CHAPTER 16: POLLEN AND DIATOM DIAGRAMS FROM LOCH SCOLPAIG AND BALELONE FARM, NORTH UIST

A M Mannion & S P Moseley (1987)

[*Chapters 16 and 17 describe analyses of pollen, diatoms and the geochemistry of lake sediments on sites increasingly distant from the excavated areas. Our aim had been to investigate, if possible, the scale of landscape impact of the Bronze Age settlement of the islands, given that it seemed likely that the earlier deposits at Baleshare were of that age. We also wished to investigate the landscape impact of the Iron Age settlers which, on then current evidence, was on a much larger scale than the impact of earlier, or later, settlement in the Long Isle. The pollen and diatom work undertaken by Mannion and Moseley (this chapter) indicated that, following the development of the machair in this area, probably in the late Neolithic, its botanical signal largely obscured evidence for human activity. Hirons (Chapter 17) therefore undertook analyses to ascertain the usefulness of studying machair development and the environmental history of the blacklands/machair ecotone using sediments from lake deposits on the machair margin and in the eastern catchment of the islands.* J Barber]

16.1 POLLEN ANALYSIS

16.1.1 Introduction

The combination of an oceanic climate with the Machair plain of the Uists provides a niche for a floristically rich grassland with herbs (Dickinson & Randall 1979) which is unparalleled elsewhere in Europe. The ecological significance of the Outer Hebrides, situated as they are at the Atlantic fringe of north-west Europe, is reflected in the presence of 4 National Nature Reserves (NNR's) and 35 Sites of Special Scientific Interest (SSSI's) (Ratcliffe 1977). North Uist has five SSSI's which are either coastal dune/machair sites or lochs. Overall, with the exception of scrub developments on many of the islands in the numerous lochs of the area, the islands present a tree-less landscape and apart from the machair vegetation and bare rock, peatland vegetation predominates. Although pollen diagrams are available from Lewis (Erdtman 1924; Birks & Madsen 1979; Bohncke 1988), South Uist (Heslop-Harrison & Blackburn 1946), Barra (Blackburn 1946), Benbecula (Ritchie 1966) and St Kilda (Walker 1984) no similar work had been done on North Uist at the time the analyses were undertaken. Therefore, samples for palynological analyses were collected from the nearby sites of Loch Scolpaig and a peat deposit at Balelone Farm (Figure 92) to provide an environmental context for the archaeological deposits.

16.1.2 Site descriptions

Loch Scolpaig (NF 733 753) is a shallow lake approximately 7 m OD on the Machair plain of North Uist. To the west there are dune ridges which slope to the beach or coastal cliff and to the east there is blanket peat from which a fringing hydrosere of grasses, sedges, reeds and *Menyanthes trifoliata* extends into the lake, the open water of which supports a luxuriant growth of *Nymphaea alba*. In contrast, the blanket peat deposit near Balelone Farm (NF 731741) is at 25 m OD above which the peat becomes thinner with outcrops of bare rock and below which the machair plain extends to the coast. In the vicinity of the coring site the present-day vegetation is dominated by *Eriophorum angustifolium*, *Deschampsia flexuosa* and *Potentilla erecta*. The stratigraphy of both cores is described in Tables 42 and 43.

16.1.3 Results: Loch Scolpaig

The results of the pollen analyses are given as pollen percentages (Figure 93a) and as pollen concentration data (Figure 93b) both of which reflect similar changes in the pollen spectra. To facilitate interpretation, the pollen diagrams from Loch Scolpaig have been divided into three local pollen assemblage zones (*sensu* West 1970) as follows:–

Zone Scl 2.60–2.35 m. Gramineae-Cyperaceae-Salix-Rumex zone
Gramineae pollen values vary between 3% and 27% while *Salix*, Cyperaceae and *Rumex acetosella* maintain consistently high proportions of between 5% and 25%. In addition, pol-

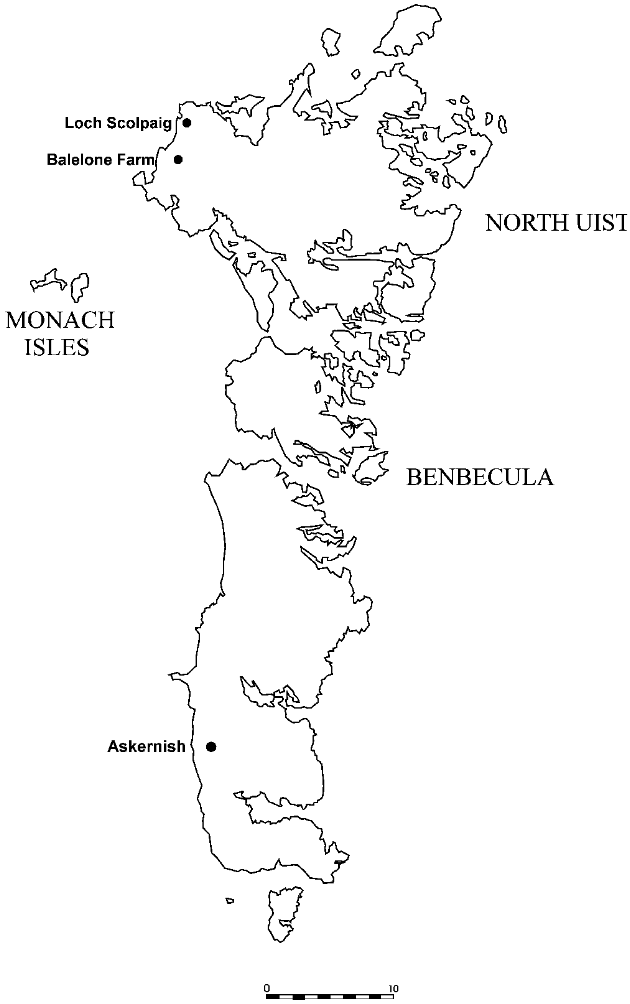

Figure 92. Location map showing sampling sites discussed in Chapters 16 & 17

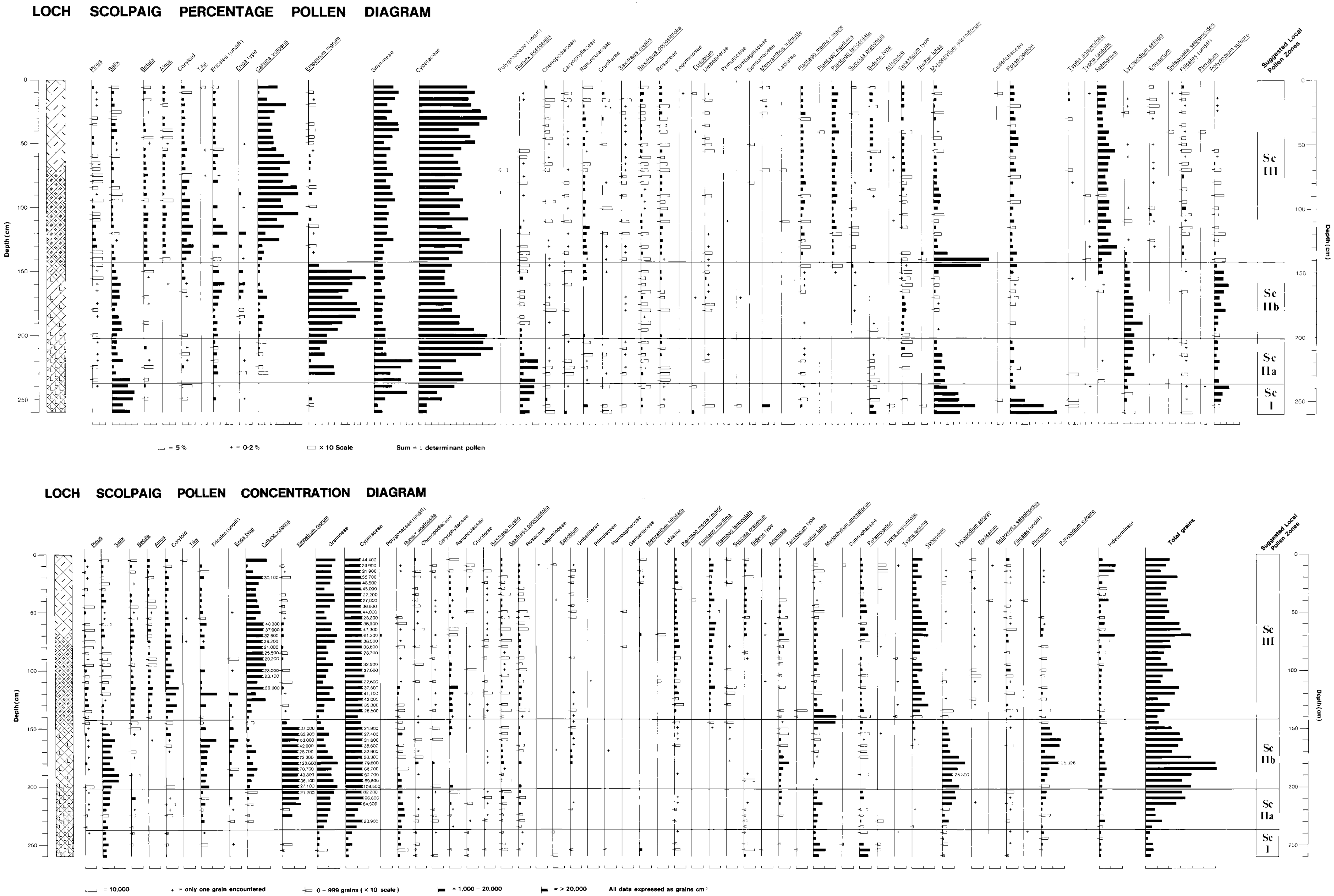

Figure 93. Loch Scolpaig; a) pollen percentages b) concentration data

Depth (cm)	Description (below sediment surface)
75-0	Very coarse detritus mud, with a dark brown matrix and root fragments. Dh2, Dg1, 1dl
148-75	Finer detrital mud with a dark brown to black matrix with a few plant fragments. Ld2, Dh1, Dg1
152-148	Transition between 75-148cm and 153-260 cm
260-152	Fine detrital mud with a high clay content, few plant remains and mica plates. d2. As2. Agt
260+	Gravel

Table 42. Loch Scolpaig. The stratigraphy of the core described using a modified Tro els-Smith sediment classification scheme (Aaby 1979)

Depth (m)	Description (below sediment surface)
0.06-0.0	Intertwined roots of Gramineae and herbaceous species.
0.12-0.05	Fine dark brown matrix with rootlets and sand grains. Th2, D11, Dh1, Sh+.
0.34-0.12	As above but coarsening down profile, some mica plates and large quartz fragments (c. 1cm diam) Th2, Dh1, Ga1.
0.35-0.34	Coarse sand, few plant remains. Gs2, Ga2, Sh+.
0.45-0.34	As 0.34-0.12 but with fewer plant remains and less gritty. Th2, Dh1, Sh1, Ga+.
0.63-0.45	Darker more humified peat with obvious plant macroscopic remains. Th2, Sh2, Dh+, Ag+.
0.68-0.63	Coarse sand/silt. Ga2, Ag1, As1, Sh+.
0.77-0.68	Dark brown peat. Th2, Dh1, Sh1.
0.79-0.77	Matted fibrous plant remains. Dh2, Dg2, Sh+.
0.82-0.79	Dark brown peat. Th2, Dh1, Sh1, Ag+.
0.83-0.82	Coarse sand/silt. Ga2, Ag1, As1.
0.95-0.83	Dark brown peat with thin (c. 3-4mm). silt layers. Th2, Dh1, Sh1, Ag+.
1.03-0.95	Dark brown/black peat, little grit. Dh2, D11, Th1.
1.23-1.03	As 1.03-0.95 but with coarser texture and lighter in colour. Dh2, D11, Th1.
1.46-1.23	Dark brown/black peat becoming gritty down profile. Dh2, D11, Sh1, As+.
1.63-1.46	Black peat with very humified matrix but plant remains discernable. Dh2, Th1, Sh1, D1+.
2.07-1.63	Coarse sand, few plant remains but well humified organic matrix. Ga2, Gs1, Sh1.
3.00-2.07	Black, almost amorphous peat with wood fragments at 2.23m and silt band at 2.30-2.31m. Sh2, Th1, D11.

Table 43. Balelone Farm. The stratigraphy of the core described using a modified Tro els-Smith sediment classification scheme (Aaby 1979)

len of aquatics is well represented, especially that of *Myriophyllum alterniflorum*.

Zone ScII 2.35–1.45 m. Salix-Empetrum-Gramineae-Cyperaceae zone
Cyperaceae pollen predominates, achieving values of up to 50% of the total pollen. *Empetrum nigrum* pollen is also dominant with values of up to 38% of total whilst Gramineae pollen values are initially high at 25% declining to 10% at the close of the zone. Pollen of *Salix* is consistently recorded throughout the zone at between 5% and 10% of total and initially high values (between 5% and 25%) of *Rumex acetosella* decline from 2.05 m upwards when its record becomes sporadic.

This zone is divided into two subzones:

Subzone ScIIa 2.35–2.05 m: *Empetrum nigrum* pollen and *Lycopodium selago* spores increase markedly while *Salix* and *Rumex* pollen is consistently present and pollen of aquatics declines.

Subzone ScIIb 2.05–1.45 m: High values of both *Empetrum nigrum* and *Lycopodium selago* are maintained whilst the concentration of *Salix* pollen increases from ScI and ScIIa. Although proportions and concentrations of Gramineae and Cyperaceae pollen remain high they both decline toward the close of the subzone and the record of *Rumex acetosella* becomes discontinuous. The highest pollen concentration values for the entire core are achieved in this subzone.

Zone ScIII 1.45–0.00 m. Calluna-Graminea e-Cyperaceae zone

The opening of this zone is marked by a rise in *Calluna* and *Alnus* pollen proportions and concentrations and a sharp decline in *Empetrum nigrum*. Values for Sphagnum, *Plantago lanceolata* and *Plantago major/media* also increase. Gramineae and Cyperaceae values remain high and apart from that of *Salix*, tree pollen is almost entirely restricted to this zone. *Pinus*, *Betula*, *Alnus* and Coryloid pollen types are consistently recorded but only in low proportions (5–10% of total pollen) and concentrations.

16.1.4 Results: Balelone Farm

Due to the hiatus in the pollen stratigraphic record of the Balelone Farm profile which, with the exception of the 2.15 m horizon, occurs between 2.40 m and 1.60 m, zonation of the pollen diagrams (Figures 94a & b) was considered fruitless and has not been attempted. However, the 2.55 m level

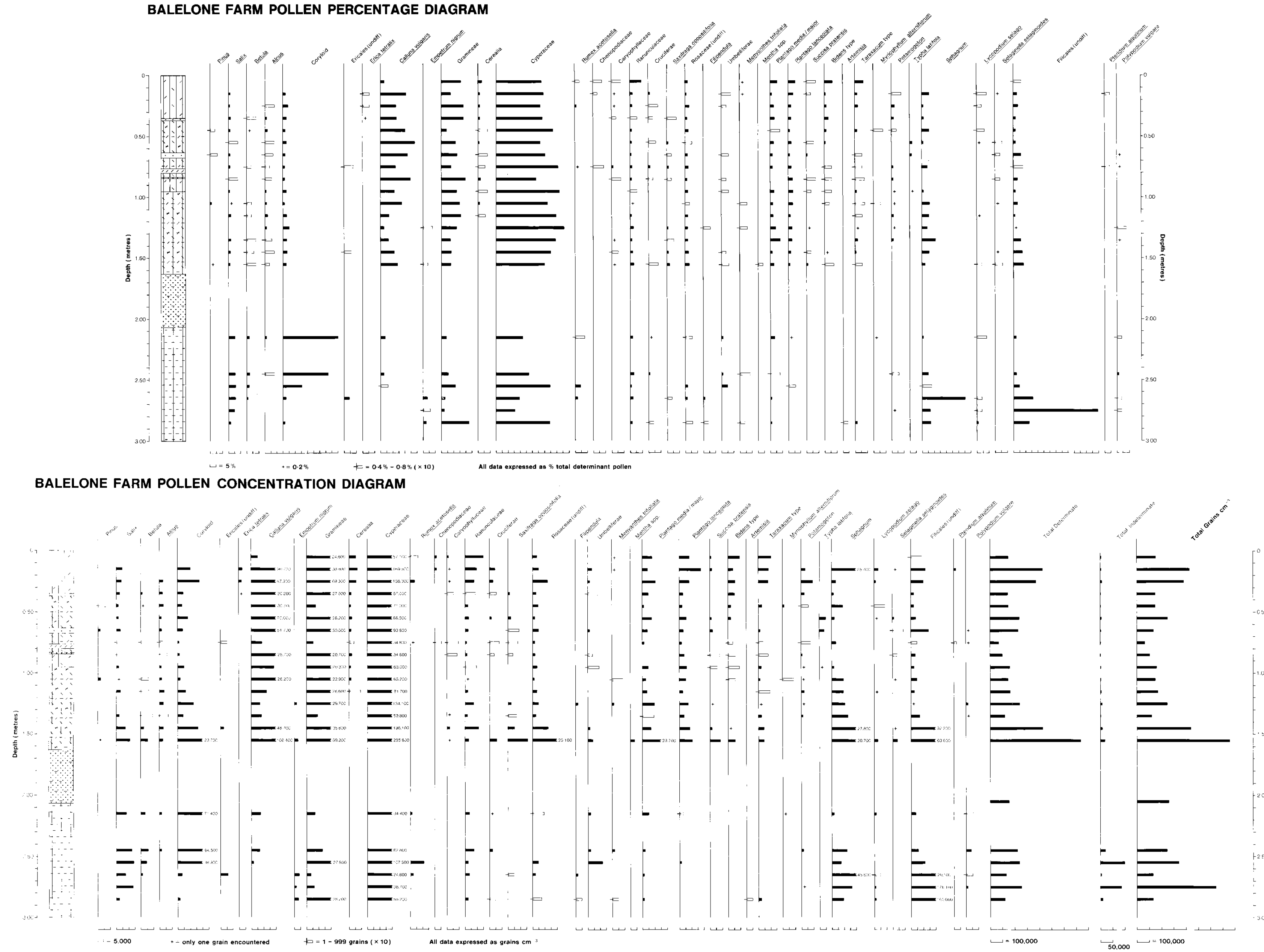

Figure 94. Balelone Farm; a) pollen percentages b) concentration data

Depth (cm)	Lab no.	Date (years BP)
75	GU-1766	2525 ± 85
150	GU-1765	2860 ± 110
225	GU-1764	7905 ± 130
300	GU-1767	8730 ± 200

Table 44. Balelone Farm. Radiocarbon dates from the pollen core. All dates are calculated on a half-life of 5568 ± 30 and errors are expressed at the ± one-sigma level of confidence

is of particular significance since it marks the decline in *Empetrum* and increases in *Calluna* and Coryloid-type followed by a rise in *Alnus* at 2.45 m. Below 2.55 m *Empetrum*, *Salix*, Cyperaceae and Gramineae pollen, along with Sphagnum and Filicales spores dominate the assemblages. Above the hiatus from 1.60 m upwards *Alnus*, *Salix* and Coryloid-type are consistently recorded in low proportions with sporadic *Betula* and *Pinus* but the pollen spectra are dominated by *Calluna vulgaris,* Gramineae, Cyperaceae, Sphagnum and Filicales. In addition, there is a continuous record of Cerealia-type pollen from 1.15 m upward.

The results of the radiocarbon age determinations for the Balelone Farm profile are given in Table 44.

16.1.5 Inferred vegetational history

Loch Scolpaig

Zone ScI; The pollen spectra of this zone suggest that the vegetation was predominantly grassland with a mixture of herbs such as *Plantago major/media*. The abundance of Cyperaceae pollen, together with *Salix* and species such as *Rumex* and *Bidens*, probably reflects the vegetation at nearby wetter sites or at the edge of the lake itself where vegetation dominated by *Myriophyllum alterniflorum* and *Potamogeton* spp. was well established. Low pollen concentrations may reflect the presence of bare ground.

Sub Zone ScIIa; Vegetation similar to the previous zone persisted although increased pollen concentrations, especially of Gramineae and Cyperaceae, may reflect greater vegetation cover. Although *Salix* pollen percentages decline from the previous zone, it maintains its concentration values which imply that it maintains its status in the vegetation. Abundant spores of *Lycopodium selago* may reflect its colonisation of rock outcrops to the west of the lake basin where *Empetrum* was also becoming established either prior to or during initial peat accumulation (see below). These pollen spectra are similar to those recorded at the base of the Little Loch Roag core from Lewis which Birks and Madsen (1979) suggest may reflect a vegetation similar to present-day sub-alpine communities in Norway. In the lake itself *Myriophyllum alternifolium* and *Potamogeton* spp. continue to flourish.

Sub Zone ScIIb; Grassland communities with abundant herbs, notably *Saxifraga oppositifolia* and *Taraxacum*-type maintained their dominance whilst Empetrum increased markedly and *Lycopodium selago* and *Salix* continued to be important components of the vegetation. Increased pollen concentration values and the decrease in *Rumex acetosella* may reflect the development of a more closed vegetation cover than in ScI or ScIIa although in the lake the declining and sporadic record of aquatics indicates some disruption of the hydrosere, possibly due to a high sediment input from the catchment.

Zone ScIII; The decline in both percentages and concentrations of *Salix* and *Empetrum nigrum* pollen corresponds with a marked increase in *Calluna vulgaris* pollen reflecting the expansion of *Calluna* heath and possibly peat forming communities. It can only be inferred that the earlier *Empetrum nigrum* dominance in ScII initiated soil acidification which allowed *Calluna vulgaris* to invade successfully. In addition, herb-rich grassland continued to persist, presumably on the machair plain which Ritchie (1979) suggests had been initiated sometime before 5700 uncal BP.

Moreover, the rise in *Alnus* pollen percentages and concentrations recorded at the ScII/ScIII boundary may mark the onset of the Flandrian climatic optimum even if, as has been suggested for Lewis (Birks & Madsen 1979), *Alnus* pollen was derived by long-distance transport from the Inner Hebrides where the *Alnus* rise is well marked at 6500 uncal BP (Birks & Williams 1983) or from the mainland. This may also be the origin of the low but consistent proportions of other tree pollen types, especially *Betula*, *Pinus* and Coryloid-type, which are almost entirely confined to zone ScIII. The pollen concentration data for all Arboreal Pollen (AP) types confirm that these low percentages are a true reflection of the status of the AP in the pollen assemblages and not simply an artefact of percentage calculations which may occur as a result of swamping by Non-Arboreal Pollen (NAP).

Pollen diagrams from elsewhere in the Outer Hebrides also show low AP frequencies as do some diagrams from the Inner Hebrides (Flenley & Pearson 1967; Birks & Williams 1983), the Shetlands (Hawksworth 1969; Johansen 1975); Orkney (Moar 1969) and north-east Caithness (Peglar 1979), indicating the presence of an almost treeless landscape in these areas throughout the Flandrian. However, Wilkins (1984) has described radiocarbon dated macroscopic tree remains of *Pinus*, *Salix* and *Betula* from blanket peat at forty sites on Lewis and suggests that *Pinus* at least grew extensively on the island prior to 4500 uncal BP; Wilkins (*ibid*) explains low AP counts as a consequence of wind blowing off the sea so that little pollen was carried westwards. In the authors' view this is an inadequate explanation and it seems more likely that the flowering capacity and hence pollen productivity of trees was impaired due to exposure to high winds or other, less than favourable environmental conditions such as impoverished soils. Indeed, Mathews (1975) has proposed impaired flowering capacity to explain the presence of abundant *Betula* macrofossils in association with low *Betula* pollen percentages at a glacial site in the Yukon and the occurrence of *Alnus* macrofossils in sediments 2000 years older than the *Alnus* pollen rise in the North West Territories, Canada. Whatever the explanation for low AP percentages and concentrations it seems likely that the Outer Hebrides were more densely wooded than has hitherto been considered and confirms the molluscan evidence (Burleigh, Evans & Simpson 1973) for woodland presence at Northton, South Harris prior to 4400 uncal BP.

The possibility that the ScII/ScIII boundary represents the onset of the climatic optimum is endorsed by increasing proportions and concentrations of Sphagnum spores which may also reflect wetter conditions. This, together with a simultaneous increase in *Calluna vulgaris* pollen attests to an increase in peatland vegetation in the vicinity of the lake giving rise to plant communities similar to those which exist today. The occurrence of *Plantago lanceolata* pollen in low but consistent concentrations and proportions is more difficult to interpret. A similar record was obtained by Birks & Madsen (1979) from Lewis which they suggest may have resulted from long-distance transport from the mainland. Alternatively, *P. lanceolata* may have been as significant a constituent of coastal cliff and maritime grassland communities as it is in the Hebrides today (McVean 1961; Birks 1973; Dickinson & Randall 1979) and elsewhere in Scotland it is recorded in significant amounts (Godwin 1975) in the early Flandrian prior to anthropogenic disturbance. In the absence of Cerealia-type pollen from the Loch Scolpaig core there is no indisputable evidence for human influence. Overall, there is little change in the pollen spectra indicating that the vegetation of North Uist has not changed significantly since the opening of Zone ScIII.

Balelone Farm; pre-hiatus

The radiocarbon date from the base of the peat profile indicates that peat formation began at approximately 8730 ± 200 uncal BP from which time the pollen assemblages indicate the presence of grassland, stands of *Salix* and peat forming communities dominated by *Empetrum nigrum* and *Sphagnum* spp. The marked Coryloid-type pollen increase at the 2.55 m level may reflect the establishment of *Myrica gale* on the peat surface in association with *Calluna vulgaris* which appears to replace *Empetrum nigrum*. The *Alnus* rise at 245 cm is, as for Loch Scolpaig, again considered to represent the onset of the Flandrian climatic optimum.

Apart from the polleniferous horizon at 2.15 m, which shows a similar pattern to the 2.45 m spectrum, the hiatus in the pollen stratigraphic record is difficult to explain as indeed is the radiocarbon date of 7905 ± 130 uncal BP at its base. This latter will be considered below in discussing the relationship between Loch Scolpaig, Balelone Farm and Little Loch Roag. Coarse sand is recorded in the stratigraphy which may be the result of changing hydrological conditions during the climatic optimum when wetter conditions may have increased run-off from higher areas above the site that gathered coarse particulate matter which was subsequently deposited in the hollow where peat was accumulating.

Balelone Farm; post-hiatus

Grassland communities with a mixture of herbs such as *Plantago media/major* and *Taraxacum*-type were important in the vegetation along with peat-forming communities of *Calluna vulgaris* and *Sphagnum* spp. The status of woodland in the area has already been discussed above and the same comments apply to the Balelone Farm record, although here the AP percentages and proportions, especially for *Betula* and *Pinus*, are not so consistent. Of particular note is the relationship between the *Plantago lanceolata* pollen record and that of Cerealia-type. The former is well established before the latter which implies that the two are independent and lends support to the view (*above*) that *P. lanceolata* has indeed occurred as a component of the natural vegetation in North Uist. The Cerealia-type pollen occurs between the 150 m and 775 m levels dated at 2860 uncal BP and 2525 uncal BP respectively and reflects cereal cultivation in the area from about 2700 uncal BP. Despite this conclusive evidence for anthropogenic activity there is no other evidence to suggest that it affected the natural vegetation of North Uist in any significant way.

16.1.6 The relationship between Loch Scolpaig, Balelone Farm and Little Loch Roag

In general terms, the pollen diagrams from Loch Scolpaig and Balelone Farm show the same overall trends which are also similar to those at Little Loch Roag, Lewis (Birks & Madsen 1979). The record from the former site, in common with Little Loch Roag, is longer than that at Balelone Farm, reflecting sedimentation in the lake for some time prior to peat initiation. Since the assemblages of the Loch Scolpaig ScI and ScIIa zones are similar to the basal assemblages for Little Loch Roag, sedimentation probably began at approximately the same time in both basins. A radiocarbon date from the latter indicates that this was about 9000 uncal BP. The most obvious similarity is the presence of low AP proportions, reasons for which have been discussed above. The hiatus in the Balelone Farm profile makes precise correlation between the sites difficult. However, the replacement of *Empetrum nigrum* by *Calluna vulgaris* at 255 cm and the *Alnus* rise at 245 cm in the Balelone Farm profile mirror the changes at the Loch Scolpaig ScIIb/ScIII boundary. The 225 cm horizon at Balelone Farm is radiocarbon dated (Table 44) to 7905 ± 130 uncal BP which both these vegetational changes must therefore pre-date. However, similar changes at Little Loch Roag (Birks & Madsen 1979) are dated to 7700 uncal BP and 6100 uncal BP respectively, indicating that either the changes were not synchronous between sites or that there is an error in either the Little Loch Roag date of 6100 uncal BP or the Balelone Farm date of 7900 uncal BP. Since the *Alnus* rise in the Inner Hebrides is dated to 6500 BP (Birks & Williams 1983) and is similar to the Little Loch Roag date, it seems most likely that an error lies in the Balelone Farm date.

Apart from this anomaly, the similarity of the pollen diagrams from all three sites reflects a similar vegetation history.

16.2 DIATOM ANALYIS

16.2.1 Introduction

A 2.60 m core was collected with a Russian sampler from a central point in Loch Scolpaig, in July 1983. The stratigraphy is described in Table 42. Samples were extracted from the core for diatom analysis to examine the development of the lake ecosystem since its inception during the Late Devensian

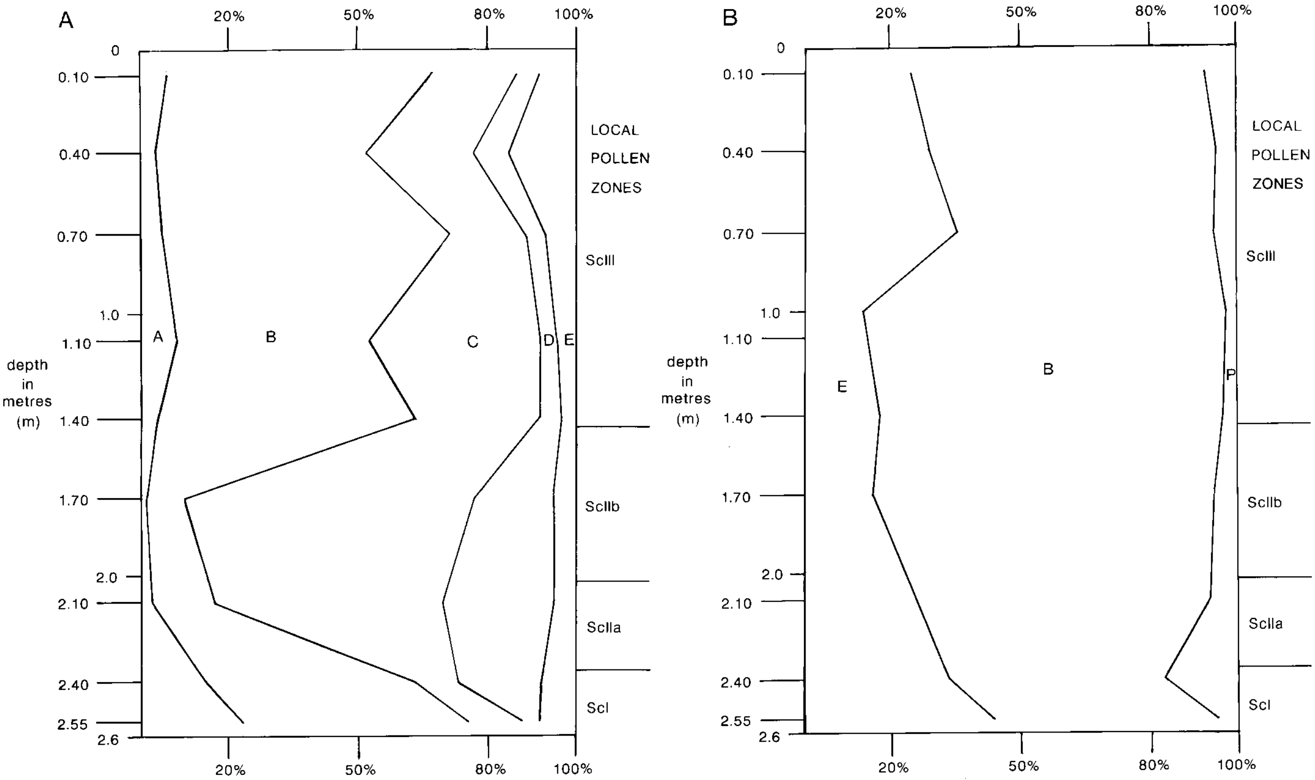

Figure 95. Loch Scolpaig; a) pH spectrum. The proportion of total ascribed to (A) alkalibiontic, (B) alkaliphilous, (C) indifferent, (D) acidophilous and (E) unknown; b) Ecological spectrum. The proportion of total ascribed to (E) epiphytes, (B) benthic species and (P) planktonic species

(*above*) and to determine what effect prehistoric settlement in the catchment may have had on lake development.

16.2.2 Results

The results of the diatom counts, in terms of the incidence of all species and their percentage occurrence are given below. In addition, a pH spectrum (Figure 95a) has been constructed to provide an indication of how the pH status of the lake waters have changed over time.

The following categories (after Hustedt 1937–39) have been used:

ALKALIBIONTIC: Diatoms restricted to water of Ph greater than 7

ALKALIPHILOUS: Diatoms most frequently found in water of pH greater than 7

INDIFFERENT: Diatoms of equable occurrence at pH about 7

ACIDOPHILOUS: Diatoms most frequently found in water below pH7 but may also be found at higher pH values

The diatom species from the Loch Scolpaig sediments have been ascribed to these categories on the basis of the classifications of Foged (1947–1948; 1953; 1954; 1977), Jorgensen (1948; 1950), Round (1957; 1964) and Florin (1970).

The ecological spectrum (Figure 95b) is based on the planktonic, benthic and epiphytic categories of Patrick (1948) and Round (1957) and has been constructed by determining the habitat requirements of individual species as given in the literature cited above.

Data for the pH and ecological spectra are summarised in Tables 45 and 46.

16.2.3 Zonation

Three local diatom assemblage zones (*sensu* Battarbee 1979 & Mannion 1980) have been delimited as follows:

Zone Sc DI 2.60 m–2.35 m

Epiphytic species show a decline as benthic species increase and the pH spectrum changes from dominance by alkalibiontic and alkaliphilous species to dominance by indifferent species. Acidophilous species also show an increase.

Zone Sc DI 2.35 m–1.55 m

The ecological spectrum remains unchanged and the predominance of benthic species persists. The pH spectrum is dominated by indifferent and acidophilous species which decline toward the close of this zone to be replaced by alkaliphilous species.

Zone Sc DIII 1.55 m–0.00 m

The diatom flora remains alkaliphilous and benthic with a slight increase in acidophilous species and epiphytes towards the surface.

Level (m)	Alkalibiontic (A)	Alkaliphilous (B)	Indifferent (C)	Acidophilous	Unknown
0.1	5.79	58.06	23.63	6.76	5.95
0.4	4.46	47.29	26.12	7.56	14.08
0.7	5.52	65.81	18.99	2.78	5.88
1.1	7.3	47.42	39.8	2.79	2.47
1.4	3.74	61.44	29	3.33	0.94
1.7	0.15	10.76	65.4	19.35	4.75
2.1	1.46	18.37	51.87	22.37	4.88
2.4	13.87	53.25	7.82	16.96	7.86
2.55	22.84	53.98	10.96	2.07	10.16

Table 45. Loch Scolpaig. Summary of results for the pH spectrum (%)

Since there is no generally accepted series of diatom zones of regional significance for relative dating as there is for pollen zones (Mannion 1980), the local diatom zones described above have been ascribed to a tentative chronology using the results of pollen analysis from the same core (see above). In addition two horizons on Figures 93 and 94 have been ascribed an approximate radiocarbon age which has been inferred, on the basis of pollen assemblage zones, from Little Loch Roag, Lewis (Birks & Madsen 1979).

16.2.4 Discussion

The early stages of diatom community development, a preponderance of alkalibiontic and alkaliphilous species, is similar to that of many Late Devensian and early Flandrian profiles in Britain, eg in North Wales (Crabtree 1969) and the Lake District (Haworth 1976). This may be due to high base availability in drainage from relatively freshly weathered glacial material from which bases are often removed first. In addition, the calcareous machair environment in which Loch Scolpaig is situated, would provide a good supply of base-rich material. The dominance of benthic species is also to be expected in a predominantly minerogenic environment. The high proportion of epiphytes is a little surprising but the pollen diagram from Loch Scolpaig (*above*) shows high concentrations of pollen of aquatic species such as *Myriopyllum alterniflorum* and Potamogeton which would provide a suitable habitat for epiphytic species. Of the epiphytes recorded (*below*) the majority are Epithemie spp which are alkalibiontic and may have been particularly favoured by high pH values.

Level (m)	Epiphytic	Benthic	Planktonic
0.1	23.61	70.62	4.99
0.4	26.07	70.34	3.1
0.7	31.55	65.66	1.61
1.1	12.43	85.94	1.4
1.4	18.01	78.73	1.76
1.7	17.36	77.3	5.79
2.1	23.47	70.43	4.76
2.4	28.07	58.42	13.27
2.55	40.48	55.08	3.18

Table 46. Loch Scolpaig. Summary of results for the ecological spectrum (%)

In local diatom zone Sc DII indifferent and acidophilous species increase at the expense of alkaliphilous species. This may have been a response to a reduction in base input into the lake ecosystem as the base content of glacial deposits and weathered bed rock was depleted. The pollen spectra also suggest the development of a more acidophilous vegetation in catchment which may have produced soil and humus acidification, drainage from which into Loch Scolpaig, influenced the diatom communities. However, alkaliphilous species are still well represented and this is probably a reflection of continued base-rich drainage from the machair sand. The predominance of benthic species indicates the persistence of a minerogenic environment which is borne out by the high clay content of the stratigraphy (above).

Above 1.55 m in diatom zone Sc DIII alkaliphilous species again increase and the diatom spectrum shows little overall change from this level to present, the stabilisation period having occurred in zone Sc DII. In view of the pollen analytical results, this is not surprising since the latter show that once blanket bog and moorland communities had established themselves at approximately 6900 radiocarbon years BP little change in the catchment vegetation has occurred to the present-day. Consequently, it is unlikely that drainage characteristics from the catchment have changed to influence the diatom populations in the lake. The predominance of alkaliphilous and benthic species throughout this zone reflect a minerogenic environment and the importance of base-rich drainage from the Machair sand which must, at least to some extent, neutralise the acid drainage from blanket bog and weathered, acid, gneiss bedrock in the catchment. There are no changes in the diatom spectra which can be unequivocally ascribed to the influence of human activity in the catchment although the increase in epiphytes at 0.7 m and the slight increase in acidophilous species at 0.4 m may well be a response to anthropogenic activity.

Two further points are also worthy of mention. Firstly, there are no marine diatom species recorded, indicating that there have been no marine incursions in the lake's history. There are however, a number of species which prefer brackish water and their presence has probably been encouraged by sea spray entering the lake. Secondly, the lack of planktonic development throughout the profile is unusual in comparison with published British data. This may be a response to lack of water depth since the core of only 2.6 m covers part of the Late Devensian and the entire Flandrian periods and today water depth does no exceed 1 m. In addition, Loch Scolpaig occupies a unique environment in a lowland coastal position and receives drainage from both base-rich and base-poor sources.