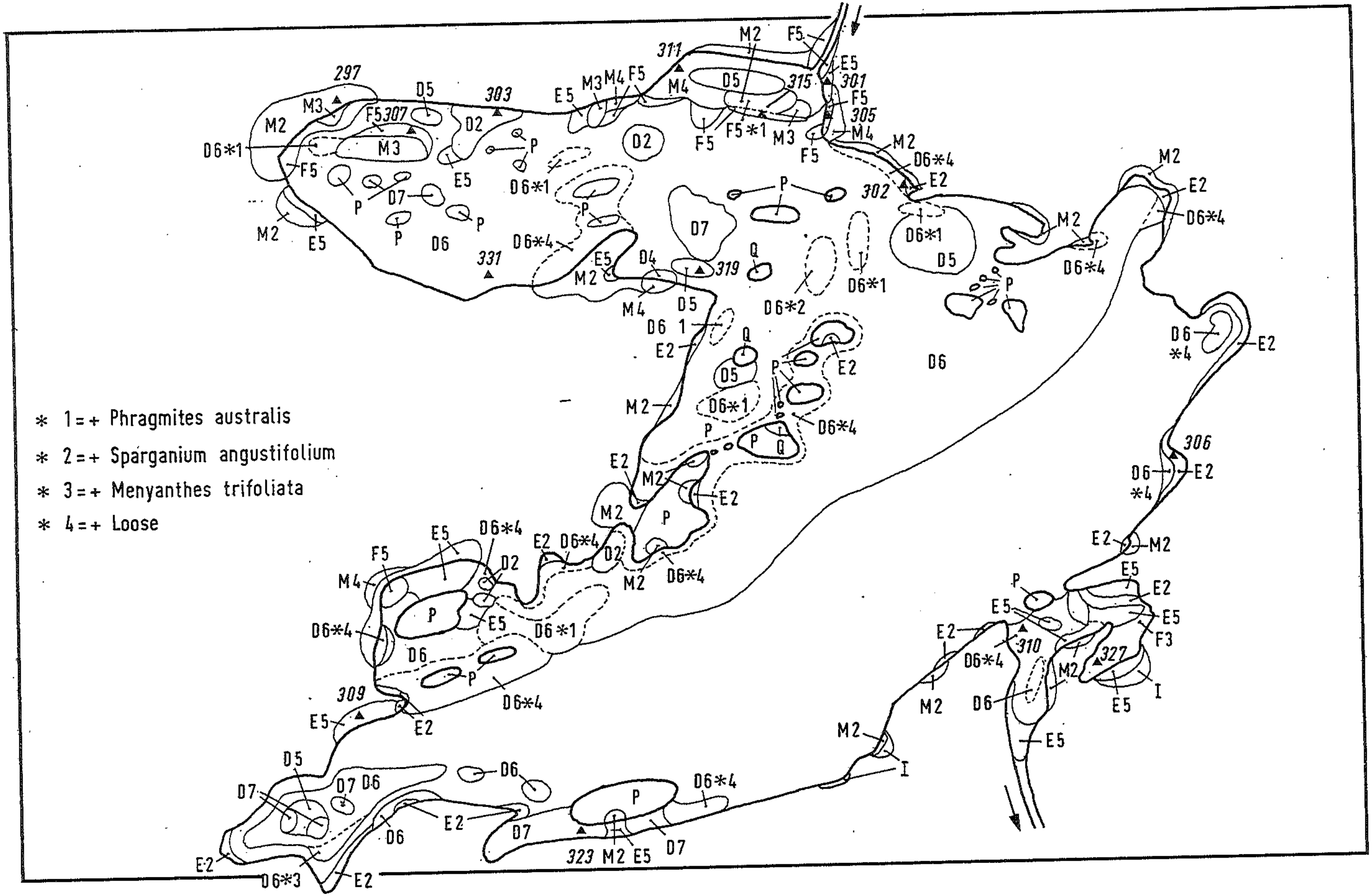


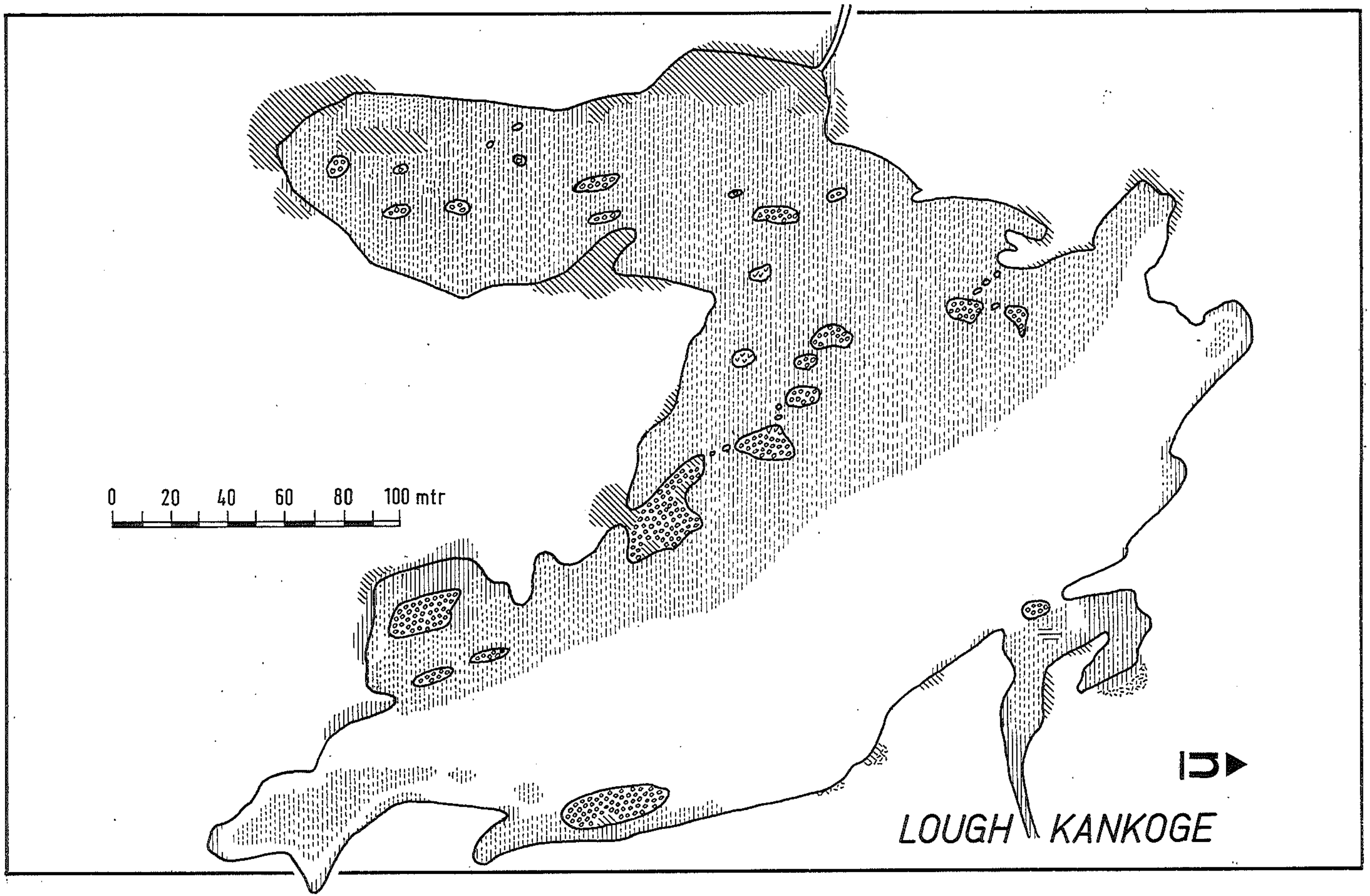
LOUGH LETTERSHASK WEST

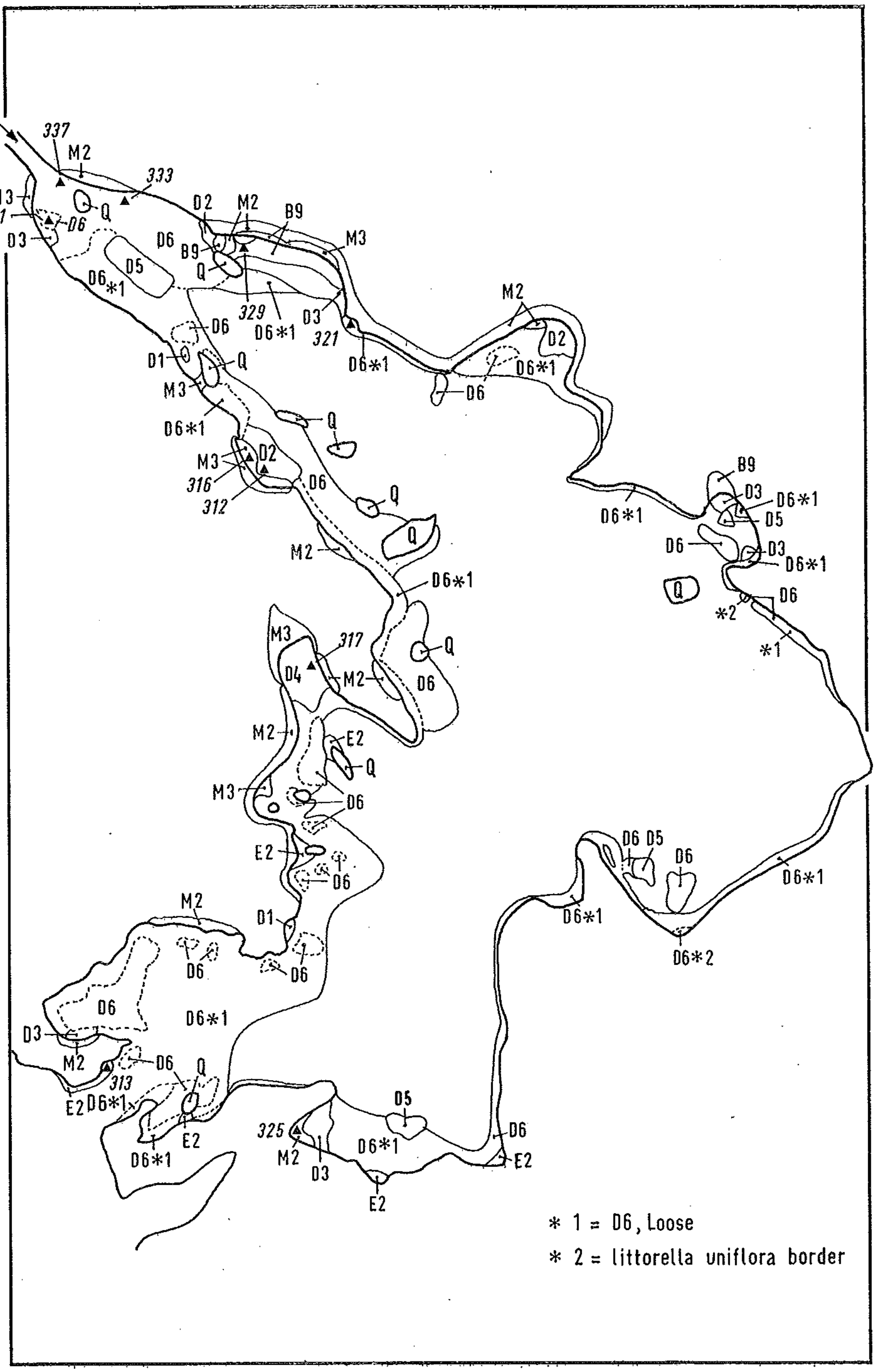


M2
F2
314
290
D5
292
B10
D9
296
F2
D5
F2*7
300
E2
B3
B12
D5*2
D10
E1
M2
F1
D10*4
D9
B1
F4
D5*1
E2
294
304
E1
F1
E6
M2
F2
E2
D5
F2
M2
D8
M2
D9
D9
B1
F2
D9*5
E2
E2
E1
E2
M2
E1
D9
D8
D9*3
E1
D8
E2
D10
D9
E2
288
284
280
D9
D9*3
298
E1
D8
E2
E2
D8
E1
E1
D9
D9*3
E2
B12
D10
D9
E1
B12
D5
E1
F1
308
E2
B12
B3*6
B3
E2
M2
E2
E1
B12
E1
B12
B12
E2
B12
* 1 = Menyanthes trifoliata
* 2 = Phragmites australis, loose
* 3 = Eleocharis palustris
* 4 = Myriophyllum spicatum
* 5 = Sparganium angustifolium
* 6 = Sparganium erectum
* 7 = Iris pseudacoris

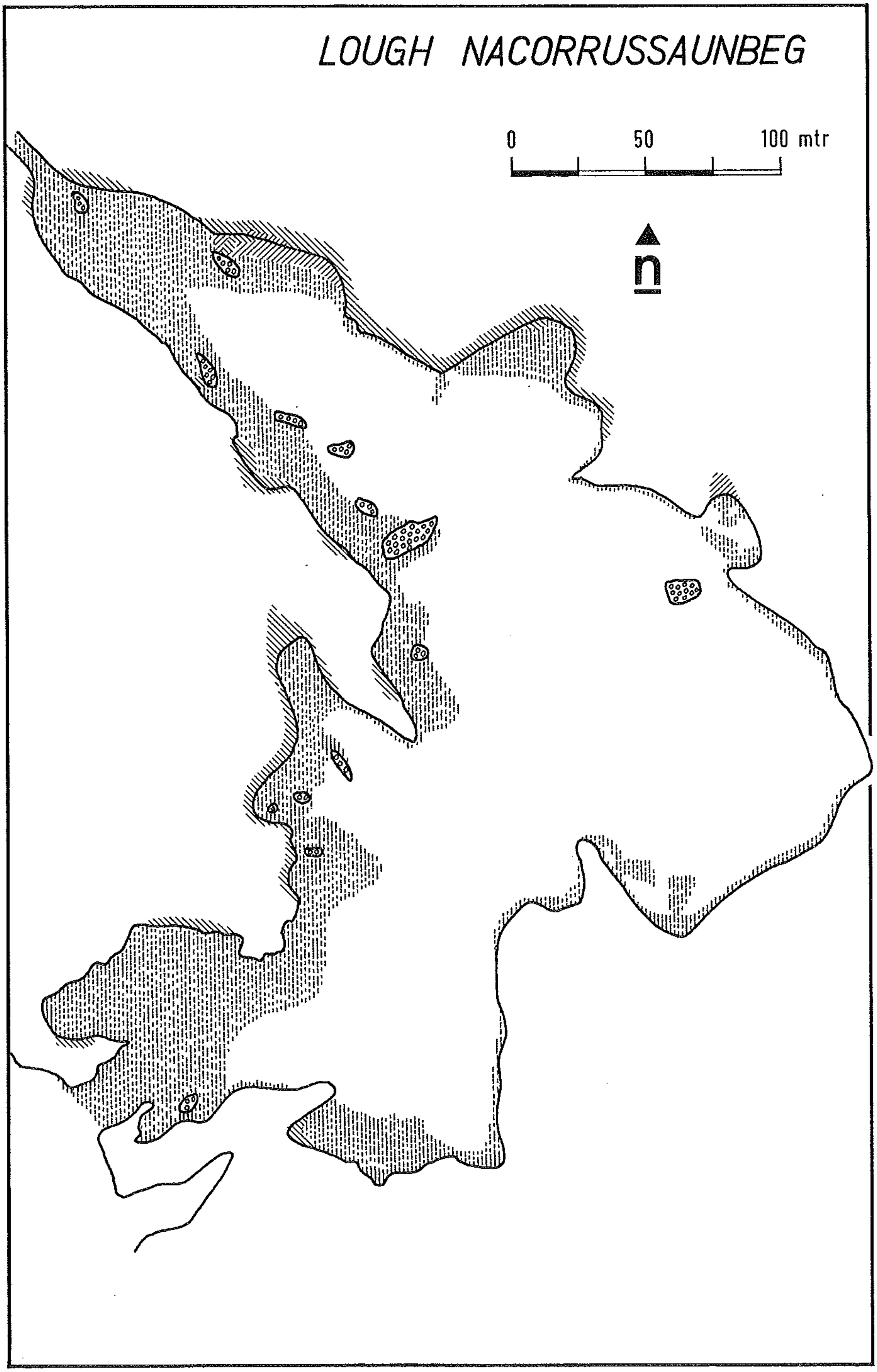

LETTERSHASK EAST
n
0
50
100 mtr

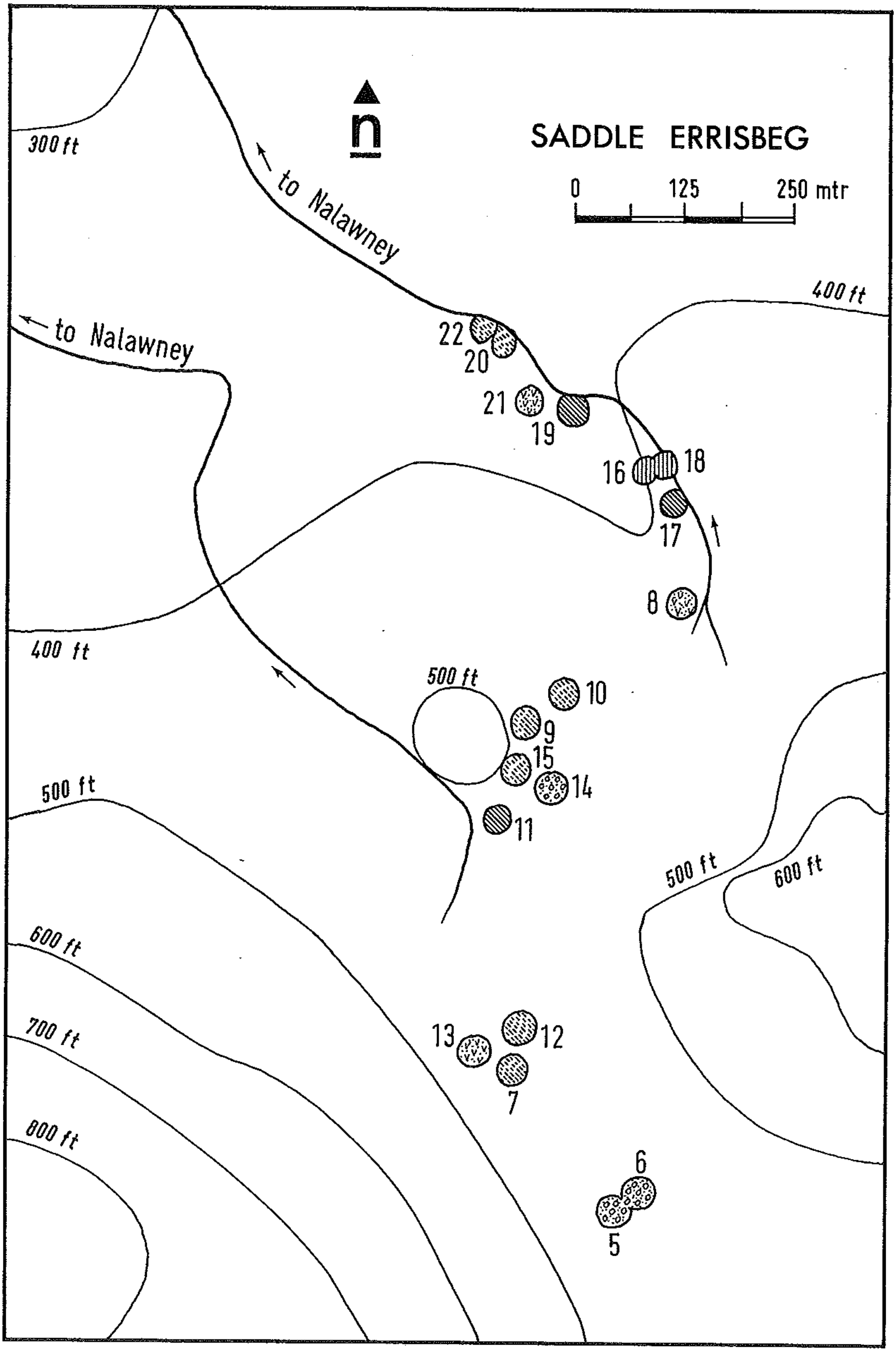

* 1 = + Phragmites australis
* 2 = + Spárganium angustifolium
* 3 = + Menyanthes trifoliata
* 4 = + Loose
297
303
311
315
301
305
302
307
331
319
306
309
310
327
323

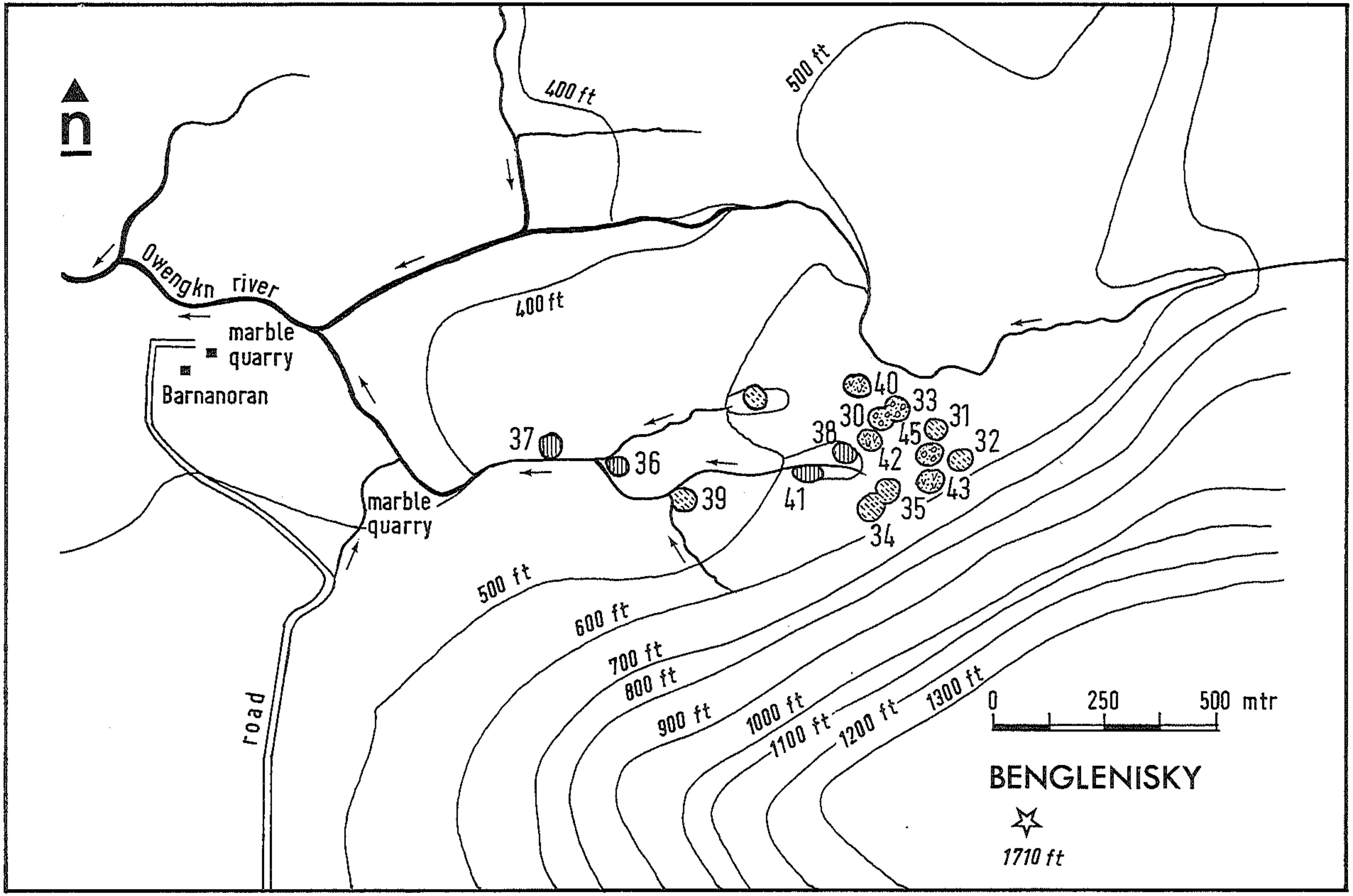

0 20 40 60 80 100 mtr
n
LOUGH KANKOGE

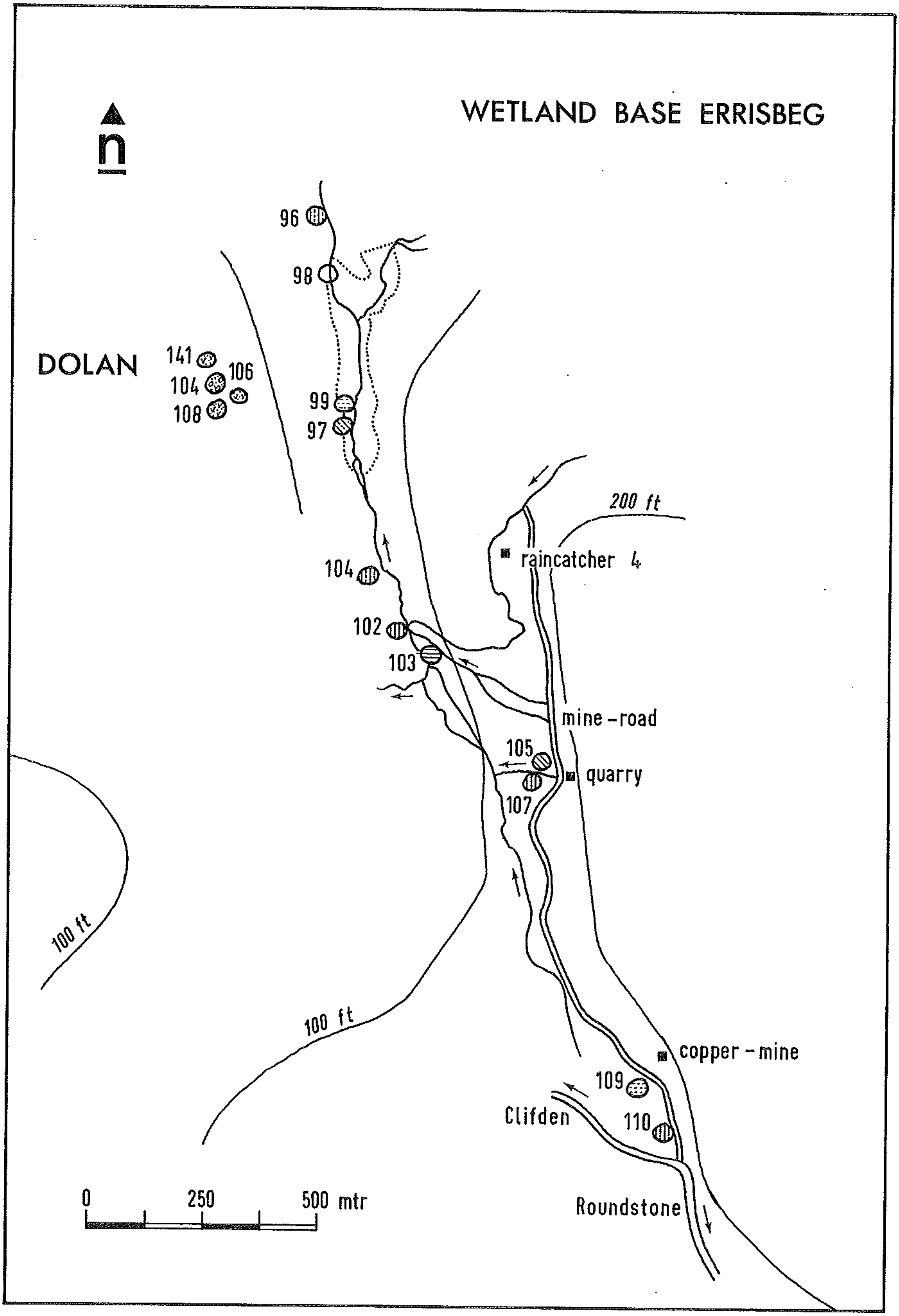


337
M2
333
M3
341
D6
D3
Q
D5
D6*1
D6
D2
M2
B9
B9
Q
M3
329
D6*1
D3
321
D6*1
M2
D2
D6*1
D6
D1
Q
M3
D6*1
Q
M3
D2
316
312
D6
Q
Q
M2
D6*1
B9
D3
D6*1
D5
D6
D3
D6*1
D6*1
Q
D6
*2
*1
M3
317
D4
M2
Q
D6
M2
E2
Q
M3
D6
E2
D6
D1
M2
D6
D6
D6
D6*1
D6 D5
D6
D6*1
D6*1
D6*2
D3
M2
313
D6
Q
E2
D6*1
E2
D6*1
325
M2
D3
D5
D6*1
E2
D6
E2
* 1 = D6, Loose
* 2 = littorella uniflora border


LOUGH NACORRUSSAUNBEG
0
50
100 mtr
n


SADDLE ERRISBEG
n
0
125
250 mtr
300 ft
400 ft
400 ft
500 ft
500 ft
500 ft
600 ft
600 ft
700 ft
800 ft
to Nalawney
to Nalawney
22
20
21
19
16
18
17
8
10
9
15
14
11
13
12
7
6
5


n
400 ft
500 ft
Owengkn river
marble quarry
Barnanoran
400 ft
37
36
39
41
38
40
33
30
45
31
32
42
43
35
34
marble quarry
road
500 ft
600 ft
700 ft
800 ft
900 ft
1000 ft
1100 ft
1200 ft
1300 ft
0
250
500 mtr
BENGLENISKY
1710 ft


WETLAND BASE ERRISBEG
n
DOLAN
96
98
141
104
106
108
99
97
104
102
103
200 ft
raincatcher 4
mine-road
105
quarry
107
100 ft
100 ft
copper-mine
109
Clifden
110
Roundstone
0
250
500 mtr

Errata

page 3: The last paragraph of chapter 1.3. has to be ommitted.

page 57: The second part of table 3. (page 58) is added separately.

page 67-75: "character species" should be read "character-species".

page 86: "Eleocharis multi-caulis" should be read "Eleocharis multicaulis".

page 159: Fig. 12. in title: "Cd^{++}" should be read "Ca^{++}".

Table B, in "recorded once": Iris pseudacoris = Iris pseudacorus; Oenanthe lachenalli = Oenanthe lachenalii; Brym pseudotriquetrum = Bryum pseudotriquetrum.

Table C: Iris pseudacoris = Iris pseudacorus.
in "recorded once": Brachytecium = Brachythecium; Oxyrhynchium swarzii = Oxyrhynchium swartzii; Pellia ep phylla = Pellia epiphylla

Table D, in "recorded once": Sphagnum patyphyllum = Sphagnum platyphyllum; Iris pseudacoris = Iris pseudacorus.

Table E, in "recorded once": Carec flacca = Carex flacca; Anthoxantum odotat = Anthoxanthum odoratum.

Table F: Iris pseudacoris = Iris pseudacorus.
in "recorded once": Polyganum = Polygonum; Rhytidiadelphis = Rhytidiadelphus; Scirpus cernuus = Isolepis cernua.

Table G: Iris pseudacoris = Iris pseudacorus.
in "recorded once": Leptodyctium = Leptodictyum.

Table H: Potentllla = Potentilla.
in "recorded once": Leptodyctium = Leptodictyum; Angelica sylvestis = Angelica sylvestris.

Table I: Oxyrrhynchium prealongum = Oxyrhynchium praelongum; Chiloscyphus polyanthes = Chilocyphus polyanthus.
in "recorded once": Festuca arundinatia = Festuca arundinacea; Festuca gigantica = Festuca gigentea; Iris pseudacoris = Iris pseudacorus.

Table J: Iris pseudacoris = Iris pseudacorus.
in "recorded twice": Rorippa nasturtiun-aquatica = Rorippa nasturtium-aquatica; Fissibens = Fissidens.
in "recorded once": Dryoptris = Dryopteris; Frullanea = Frullania; Campylium polyganum = Campylium polygamum; Thydium = Thuidium.

Table K: Angelica sylvetris = Angelica sylvestris.
in "recorded twice": Potamogeton colotatus = Potamogeton coloratus; Polygala serpillyfolia = Polygala serpyllifolia; Campilium polyganum = Campylium polygamum.
in "recorded once": Splagnum = Splachnum; Pnguicula = Pinguicula; Erica tetrlx = Erica tetralix; Carec = Carex.

Table L, in "recorded once": Chiloscyphus polyanthes = Chiloscyphus polyanthus.

Table M, in "recorded twice": Mentha aqyatica = Mentha aquatica; Lophocolea bidentatar = Lophocolea bidentata.
in "recorded once": Luzula multiflota = Luzula multiflora; Teleranea = Telaranea (bis); Sphagnim = Sphagnum; Linum cathartrcum = Linum catharticum; juncus effusus = Juncus effusus; salix repens = Salix repens; Racomitrium = Rhacomitrium; Polytrichum juniperum = Polytrichum juniperinum.

Table N: Cladopiella = Cladopodiella; Campylopus atro virens = Campylopus atrovirens; Teleranea = Telaranea.
in "recorded once": Racomitrium = Rhacomitrium.

Table O: Leucobrium = Leucobryum.
in "recorded once": Sphagnum magelanicum = Sphagnum magellanicum; Ricardia multifida = Riccardia multifida.

Table 7: unit number "M2" = "M2+M3"; unit number "M3" = "M4"; number of relevés for unit number M4 should be "5"; Fontinalis antipiretica = Fontinalis antipyretica; Eleochris = Eleocharis; Teleranea = Telaranea; Cladonia unciales = Cladonia uncialis; Leucobrium = Leucobryum; Rhinanthes = Rhinanthus.

Table 8: The number of relevés for unit number M4 should be "5".

Table 10: Leucobrium = Leucobryum; Cladomia = Cladonia; Hypnum cupressiforma = Hypnum cupressiforme; Teleranea = Telaranea; Andromeda polyfolia = Andromeda polifolia; Vaccinium vitis-idea = Vaccinium vitis-idaea; Carex heleonastis = Carex heleonastes; Drepanocladus inte media = Drepanocladus intermedia; Tofieldia caluculata = Tofieldia calyculata.

N.B. The nomenclature of table 10 has not been brought in accordance with that of the text and the other tables.