KINGSHOUSE

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OS Grid Reference: NN285555

Highlights

Pollen preserved in the sediments that infill a topographic depression nearKingshouse provide an important record, supported by radiocarbon dating, of vegetational history and environmental changes during the early and middle Holocene. A radiocarbon date from the basal organic sediments provides a minimum date for the deglaciation of Rannoch Moor at the end of the Loch Lomond Readvance.

Introduction

The Kingshouse site (NN 282555) is situated in the north-western part of Rannoch Moor near the heads of Glen Etive and Glen Coe, and lies approximately 2.25 km north-east of the Kingshouse Hotel at an altitude of *c.* 340 m OD. It is the second of three sites in the Kingshouse area studied by Lowe and Walker (1976), and is known as Kingshouse 2. The importance of the site lies partly in the fact that it contains a detailed record of vegetational changes in the Rannoch Moor area of the west-central Grampian Highlands during the early and middle Holocene, but principally in the sequence of radiocarbon dates obtained from the lowermost sediments. The age determination on the basal organic sediments is one of the earliest from a site inside the Loch Lomond Readvance limits and, if correct, provides a minimum date for the deglaciation of Rannoch Moor. Details of the stratigraphy of the site can be found in Lowe and Walker (1976, 1980) and in Walker and Lowe (1977, 1980).

Description

The site is a small enclosed basin (maximum dimensions 40 m by 25 m) which has been buried beneath blanket peat. Almost 4.5 m of sediment have accumulated at the deepest point. The basal sediment sequence is complex (Figure 10.14): coarse gravels and sand are succeeded upwards by laminated silt and fine sand, clay, a thin band of gyttja, fine sand with abundant remains of the terrestrial moss Rhacomitrium lanuginosum and fine–medium-grained sand with occasional moss fragments. This sequence is overlain by over 4 m of limnic, telmatic and terrestrial organic sediments. The lower inorganic sediments are essentially barren of pollen, but a pollen diagram has been constructed for the lower 2.35 m of the overlying organic sediments, and a single pollen count was obtained from the thin gyttja layer near the base of the profile (Figure 10.14). The diagram was divided into local pollen assemblage zones and these were integrated with pollen data from the nearby sites atKingshouse 1 and Kingshouse 3 to form a sequence of regional pollen asssemblage zones (R zones) for western Rannoch Moor (Walker and Lowe, 1977).

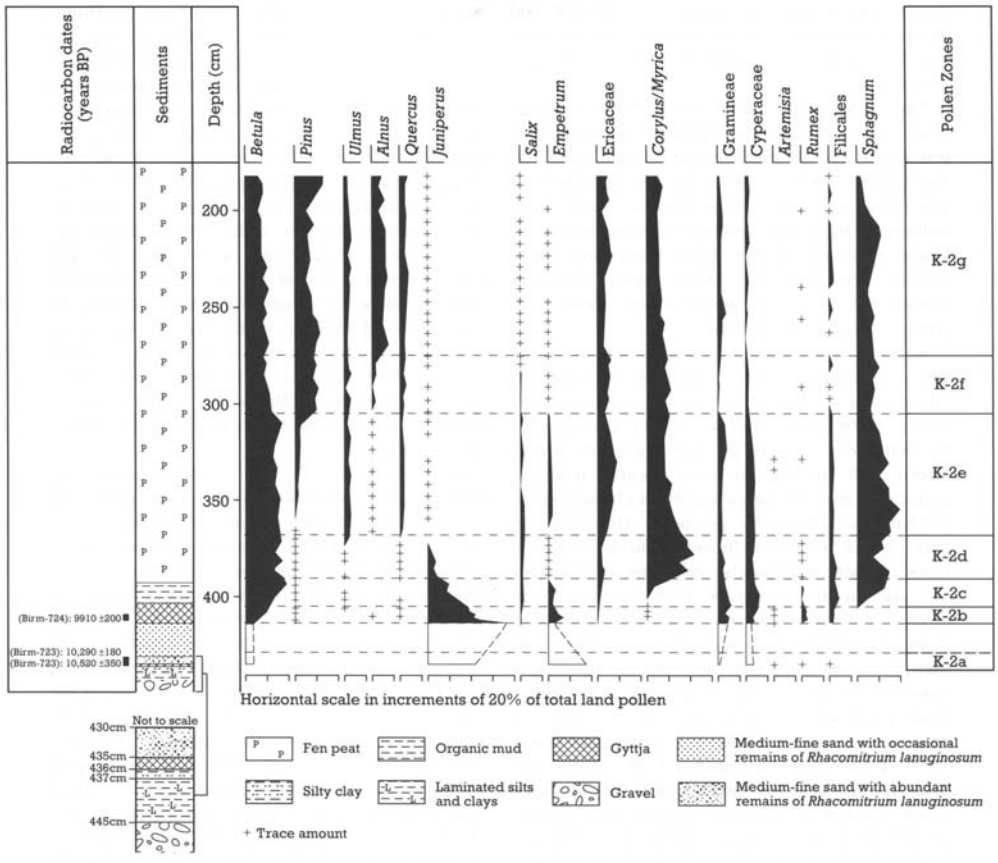

Figure 10.14: Kingshouse: relative pollen diagram showing selected taxa as percentages of total land pollen (from Walker and Lowe, 1977).

Three radiocarbon dates were obtained from the lowermost part of the Kingshouse 2 profile (Figure 10.14). The thin layer of gyttja within the basal sediments yielded a radiocarbon age of 10,520 + 330 BP (Birm-723), and a date of 10,290 + 180 BP (Birm-722) was obtained from fragments of moss, *Rhacomitrium lanuginosum,* in the fine sands above. The contact between these sands and the overlying organic sediments was dated at 9910 + 200 BP (Birm-724) (Lowe and Walker, 1976).

Interpretation

The earliest vegetational records reflect a landscape immediately following deglaciation of *Empetrum* heath and juniper scrub with patches of ground covered by a moss carpet or by grasses. Indeed, the high *Empetrum* and *Juniperus* pollen frequencies, in conjunction with the macrofossil evidence of *Rhacomitrium lanuginosum,* suggest vegetational affinities with the "Rhacomitreto–Empetretum' (Rhacomitrium–Empetrum heath) and *Juniperetum nanae* (dwarf juniper scrub) associations which are common in parts of the western and northern Scottish Highlands today (McVean and Ratcliffe, 1962). Subsequently, the *Empetrum* heath communities were invaded by *Juniperus communis* and then by tree birch. Following the arrival of *Betula*, the landscape of the area appears to have been a mosaic of birch copses and heath and moorland communities, separated by areas of grassland on the steeper slopes around the Rannoch basin (see also Walker and Lowe, 1979, 1981). The juniper maximum in the Kingshouse 2 profile has been dated at 9910 + 200 BP (Birm-724) and dates from other areas of Scotland suggest that tree birch would have been well established on western Rannoch Moor by 9000 BP (Birks, 1972b; Harkness and Wilson, 1979; O'Sullivan, 1976; Walker and Lowe, 1982, 1985).

The pollen records from the Kingshouse sites show that, following the period of open birchwoods, the landscape underwent further change with the arrival first of hazel (*Corylus avellana*) which expanded throughout Scotland early in the eighth millennium BP (Huntley and Birks, 1983), and subsequently with the immigration of woodland taxa including elm, oak, pine and, at a later date, alder. *Pinus* sylvestris and *Betula* appear to have formed the dominant

elements of the woodland cover during the middle Holocene, whereas *Ulmus* and *Quercus* were more restricted in their distribution. The continuous representation of Ericaceae and Gramineae throughout the middle Holocene part of the Kingshouse 2 profile suggests that areas of heath and grassland communities may have existed between the woodland stands, and on the upper slopes and plateau surfaces above the regional treeline. Radiocarbon dates from the Cairngorms (Birks, 1970; O'Sullivan, 1975, 1976) and from north-west Scotland (Birks, 1972b; Birks and Williams, 1983; Pennington *et al*., 1972; Williams, 1977) indicate that pine began to arrive in the Scottish Highlands soon after 8000 BP, that pine and birch forest was widely established by 7000 BP and that the woodlands were further diversified by the immigration of alder between 7000 and 6000 BP.

The radiocarbon date (Birm-722) obtained from the terrestrial moss fragments is particularly important, for although errors arising from the "hard-water effect' or from the incorporation of reworked mineral carbon residues may have influenced the dates obtained from organic mud/gyttja (Lowe and Walker, 1980; Sutherland, 1980; Walker and Harkness, 1990), such problems would not be encountered where moss constitutes the dating medium.

A more intractable problem arises from the discovery of "plateaux' of essentially constant 14C enrichment at around 10,000 BP (Ammann and Lotter, 1989; Zbinden *et al*., 1989). This appears to have been caused by fluctuations in atmospheric 14C production and clearly poses a major difficulty for the radiocarbon chronology at the Lateglacial/Holocene boundary. However, the date on the terrestrial moss sample from Kinghouse 2 falls outside the envelope of constant 14C age on the curves of Ammann and Lotter (1989). Moreover, the fact that the three dates from the profile are internally consistent and that there is a broad measure of agreement between the dates from Kingshouse 2 and those from comparable biostratigraphic horizons at other sites on Rannoch Moor (Walker and Lowe, 1979, 1980) may be significant. If correct, the dates point towards deglaciation of Rannoch Moor well before 10,000 BP and probably before 10,200 BP by which time *Empetrum* heath and juniper scrub had become widely established locally.

The data from Kingshouse 2 are important in a wider context. The contrast between the dwarf-shrub-dominated pollen assemblage at the base of the profile and the largely herbaceous pollen assemblages found in the lowermost horizons of kettle hole basins in the valleys to the east of Rannoch Moor points towards a pattern of time-transgressive deglaciation following the Loch Lomond Readvance ice maximum (Lowe and Walker, 1981), although strictly the basal pollen relate only to the time of melting of buried ice and not necessarily to regional deglaciation. Basal organic sediments from a site located behind the Loch Lomond Readvance moraine at Callander (see Mollands) have been dated at 10,670 + 85 BP (Lowe, 1978). If this age determination and those from Kingshouse 2 are correct, deglaciation from the Loch Lomond ice maximum may have been completed within around 300 years. However, a radiocarbon date of 10,560 + 160 BP (Q-2673) on organic detritus beneath till of the Loch Lomond Readvance at Croftamie (see below) to the north of Glasgow (Rose *et al*., 1988), suggests either marked spatial and temporal variations in the pattern of the Loch Lomond Readvance ice wastage, or significant errors in the available radiocarbon chronology. Nevertheless, studies have shown that the Rannoch basin was one of the major ice accumulation and dispersal centres in Scotland during the Loch Lomond Readvance and that, in view of the thick ice cover (over 400 m in places –Thorp, 1984, 1986), Rannoch Moor would have been one of the last localities in Scotland to be deglaciated following the readvance (see Sutherland, 1984a).

Kingshouse 2 is a site of considerable significance. In association with the neighbouring sites of Kingshouse 1 and Kingshouse 3, it provides a vegetational record for this area of the Grampian Highlands in the period immediately following the wastage of the last glaciers until the establishment of alder in the middle Holocene some 5000 years later. The site appears to lie near the western edge of former pine woodland and may prove to be useful in delimiting the ecotone between the middle Holocene birch–pine forests of the central Grampian Highlands and the birch and oak forests of the coastal lowlands to the west. Kingshouse 2 is most important, however, in the establishment of a chronology for deglaciation following the Loch Lomond Readvance. The radiocarbon date on the moss fragments is of particular significance and thus far is the only one obtained from plant macrofossil material from sites within the last glacier limits. In conjunction with the other age determinations from the site and from

elsewhere on Rannoch Moor, it may imply much earlier deglaciation following the Loch Lomond Readvance than has previously been assumed (Sissons, 1979e).

The pollen stratigraphy indicates the complex and rapid vegetational changes that occurred following deglaciation, and suggests that the environmental changes associated with ice wastage were rapid and large. Nowhere else in north-west Europe is the evidence for rapid deglaciation and climatic change so clearly developed as on Rannoch Moor (H.J.B. Birks, unpublished data).

Conclusions

Kingshouse is one of a number of sites that contribute significant evidence for interpreting the environmental changes that occurred at the end of the last ice age (around 10,000 years ago). It is particularly important for establishing the timing of deglaciation at the end of the Loch Lomond Readvance (approximately 11,000–10,000 years ago), the evidence suggesting that this may have occurred relatively earlier than has previously been assumed. The pollen preserved in the sediments at Kingshouse also provide a valuable record of subsequent vegetational development in the west-central Highlands in the period after glacier ice had melted.

Reference list

Ammann, B. and Lotter, A.F. (1989) Late-Glacial radiocarbon and palynostratigraphy on the Swiss plateau. *Boreas*, **18**, 109–26.

Birks, H.H. (1970) Studies in the vegetational history of Scotland I. A pollen diagram from Abernethy Forest, Inverness-shire. *Journal of Ecology*, **58**, 827–46.

Birks, H.H. (1972b) Studies in the vegetational history of Scotland III. A radiocarbon dated pollen diagram from Loch Maree, Ross and Cromarty. *New Phytologist*, **71**, 731–54.

Birks, H.J.B. and Williams, W. (1983) Late Quaternary vegetational history of the Inner Hebrides. *Proceedings of the Royal Society of Edinburgh*, **83B**, 269–92.

Harkness, D.D. and Wilson, H.W. (1979) Scottish Universities Research and Reactor Centre radiocarbon measurements III. *Radiocarbon*, **21**, 203–56.

Huntley, B. and Birks, H.J.B. (1983) *An Atlas of Past and Present Pollen Maps for Europe: 0–13,000 Years Ago*. Cambridge, Cambridge University Press, 667pp.

Lowe, J.J. (1978) Radiocarbon-dated Lateglacial and early Flandrian pollen profiles from the Teith Valley, Perthshire, Scotland. *Pollen et Spores*, **20**, 367–97.

Lowe, J.J. and Walker, M.J.C. (1976) Radiocarbon dates and deglaciation of Rannoch Moor, Scotland. *Nature*, **246**, 632–3.

Lowe, J.J. and Walker, M.J.C. (1980) Problems associated with radiocarbon dating the close of the Lateglacial period in the Rannoch Moor area, Scotland. In *Studies in the Lateglacial of North-west Europe* (eds J.J. Lowe, J.M. Gray and J.E. Robinson). Oxford, Pergamon Press, 123–38.

Lowe, J.J. and Walker, M.J.C. (1981) The early Postglacial environment of Scotland: evidence from a site near Tyndrum, Perthshire. *Boreas*, **10**, 281–94.

McVean, D.N. and Ratcliffe, D.A. (1962) Plant Communities in the Scottish Highlands. A Study of Scottish Mountain Moorland and Forest Vegetation. London, HMSO, 445pp.

O'Sullivan, P.E. (1975) Early and Middle-Flandrian pollen zonation in the Eastern Highlands of Scotland. *Boreas*, **4**, 197–207.

O'Sullivan, P.E. (1976) Pollen analysis and radiocarbon dating of a core from Loch Pityoulish, eastern Highlands of Scotland. *Journal of Biogeography*, **3**, 293–302.

Pennington, W., Haworth, E.Y., Bonny, A.P. and Lishman, J.P. (1972) Lake sediments in northern Scotland. *Philosophical Transactions of the Royal Society of London*, **264B**, 191–294.

Rose, J., Lowe, J.J., Switsur, R. (1988) A radiocarbon date on plant detritus beneath till from the type area of the Loch Lomond Readvance. *Scottish Journal of Geology*, **24**, 113–24.

Sissons, J.B. (1979e) The Loch Lomond Stadial in the British Isles. *Nature*, **280**, 199–203.

Sutherland, D.G. (1980) Problems of radiocarbon dating deposits from newly deglaciated terrain: examples from the Scottish Lateglacial. In *Studies in the Lateglacial of Northwest Europe* (eds J.J. Lowe, J.M. Gray and J.E. Robinson). Oxford, Pergamon Press, 139–49.

Sutherland, D.G. (1984a) The Quaternary deposits and landforms of Scotland and the

neighbouring shelves: a review. *Quaternary Science Reviews*, **3**, 157–254.

Thorp, P. (1984) The glacial geomorphology of part of the western Grampians of Scotland with especial reference to the limits of the Loch Lomond Advance. Unpublished PhD thesis, City of London Polytechnic.

Thorp, P.W. (1986) A mountain icefield of Loch Lomond Stadial age, western Grampians, Scotland. *Boreas*, **15**, 83–97.

Walker, M.J.C. and Harkness, D.D. (1990) Radiocarbon dating the Devensian Lateglacial in Britian: new evidence from Llanilid, South Wales. *Journal of Quaternary Science*, **5**, 135–44.

Walker, M.J.C. and Lowe, J.J. (1977) Postglacial environmental history of Rannoch Moor, Scotland. I. Three pollen diagrams from the Kingshouse area. *Journal of Biogeography*, **4**, 333–51.

Walker, M.J.C. and Lowe, J.J. (1979) Postglacial environmental history of Rannoch Moor, Scotland. II. Pollen diagrams and radiocarbon dates from the Rannoch Station and Corrour areas. *Journal of Biogeography*, **6**, 349–62.

Walker, M.J.C. and Lowe, J.J. (1980) Pollen analyses, radiocarbon dates and the deglaciation of Rannoch Moor, Scotland, following the Loch Lomond Advance. In *Timescales in Geomorphology* (eds R.A. Cullingford, D.A. Davidson and J. Lewin). Chichester, John Wiley, 247–59.

Walker, M.J.C. and Lowe, J.J. (1981) Postglacial environmental history of Rannoch Moor, Scotland. III. Early- and mid-Flandrian pollen stratigraphic data from sites on western Rannoch Moor and near Fort William. *Journal of Biogeography*, **8**, 475–91.

Walker, M.J.C. and Lowe, J.J. (1982) Lateglacial and early Flandrian chronology of the Isle of Mull, Scotland. *Nature*, **296**, 558–61.

Walker, M.J.C. and Lowe, J.J. (1985) Flandrian environmental history of the Isle of Mull, Scotland. I. Pollen-stratigraphic evidence and radiocarbon dates from Glen More, south-central Mull. *New Phytologist*, **99**, 587–610.

Williams, W. (1977) The Flandrian vegetational history of the Isle of Skye and the Morar Peninsula. Unpublished PhD thesis, University of Cambridge.

Zbinden, H., Andrée, M., Oeschger, H., Ammann, B., Lotter, A., Bonani, G. and Wölfli, W. (1989) Atmospheric radiocarbon at the end of the last glacial: an estimate based on AMS radiocarbon dates on terrestrial macrofossils from lake sediments. *Radiocarbon*, **31**, 795–804.