8.1 Palynological studies in northeast Skye and Raasay | Fraser Green & Kevin Edwards

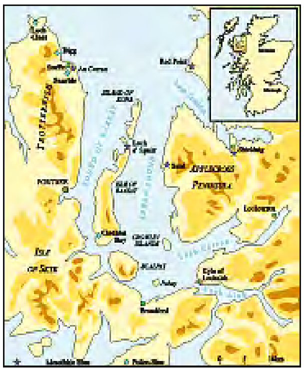
8.1.1 Abstract

Pollen, microscopic charcoal and radiocarbon studies at four sites on Skye and Raasay provide environmental contexts for the archaeological investigations of Scotland's First Settlers around the Inner Sound. One coring site, from a loch in northern Trotternish, Skye, provides a regional summary of environmental change. Other sites closer to the rockshelter at An Corran, Trotternish, furnish more localised pictures of landscape change, some of which may be associated with human intervention of Mesolithic age. Intertidal organic deposits from Raasay assist in reconstructing the early Holocene environment of the area. General date ranges have been presented as uncalibrated, radiocarbon years BP. AMS radiocarbon dates were obtained on bulk sediments and these appear at the sides of the pollen diagrams as calibrated years BP. Calibration was undertaken via the program CALIB v. 5.0.1 (Stuiver & Reimer 2005). Dating estimates are based on straight-line extrapolations with the dates rounded to the nearest ten years and by-passing dates which are out of time sequence (as at Loch Cleat; Edwards & Whittington 2001).

8.1.2 Introduction

This contribution seeks to reconstruct the composition and evolution of the terrestrial natural environment around the Inner Sound during the first half of the Holocene, *c*10000–5000 BP. This time span encompasses the conventional period of the Mesolithic in Scottish archaeology, and the intention is to provide an environmental context to the Mesolithic settlement of this region and to assess the evidence for hunter-gatherer impacts on the landscape. Pollen and microscopic charcoal analyses are the principal tools used to achieve these aims and the work follows a similar design to that pursued elsewhere in the Inner Hebrides (Hirons & Edwards 1990; Edwards & Berridge 1994; Edwards 2000b; Sugden & Edwards 2000).

8.1.3 Core sites



Illus 547: The Inner Sound showing pollen sample sites and Mesolithic sites

Three coring sites in northern Trotternish, Skye, were selected on the basis of their general proximity to the Mesolithic site of An Corran, and their suitability for providing a probable undisturbed pollen record (see Illustration 547, right). The sites were also chosen to reflect differences in pollen source area and taphonomy so that comparisons could be made with regard to the detection of small scale human impacts. An intertidal peat site at Clachan Bay, Raasay, was also studied and summary results are published here. Palynological data from the rockshelter at Sand, Applecross, are presented elsewhere (Green & Edwards, Section 3.16; Green 2005).

8.1.3.1 Digg

Illus 548: The Digg Basin and the surrounding area, showing the core location

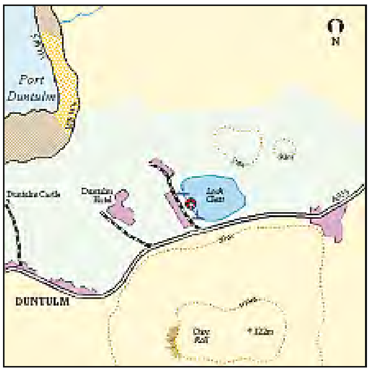
The mire at Digg occupies a broad basin above the western shores of Staffin Bay, a locally significant embayment in the northeast of the Trotternish Peninsula (see Illustration 548, left). The Digg basin is located on a shelf at 40m OD and the eastern edge drops steeply to the sea with the coast less than 100m distant. The coring location (OS Grid reference NG 471286 9609) was selected after a series of trial boring transects were taken in order to ascertain the deepest part of the basin. The basin measures approximately 200m long and 100m wide. The relief of the surrounding area is steep and complex as a result of successive landslipping from the unstable Trotternish Ridge 2km to the west (Ballantyne *et al* 1991). It is possible that the Digg basin itself occupies a depression between rotational landslip blocks. A small stream at its southern end, which falls over the adjacent cliff into Staffin Bay, drains the basin. Although there is no inflow stream, the steep slopes to the north and west are likely to act as drains into the mire. Geologically, the country rock is classified as part of the Upper Jurassic marine facies, mainly clays, shales and sandstones. Overlying this, technically as a drift deposit, are the Tertiary basalt blocks and rubble from the landslips. Soils in the area vary with the topography, and where drainage is suitable the relatively base-rich bedrock produces thin brown earths. In more waterlogged situations, peaty podsols and gleys predominate (Hudson & Henderson 1983).

8.1.3.2 Suarbie

The core at Suarbie was removed from a large area of blanket mire that forms a more or less continuous cover between the Trotternish Ridge in the west, and the lower agricultural lands beside the coast in the east, a distance of *c*5km (see Illustration 549, right). This blanket bog extends northwards as far as the southern slopes of The Quiraing, and southwards to where The Storr abuts the sea cliffs at Rigg – some 12km. Discrete areas of mire are interrupted by the courses of several rivers running from the Ridge to the sea, most notably the Stenscholl/Kilmartin in the north, and the Lealt in the south. The coring site (NG 48224 65822) is within the Stenscholl catchment, *c*400m west of the main stream of the Kilmartin River, 60m west of the Suarbie Burn and *c*500m northeast of the deserted settlement of Suarbie. The bog here occupies a broad depression of gently sloping land between north-easterly flowing burns. The underlying geology of the site is dominated by intrusive dolerite sills of Tertiary age, but the catchment drains softer Jurassic sedimentary rocks to the west, above which the extrusive basalts of the Trotternish Ridge occur. All these lithologies possess a relatively high base-status. Blanket peat is the dominant soil type, with mineral soils being uncommon in the vicinity – these are mostly peaty gleys and peaty podsols occurring where peat generation is restricted by topography or human intervention. Non-calcareous gleys are also fairly regular over the Jurassic sediments, particularly closer to the coast (Hudson & Henderson 1983).

Illus 549: Suarbie and the surrounding area, showing the core location

8.1.3.3 Loch Cleat

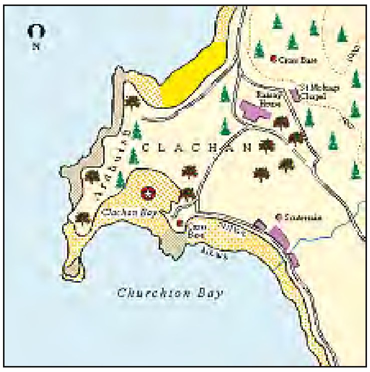


Illus 550: Loch Cleat and the surrounding area, showing the core location

Loch Cleat is a small lake on the west side of the northern tip of the Trotternish Peninsula (see Illustration 550, left). The loch is approximately 0.4km east of the coast at Port Duntulm, and 0.7km from Duntulm Castle. Rubha Hunish, the northernmost extremity of Skye, is *c*3.5km to the north. The coring site is on the western fringes of the loch (NG 41662 74287). The loch occupies a rock basin at 38m above Ordnance Datum and is little more than 100m across at the widest point. The hillslopes around the loch are generally gentle, below 15°, except for the steep 50° slope of the 122m high Cnoc Roll to the immediate south. There is no inflow stream, but a small outflow empties from the northwest into Port Duntulm. Tertiary dolerite sills dominate the underlying geology, with Jurassic sedimentary rocks outcropping closer to the coast in the east and west. The Tertiary flood basalts of the Trotternish Ridge outcrop to the south. Soils are predominantly peaty podsols in poorly drained locations and brown forest soils where drainage is better and the base-rich bedrock is sufficiently weathered (Hudson & Henderson 1983).

8.1.3.4 Clachan Bay

Clachan Bay is a minor embayment on the southern shore of the Ardhuish promontory on the southwest coast of Raasay (see Illustration 551, right). The bay faces south-south-west, is *c*150m in width, and forms part of the larger Churchton Bay. Clachan Bay is shielded from high winds and storm waves by stone piers and the proximity of the Isle of Skye, and this has probably led to the survival of the organic deposit in the intertidal zone. The underlying geology is predominately Tertiary granite, associated with the adjacent Red Hills granites on Skye, but the seaward half of the Ardhuish promontory forms part of a dolerite sill. Jurassic marine sediments and Torridonian sandstones outcrop within 5km of the site.



Illus 551: Clachan Bay and the surrounding area, showing the core location

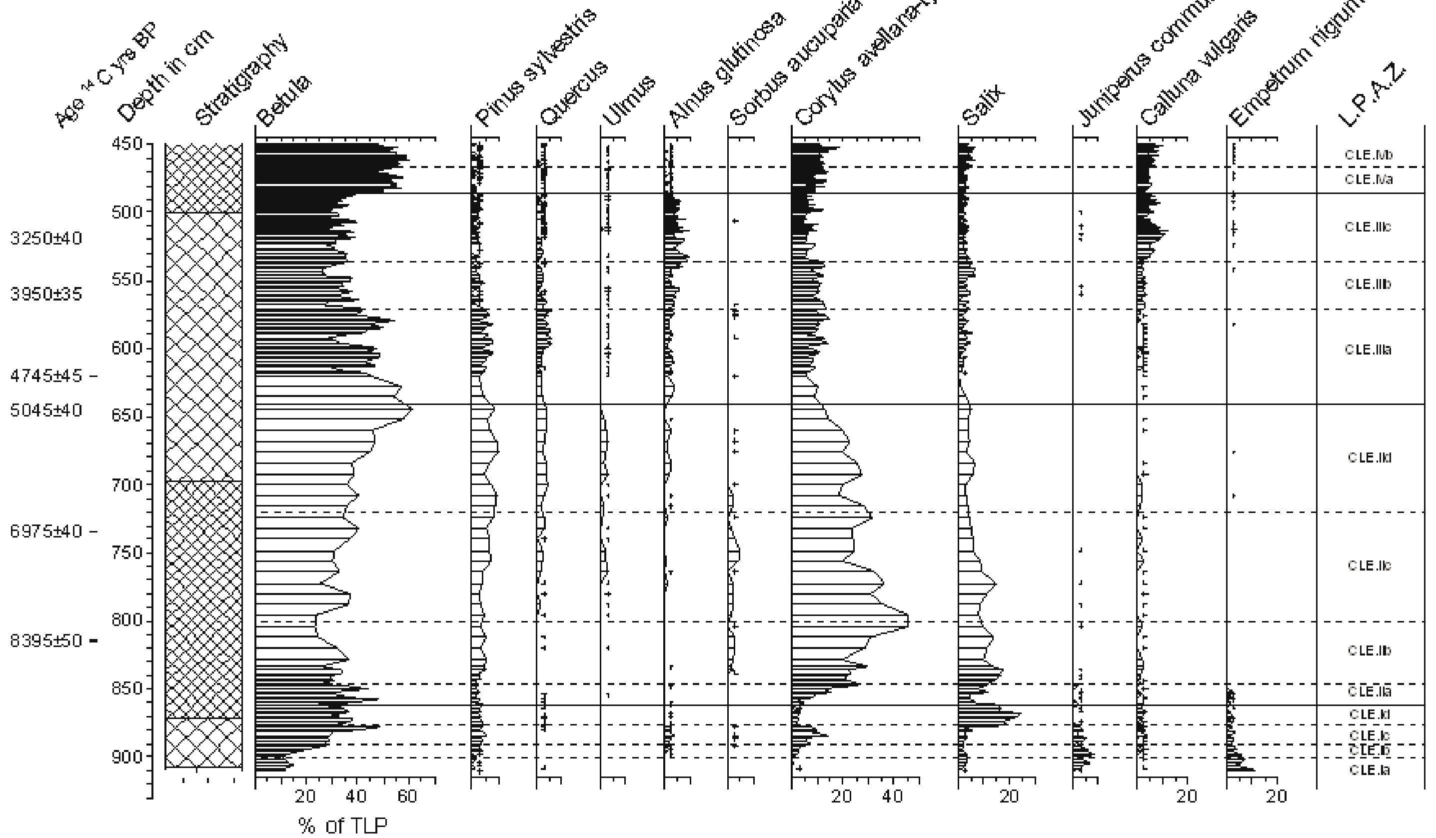
8.1.4 Methods and presentation of results

Samples for the Skye sites were obtained with Russian corers of 5 or 8cm diameter (Jowsey 1966). The intertidal peats at Clachan Bay on Raasay were sampled in monolith tins from open sections.

Laboratory sampling for all sites, where appropriate, took place at contiguous 1cm intervals. Samples of $1cm^3$ were processed for analysis of pollen and charcoal content following standard procedures (Moore *et al* 1991).

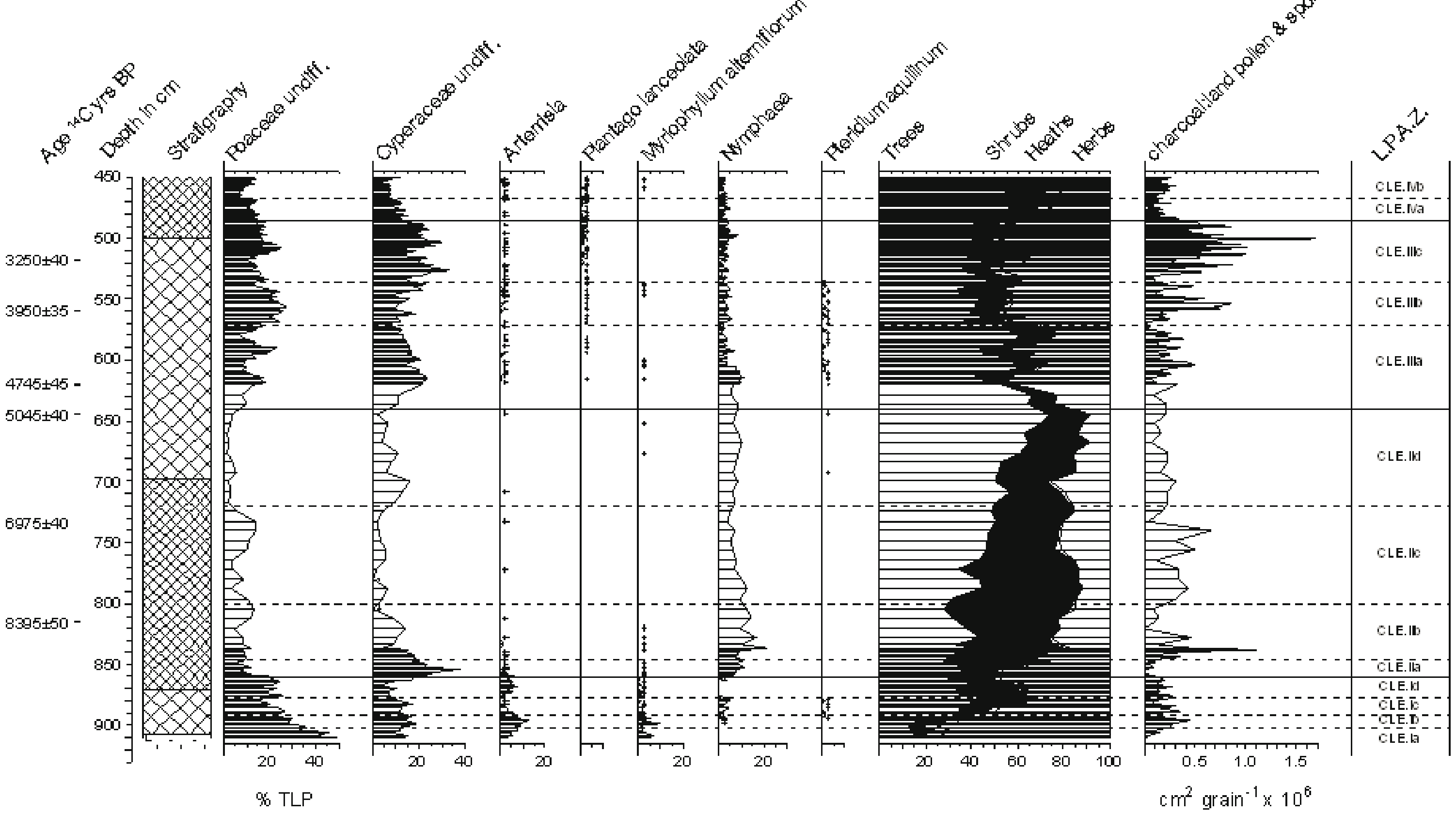
Pollen was initially counted at a minimum of 300 total land pollen (TLP). Higher resolution analysis of selected sections involved minimum counts of 500 TLP. The identification of fossil pollen and spores was based on the keys of Faegri & Iversen (1989) and Moore *et al* (1991) and aided by the type slide collection of the Department of Geography and Environment, University of Aberdeen. Pollen and spore type nomenclature follows Bennett (1994) and Stace (1997). The data were processed and presented using Tilia, TiliaGraph and TGView (Grimm 1991). The pollen diagrams are divided into local pollen assemblage zones (LPAZ) in order to facilitate discussion. Only selected pollen and spore taxa are presented here (see Illustrations 552–556, below), full discussion of the information is presented in Green (2005). Skip Charts.

Illustration 552



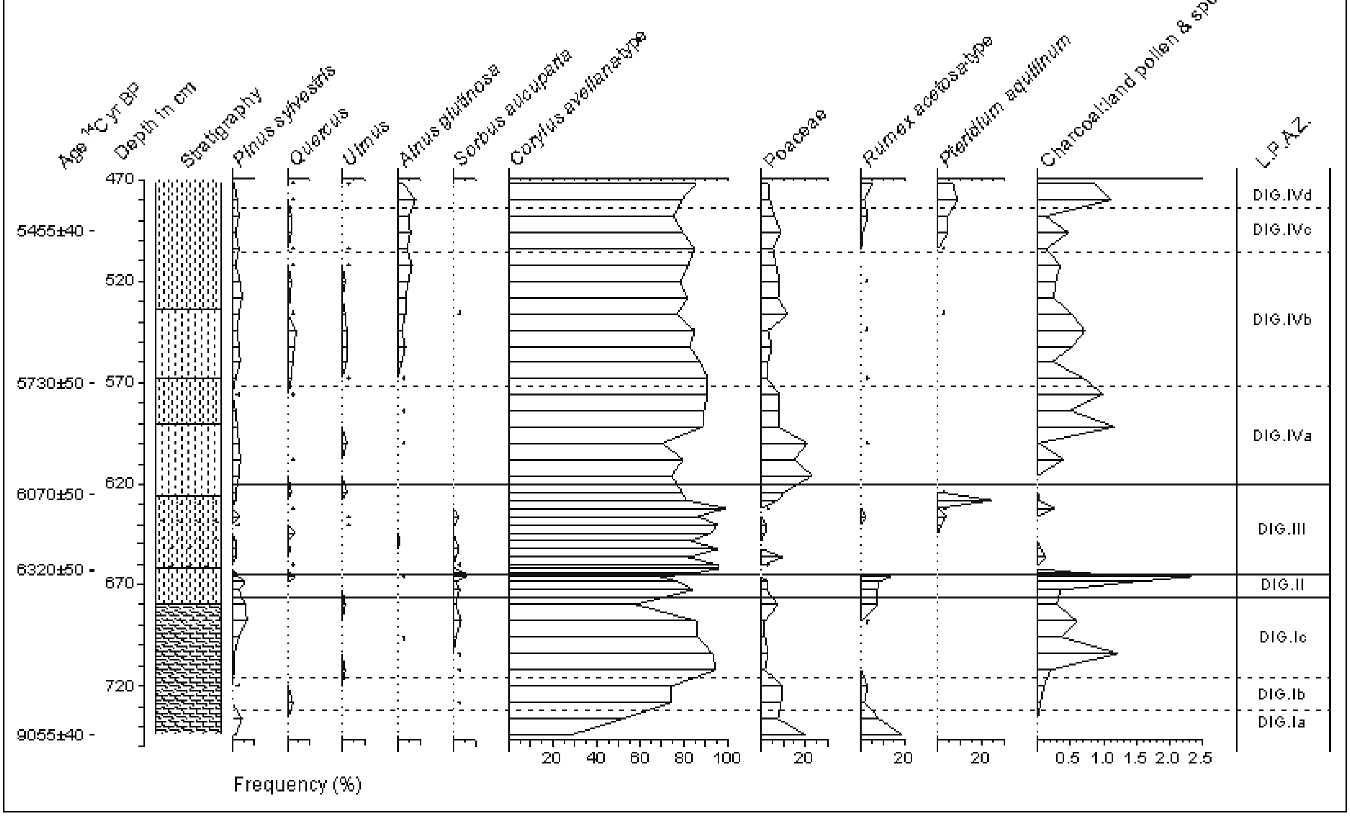
Illus 552: Pollen percentage diagram for Loch Cleat with selected taxa; taxa have been chosen to best represent the general environment. AMS radiocarbon dates were obtained on bulk sediments and these appear at the sides of the pollen diagrams as calibrated years BP Calibration was undertaken via the program CALIB v5.0.1 (Stuiver & Reimer 2005). Back to Section 8.1.5.1

Illustration 553



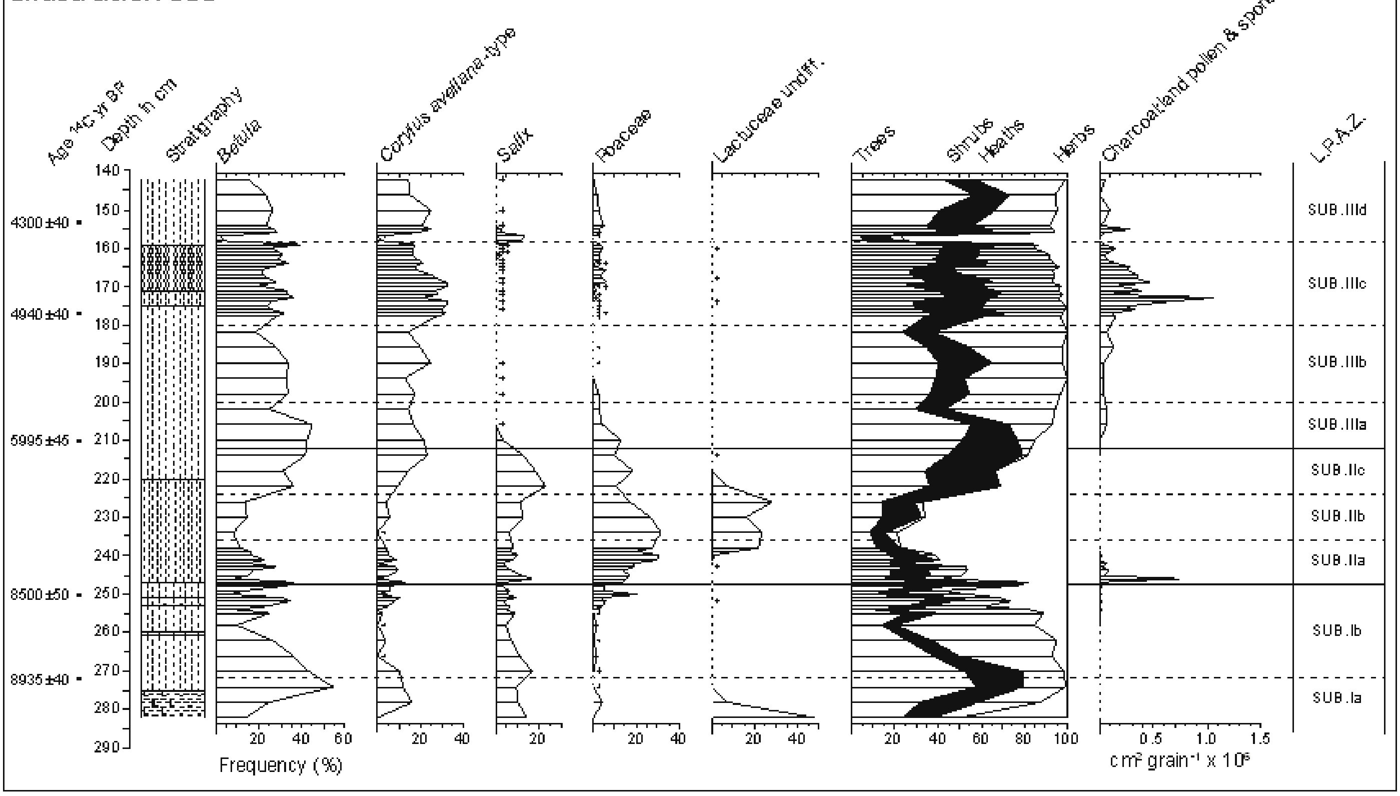
Illus 553: Pollen percentage diagram for Loch Cleat with selected taxa (cont.); taxa have been chosen to best represent the general environment. AMS radiocarbon dates were obtained on bulk sediments and these appear at the sides of the pollen diagrams as calibrated years BP Calibration was undertaken via the program CALIB v5.0.1 (Stuiver & Reimer 2005)

Illustration 554

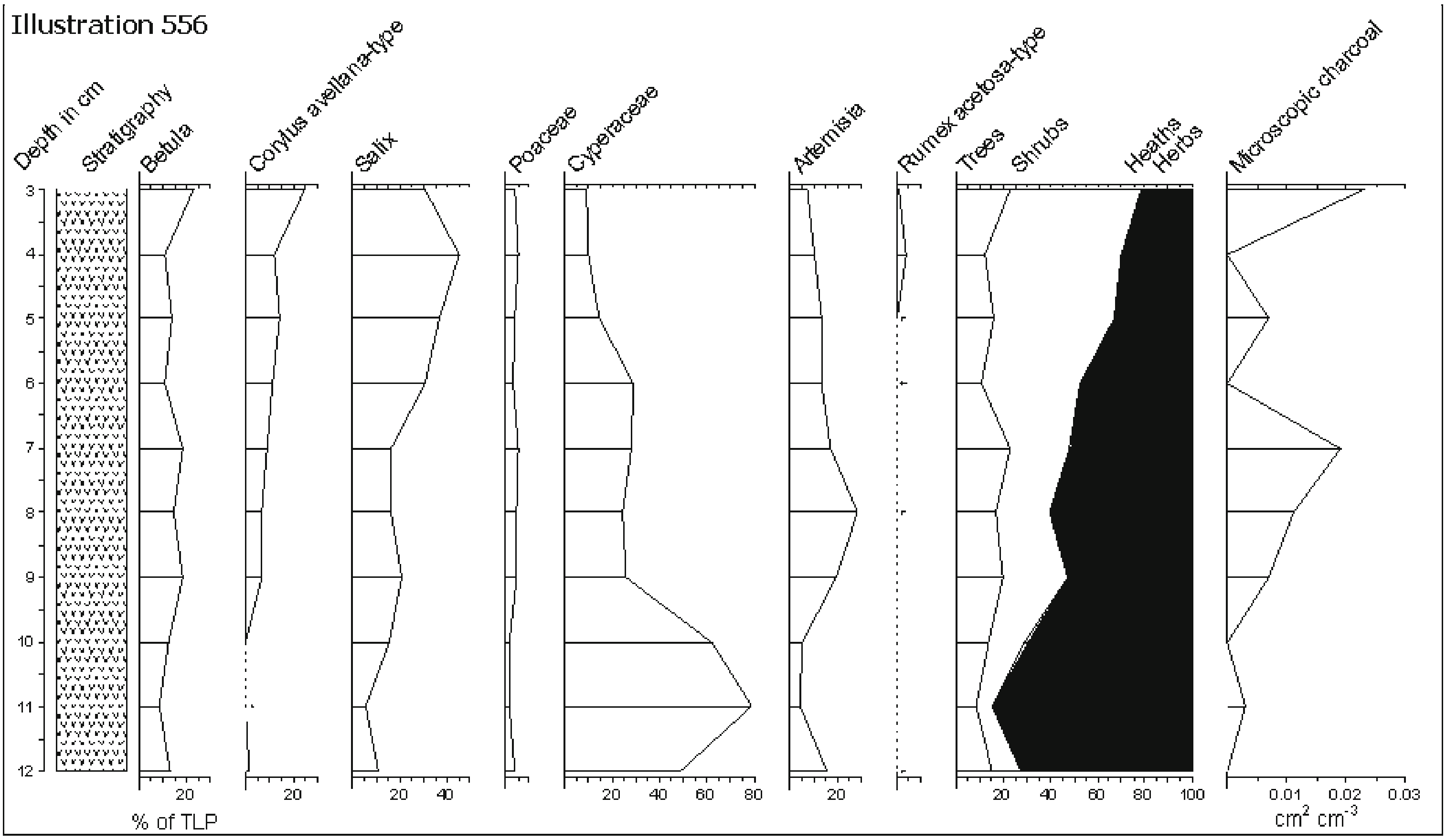


Illus 554: Pollen percentage diagram for Digg with selected taxa; taxa (eg *Betula*, *Calluna vulgaris*) that may have been present on the bog surface have been removed to better represent extra-local taxa. AMS radiocarbon dates were obtained on bulk sediments and these appear at the sides of the pollen diagrams as calibrated years BP Calibration was undertaken via the program CALIB v5.0.1 (Stuiver & Reimer 2005)

Illustration 555



Illus 555: Pollen percentage diagram for Suarbie with selected taxa; taxa have been chosen to best represent the general environment and provide evidence of possible human interference. AMS radiocarbon dates were obtained on bulk sediments and these appear at the sides of the pollen diagrams as calibrated years BP Calibration was undertaken via the program CALIB v5.0.1 (Stuiver & Reimer 2005)



Illus 556: Pollen percentage diagram for Clachan Bay with selected taxa; taxa have been chosen to best represent the general environment

Microscopic charcoal was quantified on every level sampled for pollen and also sampled at contiguous 1cm intervals for 461cm from the Loch Cleat core, from 450cm down. Charcoal was quantified in two-dimensions and then concentrations expressed as total surface area per sample volume (*cf*. Edwards & Whittington 2000) prior to expression as charcoal to pollen ratios (C:P) in an effort to obviate false charcoal peaks resulting from variations in the rate of sediment accumulation (Swain 1973).

AMS radiocarbon dates were obtained on bulk sediments and these appear at the sides of the pollen diagrams as calibrated years BP Calibration was undertaken via the program CALIB v5.0.1 (Stuiver & Reimer 2005). Dating estimates are based on straight-line extrapolations with the dates rounded to the nearest ten years and by-passing dates which are out of time sequence (as at Loch Cleat; Edwards & Whittington 2001). The full data relating to radiocarbon determinations is given in Table 183, below.

Table 183

Lab Code	Depth (cm)	Material dated	Radiocarbon age (^{14}C BP)	$\delta^{13}C$(0/00)	Calibrated dates (cal. BP)
Suarbie					
GU-11320	153–4	*Eriophorum* peat	4300±40	-27.6	4900±80
GU-11319	177–8	*Eriophorum* peat	4940±40	-27.6	5670±80
GU-11318	210–1	*Eriophorum* peat	5995±45	-27.3	6835±115
GU-11317	250–1	*Eriophorum* peat	8500±50	-27.6	9490±60
GU-11316	272–3	*Eriophorum* peat	8935±40	-27.5	10000±90
Digg					
GU-11315	495–6	*Eriophorum* peat	5455±40	-26.7	6245±75
GU-11314	570–1	*Eriophorum* peat	6730±50	-27.3	7580±100

GU-11313	625–6	*Eriophorum* peat	8070±50	-28.3	9000±300
GU-11312	663–4	*Eriophorum* peat	8320±50	-29.2	9630±120
GU-11311	744–5	Bryophyte peat	9055±40	-33.7	10200±50
Loch Cleat					
GU-11307	470–471	Fine detrital gyttja	4155±40	-28.7	4700±130
GU-11307	518–519	Fine detrital gyttja	3250±40	-28.0	3475±105
GU-11308	560–561	Fine detrital gyttja	3950±35	-28.2	4365±85
GU-11307	620–621	Fine detrital gyttja	4745±45	-28.8	5515±75
GU-11306	645–646	Fine detrital gyttja	5045±40	-29.1	5805±105
GU-11305	735–736	Fine detrital gyttja	6975±40	-29.4	7780±90
GU-11304	815–816	Fine detrital gyttja	8395±50	-29.3	9400±130
GU-11303	880–881	Fine detrital gyttja	7215±45	-24.5	8045±115

Table 183: Radiocarbon data for palaeo-environmental samples taken from Suarbie, Digg, and Loch Cleat. Calibration was undertaken via the program CALIB v5.0.1 (Stuiver & Reimer 2005).

Sediment lithology was assessed using the system of Troels-Smith (1955) and this is indicated on the pollen diagrams.

8.1.5 Discussion: general vegetation change *c*10,000–5,000 BP

Selected pollen taxa from the coring sites provide a summary of the principal changes in vegetation around the Inner Sound during the Mesolithic. The following Section describes the general pattern of change throughout this period and details the composition of the vegetation. Subsequent to this the evidence for possible human impact on the vegetation is discussed.

Much of the following is based on data from the three coring sites in northern Trotternish and cannot be ascribed to the opposite shore of the Inner Sound with great confidence. However, using existing palaeoecological studies from Wester Ross and its environs, and from comparisons with present day vegetation, the Holocene environment of the eastern shore can be tentatively reconstructed (see also Shiel, Section 8.2).

8.1.5.1 Trotternish, Raasay and the western shore

Previous palynological investigations from Skye have documented the Lateglacial period (Vasari & Vasari 1968; Birks 1973; Vasari 1977; Birks & Williams 1983; Walker & Lowe 1990), and the starting point for this discussion is the beginning of the Holocene, typically marked by the transition in lake sediments from minerogenic silts and clays associated with the Loch Lomond Stadial, to more organic material. This has been dated to *c*10,050 BP for Loch Cleat in this study and to *c*10,130 BP in Williams (1977), who also investigated Loch Cleat. Dates for this transition are not published in other studies from Skye, but pollen-stratigraphic 'events' associated with the onset of the Holocene are well constrained chronologically, and tend to support the above dates.

A typical pollen succession of *Poaceae* (grasses), *Empetrum nigrum* (crowberry), *Juniperus communis* (juniper), *Betula* (birch) and *Corylus avellana*-type (hazel type) has been identified at most sites. A degree of inter-site variation is reported by most authors (Birks & Williams 1983; Walker & Lowe 1990; Selby 2004), with location relative to exposure and the mountain mass of the Cuillin, or variations in lithology, cited as the main influences on vegetation development.

There exists a considerable discrepancy with regard to the presence of *Alnus glutinosa* (alder) and other thermophilous taxa during LPAZ CLE.Ic (*c*9740–9490 BP; see Illustration 552, above). It is suggested that the pollen and spores of *A glutinosa*, *Sorbus aucuparia* (rowan), *Pteridium aquilinum* (bracken) and *Nymphaea alba* (white water-lily) may be present in these deposits due to contamination during the coring process. This is supported by a radiocarbon date of 7215±45 BP (GU-11303) for a sample in this sub-zone, although only *Sorbus* and *Nymphaea* are at all frequent from samples matching this extrapolated date higher in the core, and *Pteridium* is not recorded at all. It could be that LPAZ CLE.Ic is contaminated by material from various parts of the upper profile, but this does not explain why taxa such as *Ulmus* (elm) and *Quercus* (oak) are missing. It is important to stress that contamination here does not mean total replacement, and this could account for the continued frequency, albeit at steadily decreasing frequencies, of taxa characteristic of the early Holocene such as *Artemisia* (mugwort), *Plantago maritima* (sea plantain) and *Juniperus communis*.

Given this chronological evidence, the lack of a consistent record for alder at this date in Williams' study (Williams 1977), and other investigations from Skye, it would seem prudent to reject the possibility of a local alder expansion in Trotternish. However, the colonisation by alder of Britain and Ireland is complex and poorly understood (Chambers & Elliott 1989; Bennett & Birks 1990). There exists a number of anomalous dates for the first Holocene presence of alder at sites throughout Britain. It is tempting to suggest that with the presence of *Pteridium aqulinum*, a sometimes pyrophytic taxon, some invasion of incipient wetlands created by anthropogenic burning might have occurred (see Smith 1984; Chambers & Price 1985; Hirons & Edwards 1990), but the charcoal evidence is not persuasive and the problem of seed source remains unresolved.

Williams (1977) provides a date of 9,760±150 BP for the beginning of the hazel rise at Loch Cleat, matching the lower boundary of LPAZ CLE.Ic. The implication here is that a climatic threshold has been reached, enabling increased pollen production in hazel, and possibly encouraging the colonisation and/or pollen production of alder and the other incidental taxa.

Subsequent to LPAZ CLE.Ic is an inferred climatic deterioration that characterises LPAZ CLE.Id. This phase is dated to *c*9,490–9,210 BP and is detected by Williams only as an isolated peak in *Salix* (willow) pollen dated to *c*9,200 BP and interpreted as an expansion of arctic-alpine willow scrub on the base-rich substrates surrounding the loch prior to the dominance of *Corylus avellana*. This phase of climatic deterioration comes to a close at *c*9,210 BP, after which herb taxa generally decline and woody taxa are reinstated. This period is the first to be covered by the profiles from Digg and Suarbie, and both these sites begin with an apparent *Corylus* expansion which probably matches the second and decisive expansion of *Corylus avellana* at Loch Cleat. The pollen data from Suarbie and Loch Cleat suggest that hazel populations are likely to have stabilised in northern Trotternish at *c*8,950 BP. The Digg profile provides a slightly later date of *c*8,800 BP for an initial peak in *C. avellana*, though this might be skewed by a strong local pollen signal from *Betula* growing close to the core site.

In the absence of radiocarbon dates for the intertidal peat at Clachan Bay, it is difficult to place inferred vegetation changes within a regional framework. The relative sea-level changes identified by Dawson (see Section 7.2) suggest that the peats were deposited at some point between *c*9,500 and 8,500 BP, and the restricted pollen assemblage, with evidence for a possible *Corylus avellana* rise, supports this. The lithic flake from the site (see Section 2.2; Hardy & Wickham-Jones 2002) is not readily dateable, but is assumed to date no later than the inferred cessation of intertidal peat accumulation around 8,500 BP. The pollen stratigraphy indicates the probable role of *Corylus* and *Betula* in forming a canopy on the drier soils, with willow in wetter habitats. The sedges (Cyperaceae) are assumed to be growing on the peat surface and the continuous frequencies of *Artemisia* pollen probably signify the growth of mugwort on nearby wasteland.

8.1.5.2 The eastern shore

The early Holocene pollen assemblages from Loch Maree (Birks 1972), Loch Clair and Loch Sionascaig (Pennington & Lishman 1971; Pennington *et al* 1972) are characterised by high values for Juniperus pollen. This reveals the affinity of these sites with those from the more continental Eastern Highlands (Birks 1970) where juniper is still a common pinewood associate today. The coastal fringes of Wester Ross probably suffered a greater degree of exposure in the early Holocene than the mountainous hinterland, and for this reason the typical succession of *Poaceae-Empetrum-Juniperus-Betula-Corylus* probably bore more resemblance to parts of Skye.

The acid soils which prevail on the Torridonian sandstone in Applecross and Torridon suggest that the site with the best analogy for these edaphic conditions on Skye is Loch Ashik (Birks & Williams 1983; Walker & Lowe 1990). The south-easterly location of Loch Ashik also provides further support for comparison, but its sheltered aspect should be borne in mind, and possibly favoured the development of woody taxa (Walker & Lowe 1990). Birks and Williams testify to the early development of birch-hazel woodland around Loch Ashik, but this may have much to do with the south-easterly location. Birks (1989) assumes that a corridor of migration must have existed along the Inner Sound to allow early colonisation in eastern Skye and the far north.

8.1.6 Discussion: the holocene woodland phase – *c*8,950–5,000 BP

8.1.6.1 General woodland development in northern Trotternish

The dominant arboreal taxa at all sites are *Betula* and *Corylus avellana*, but the relative abundance of these two taxa, and their changing frequency during this period, differ between sites. Birch reaches its early Holocene peak around Loch Cleat during the expansion of hazel in LPAZ CLE.IIa. (*c*9,210–8,960 BP). Subsequent to this, hazel expands more gradually until reaching a peak frequency of 46% TLP at *c*8,060 BP, consolidating its position as the principal canopy-former in the early Holocene woodland around Loch Cleat.

The situation at Digg and Suarbie is less easily interpreted, mainly because of the difficulty of distinguishing local from extra-local pollen inputs in peat profiles. Assuming that *Corylus avellana* pollen always originates from beyond the peatland under investigation, it seems likely that hazel was not the principal woody taxon around Suarbie at any point in the early Holocene. The surrounding soils must have formed from the same base-rich Tertiary extrusive rocks as further north, so why is hazel less well established? This could be a result of one or a combination of three or more factors:

i. the vegetation at the core site is consistently restricting the input of extra-local pollen
ii. the single peatland mass from which the core was taken was already large enough to exclude hazel from the 'local' pollen catchment
iii. the entire hinterland was dominated by either blanket bog, as today, or numerous discrete peatland mesotopes supporting a predominately acidophilous vegetation

Periods of *Betula* superiority at Digg can more easily be ascribed to incursions of birch onto the bog surface, and hazel is almost certainly the principal arboreal taxon growing in the area throughout the early Holocene.

At Loch Cleat the peak in *Corylus avellana* at *c*8,060 BP is followed by a steady decline to a minimum of 20% TLP by *c*7,350 BP. In contrast, *Betula* gradually increases over this period and continues to increase until becoming the dominant woody taxon in northern Trotternish by *c*5,000 BP. This is not the case at Digg until *c*5,600 BP, perhaps reflecting the abundance of steep, unstable ground in the vicinity, where mineral leaching and peat formation are inhibited and new habitats are created by mass movement, favouring the continued dominance of hazel.

The steady replacement of *Corylus avellana* by *Betula* in the pollen assemblage is perhaps not a reflection of an actual decline in hazel around Loch Cleat, but an artefact of decreasing pollen production in *Corylus* as the birch canopy increases the level of shade, perhaps at a slower rate here due to the exposure and marginal habitats available for woodland (Anderson 1973). Similar patterns are evident at other pollen sites in marginal locations in western Scotland, such as Lochan na Beinne Bige on Lewis (Lomax 1997; Edwards *et al* 2000). It is possible that hazel could be decreasing in actual terms however, perhaps as a result of climatic deterioration linked to the 8200 cal BP event (Alley *et al* 1997; Alley & Ágústsdótir 2005; Rohling & Pälike 2005) and, after *c*7,000 BP to the onset of wetter and perhaps stormier conditions (Ballantyne 2004). This does not account, however, for the apparent contraction of *C. avellana* prior to this date and other factors may be playing a part here. Fluctuations in the pollen of *Myrica gale*, which is included in *Corylus avellana*-type, may be influencing the hazel profile. Human agency may also be responsible for the decline and this will be discussed later.

Irrespective of this gradual shift in the composition of dominant arboreal taxa in the early Holocene woodland around Loch Cleat, the representation of tree and shrub pollen generally increases after *c*7,350 BP, reaching a combined peak of 91% at *c*5,050 BP. This confirms Williams' (1977) findings that birch-hazel woodland dominated much of northern Trotternish during this time as it did many other areas of the Hebrides (Edwards & Whittington 1997).

8.1.6.2 Woodland development on the eastern shore of the Inner Sound

The expansion of woodland on the coastal fringes of Wester Ross was probably broadly similar to that on Skye, except for the suggestion that hazel might have colonised the Wester Ross coast before 9,500 BP. Unsurprisingly, *Ulmus* seems to have spread more quickly on the mainland than the Inner Hebrides, and is judged to have colonised eastern Applecross, eastern Skye and the Morar Peninsula by *c*8,500 BP (Williams 1977; Birks & Williams 1983; Birks 1989). *Quercus* on the other hand is not considered to have ever maintained a significant presence north of approximately Kintail, though fragmented oak stands do exist today at Coille Mhor on the Lochalsh peninsula, and around Edrachillis Bay in the far north-west. Considering this and the marginally less exposed location of the eastern shores, it seems reasonable to suggest that both oak and elm were better established here than on parts of Skye at equivalent latitude.

The colonisation of Wester Ross by *Pinus sylvestris* (Scots pine) is more contentious, particularly given the persistence of semi-natural pinewood at Shieldaig at the present day and the suggestion that pine may have originated from a refugium in this region put forward by Huntley & Birks (1983). In spite of the obvious early colonisation of the hinterland recorded by Birks (1972), Pennington *et al* (1972) and Kerslake (1982) at before *c*8,000 BP, *Pinus* is not detected in significant quantities at Loch Coultrie, just north of the head of Loch Kishorn, until after *c*6,000 BP (Birks 1989). This suggests that the domination by pine of the Shieldaig area might be a mid-Holocene phenomenon, associated with the brief expansion in eastern Skye after *c*4,600 BP.

Alnus glutinosa appears to have colonised much of western Scotland in the centuries prior to *c*6,000 BP, and the eastern shores on the Inner Sound are unlikely to have differed.

8.1.7 Discussion: Mesolithic human impact in the pollen record

8.1.7.1 Human impact during the transition to woodland

The first possible indication of human interference with the vegetation occurs during LPAZ CLE.Ic (*c*9,740–9,490 BP), when an expansion in *Alnus glutinosa* occurs in association with increases in *Pteridium aquilinum* and *Corylus avellana*, but it is of doubtful validity. Climatic and stratigraphic explanations for this phase have been discussed above, and the suggestion that anthropogenic burning may have encouraged alder by increasing run-off and expanding mineral wetlands (see Smith 1984; Chambers & Price 1985; Chambers & Elliott 1989; Hirons & Edwards 1990), and encouraged bracken by disturbing soils and reducing woodland cover was rejected. There is no increase in the C:P curve to suggest a rise in the incidence of burning. The lack of dated evidence for a Mesolithic presence anywhere in Scotland at this time casts further doubt on the likelihood that this episode represents human impact.

The colonisation of hazel in the British Isles, and whether its notable expansion prior to that of other thermophilous arboreal taxa was precipitated by Mesolithic interference or climate change, remained a contentious issue for several decades (Smith 1970), but present thought very much favours a climatic explanation for this phenomenon. High microscopic charcoal values coincident with the *Corylus* rise have been noted in a number of pollen diagrams outside Scotland (Edwards & MacDonald 1991), and Huntley (1993) puts this down to relative aridity of the British climate around this time. More recently, Tallantire (2002) suggested that hazel, already identified by Huntley as possessing greater toleration of climatic extremes than other tree taxa, may have been present before the expansion, but was not able to produce significant quantities of pollen until a thermal threshold had been reached.

Besides a fairly marked but short-lived peak in the C:P curve for Loch Cleat at *c*8850 BP, there is little evidence of increased burning in northern Skye coeval with hazel expansion, and the charcoal record for the phase of decisive hazel increase at Loch Cleat is characterised by the sparsest charcoal representation in the profile.

8.1.7.2 Broad scale human impact during the phase of woodland domination

The microscopic charcoal record for Loch Cleat during this period is relatively stable, remaining at what could be considered 'background' levels (Clark 1988). The exception to this occurs after *c*8,150 BP, when a series of isolated peaks in microscopic charcoal continue until a pronounced dip in charcoal fortunes at *c*6,900 BP. These highs in charcoal are possibly referable to a regional increase in microscopic charcoal in northern Scotland identified by Tipping (1996), who suggests a shift in the climatic regime to increased aridity which would encourage the natural burning of woodland (Bradshaw *et al* 1996; Brown 1997). There is nothing in the pollen record here to suggest management of woodland with fire.

The relatively high, stable charcoal values recorded at Digg after *c*7,950 BP is interpreted here as representing extra-local charcoal input as the bog becomes more open. The C:P curve suggests that more than 'background' levels of microscopic charcoal are entering the basin, and in the absence of evidence for disturbance in the pollen record, it may be that domestic fires from local settlement sites are responsible – the Mesolithic site of An Corran is only 2km distant across the bay and other potentially early sites were located by SFS around Staffin Bay (see Section 2.2).

8.1.7.3 Local human impact during the phase of woodland domination

The first possible instance of human interference in local vegetation occurs at Suarbie in the basal sample, where Lactuceae (dandelion group) pollen dominates at *c*9,150 BP, but again it is of doubtful significance. The assumption would be that the substrate has been disturbed, encouraging the spread of weed taxa (Behre 1981; Brown 1997; Davies & Tipping 2004). No microscopic charcoal was detected, however, and the age and associated taxa suggest that the inferred disturbance is a natural phenomenon. Supporting this is the fact that the basal sediments are more minerogenic, implying instability in the substrate, and encouraging the better representation of robust palynomorphs like Lactuceae.

The next phase of possible human impact occurs at Digg from *c*8,800–8,350 BP. This concerns high charcoal values, rising from negligible levels, which suggest a local increase in burning (Simmons & Innes 1996a & 1996b). The attendant changes in the local vegetation are very difficult to interpret, as changes in the vegetation on the peat surface probably affect the recruitment of both pollen and charcoal. The sustained charcoal maximum on its own however, is a convincing argument for localised non-autogenic burning, particularly given the dearth of charcoal directly prior to the increase (see Edwards 1990). The motives of those responsible for these proposed burning episodes remain obscure.

The disturbance episode coinciding with a peak in microscopic charcoal dated to *c*8,350–6,850 BP at Suarbie is perhaps the most convincing evidence for human interference in the local environment in this study. Several items of circumstantial evidence support the argument for woodland management, including the high charcoal maximum, a drying of the bog surface, a general expansion of herb taxa and the presence of taxa associated with disturbance. The interpretation favoured here is that a brief interlude of fire management took place, possibly to encourage game if not simple woodland removal.

8.1.8 The Mesolithic-Neolithic Transition

Typical indicators of an agricultural presence in pollen assemblages, such as cereal-type and *Plantago lanceolata* pollen, have been used to demonstrate possible precocious pre-elm decline pastoral management further south (Edwards & McIntosh 1988; Edwards 1989). However, there is little to indicate an early beginning to the Neolithic in the literature for the west of Scotland. Sheridan (2000) suggests that the advent of farming may have been an intrusive event that took place at an early date, based on the pottery comparisons from apparently early levels at the chambered tomb at Achnacreebeag, Argyll (Ritchie 1970), but this interpretation has been questioned by others (Thomas 2004), and it has been suggested that the Mesolithic continued until *c*5,000 BP, despite the possible detection of cereal pollen on Islay as early as 5,470 BP (Edwards & Berridge 1994).

The earliest environmental evidence for the beginnings of the Neolithic on Skye is a phase of woodland clearance at Loch Meodal dated to *c*5,200 BP (Williams 1977; Birks & Williams 1983). *Plantago lanceolata* is first detected at Digg and Suarbie at *c*5,230 BP, but not until *c*4,750BP at Loch Cleat, which is unusual given the regional pollen input at the latter site and the evidence for woodland clearance almost three centuries earlier. The elm decline itself is perhaps visible only at Loch Cleat, with *Ulmus* values falling after *c*5,050BP. The incidence of *Plantago lanceolata* at Suarbie and Digg is associated with increases in microscopic charcoal at both sites and an expansion of heath taxa at Digg, but no sites display convincing evidence of actual woodland clearance.

The post elm decline rise in charcoal is quite different from the charcoal decline seen at many sites (Edwards 1988 & 1990; Edwards & McIntosh 1988; Simmons & Innes 1988; Tipping & Milburn 2000). Apart from signifying an expansion in human populations during the Neolithic, it may be denoting a low level of landscape impact around the sites presented here during the late Mesolithic.