Loch Etteridge

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Highlights

Pollen grains preserved in the sediments on the floor of Loch Etteridge provide an important record, supported by radiocarbon dating, of glacial history, vegetational history and environmental change during the Lateglacial and early Holocene in the eastern Grampian Highlands. The site also includes an excellent assemblage of glaciofluvial landforms formed during the melting of the Late Devensian ice-sheet.

Introduction

Loch Etteridge [NN 688 929] is located in Glen Truim, a tributary of upper Strathspey. The site occurs at an altitude of 300 m OD, approximately 5 km south-west of Newtonmore. It is important in the context of the Devensian Lateglacial in northern Britain. The sediments preserved on the floor of the loch contain a record of vegetational changes in the Grampian Highlands throughout the Lateglacial and early/middle Holocene, and the radiocarbon assay from the base of the sequence provides a minimum date for the wastage of the Late Devensian ice-sheet from the surrounding area. In addition, stratigraphic data from Loch Etteridge and from the nearby site of Drumochter form the basis for the establishment of a Late Devensian glacial chronology for this part of the Scottish Highlands. The central location of Loch Etteridge in the heart of the Grampian Highlands means that the lithostratigraphic, biostratigraphic and chronostratigraphic evidence from the site are of national significance in terms of both vegetational history and glacial chronology. The radiocarbon dates from Loch Etteridge are discussed in Sissons and Walker (1974), and the palaeoenvironmental data are described in Walker (1975a).

Description

Loch Etteridge lies in a large, dead-ice hollow and is surrounded by a complex system of kames, kame terraces and eskers (Young, 1978). The kame terraces, which slope from *c.* 310–240 m OD towards the north-east along the valley of the Milton Burn (Figure 9.10), contain small kettle holes and comprise rounded cobbles and boulders in a coarse sand matrix (Young, 1978). Kames and eskers occur principally at lower altitudes and often merge into the kame terraces; the eskers are steep, narrow ridges, ranging in height from 1 to 15 m (Young, 1978). According to Young (1978) the kame terraces formed at the margins of the melting ice-sheet.

The loch, which measures approximately 500 m in length and up to 150 m in width, is infilled at the south-west end, where over 7 m of sediment have accumulated. The lowermost sediments show a typical Lateglacial lithological sequence (Sissons *et al.,* 1973) comprising, from the base, gravels, grey silt/clay, green-grey silt/clay, green-brown gyttja, and light grey silt/clay (Figure 9.11). The last named deposits represent the Loch Lomond Stadial, while the underlying sediments are of Lateglacial Interstadial age. These Lateglacial deposits are overlain by Holocene lake muds and peats. Four radiocarbon dates (SRR–301 to SRR–304) were obtained from the Loch Etteridge sediments (Figure 9.11).

The base of the organic sediments in the profile was dated at 13,151 ± 390 BP (SRR–304), the Lateglacial *Empetrum* maximum at 11,290 165 BP (SRR–303), the onset of the Loch Lomond Stadial at 10,674 ± 120 BP (SRR–302) and the close of the Loch Lomond Stadial at 9405 ± 260 BP (SRR–301); the last age determination now appears to be at least 1000 years too young when compared with dates on similar horizons at other Scottish sites (Lowe and Walker, 1984).

Interpretation

Five local pollen assemblage zones were identified in the Lateglacial sediments at Loch Etteridge (Figure 9.11). The lowermost (zone LE–1) is characterized by high values for *Rumex* and *Salix* (including *Salix herbacea*), with significant percentages of Gramineae, *Saxifraga* and *Artemisia.* These pollen spectra are indicative of an open-habitat landscape with a limited shrub component. In the next three zones (LE–2, LE–3, LE–4) there are higher counts of pollen of shrubby, woody plants. The dominant element is *Empetrum,* reflecting the widespread development of *Empetrum* heath in Strathspey during the Lateglacial Interstadial (see also Birks and Math-ewes, 1978). There are two maxima in the *Empetrum* curve, one at the initial rise in values for the genus and a secondary peak at the close of the interstadial. Similar double maxima for *Empetrum* have been recorded in Lateglacial Inter-stadial deposits at Loch Tarff near the Great Glen (Pennington *et al.,* 1972), and at Tirinie in Glen Fender to the south of the Grampian watershed (Lowe and Walker, 1977). The episodes of *Empetrum* dominance are separated by a zone (LE–3) in which there are higher values of *Juniperus* and *Betula.* The majority of the birch grains appear to be from dwarf birch, however, and it seems unlikely that the regional birch treeline reached this area of the Grampians during the Lateglacial (Walker, 1984b). Isolated stands of tree birch may have become established late in the interstadial, however, an inference supported by the discovery of tree birch macro-fossils in late interstadial sediments at the nearby site of Abernethy Forest (Birks and Mathewes, 1978). *Salix* pollen is found at all levels representing the interstadial, reflecting the presence of shrub willows (probably such northern forms as *S. polaris, S. reticulata* or *S. glauca*)on the slopes around the Loch Etteridge basin. The occurrence of *Rumex* as an important element in the pollen spectra is indicative of the incomplete nature of the shrub-heath cover, and the continued presence of bare and disturbed ground throughout the Lateglacial Interstadial.

The Lateglacial Interstadial pollen records from Loch Etteridge and Abernethy Forest, which show the development of a shrub tundra dominated by *Empetrum* with *Betula nana* and *Salix,* are in marked contrast to those obtained from sites in the eastern and southern Grampian Highlands. In those areas the pollen data reflect an interstadial vegetation cover of moss heaths and poor grassland communities on the upper slopes, whereas a closed grassland with juniper, dwarf birch, willow, and stands of tree birch developed on the lower slopes and valley floors. Extensive copses of tree birch may have been found in more sheltered localities of the southern valleys (Walker, 1975b, 1977; Lowe and Walker, 1977; Lowe, 1978; Merritt *et al.,* 1990).

Sediments formed during the Loch Lomond Stadial at Loch Etteridge are characterized by a relatively low pollen content, uniformly low counts for woody taxa, and the virtual absence of pollen of thermophilous plants. Open-habitat taxa dominate the pollen spectra (zone LE–5), notably *Artemisia* and *Rumex,* along with species of Caryophyllaceae, Chenopodiaceae and *Saxifraga. Betula* cf. *nana* and *Salix cf. herbacea* are also recorded. An arctic-alpine tundra landscape is indicated, with large areas of bare ground and skeletal soils, intermittent snowbeds, and widespread gelifluction. Of particular significance are the very high counts for *Artemisia* pollen. This is a characteristic feature of Loch Lomond Stadial sediments at other sites in the area (Birks and Mathewes, 1978; MacPherson, 1980), but is found in much lower frequencies at sites in the eastern and south-eastern Grampians (Walker, 1975b, 1977; Lowe and Walker, 1977). In view of the known chionophobous and xerix affinities of many species of *Artemisia,* this has led to the suggestion that a relatively arid climatic regime prevailed in upper Strathspey during the Loch Lomond Stadial (Birks and Mathewes, 1978), whereas in the south-eastern Highlands the spread of *Artemisia* was restricted by snowbeds and higher soil moisture levels (Walker, 1975b). This inference has been supported by palaeo-climatic reconstructions based on glaciological evidence which indicate heavier snowfall in the eastern Grampians brought by winds from the south-east (Sissons and Sutherland, 1976). The initially low frequencies for *Artemisia* pollen in the Loch Lomond Stadial sediments at Loch Etteridge, however, may also reflect changes in snow cover/precipitation levels during the stadial (MacPherson, 1980; Lowe and Walker, 1986a), with heaviest snowfall being implied during the early and later parts of the stadial, related to the initial southward and subsequent northward migration of the oceanic Polar Front (Sissons, 1979d; see also Tipping, 1985).

Of the radiocarbon age determinations, that on the basal organic sediments is the most significant. As the date was obtained from a bulk sample of organic lake mud, the possibility of an ageing effect produced by the hard-water factor or by contamination by older mineral carbon residues cannot be excluded (Sutherland, 1980; Walker and Harkness, 1990). However, the date is comparable with those obtained from the base of a number of Scottish Lateglacial profiles (Bishop, 1963; Kirk and Godwin, 1963; Pennington, 1975b; Lowe and Walker, 1977; Vasari, 1977; Walker and Lowe, 1982) and, if correct, supports the concept of climatic amelioration in the Lateglacial Interstadial at or before 13,000 BP (Coope, 1975,

1977; Atkinson *et al.,* 1987). By that time, Late Devensian glacier ice had disappeared from upper Strathspey and, by implication, from much of the Grampian Highlands. Whether Scotland was completely deglaciated during the Lateglacial Interstadial (Sissons, 1974c, 1976b; Sissons and Walker, 1974), however, remains a matter for conjecture (Sutherland, 1984a).

The stratigraphy and pollen content of the sediments at Loch Etteridge and the nearby site of Drumochter have implications for the Late Devensian glacial sequence in this part of the Grampian Highlands. As Loch Etteridge contains a suite of Lateglacial sediments, the surrounding glaciofluvial landforms (Young, 1978) must be the product of the decay of the Late Devensian ice-sheet. To the south and east of the site, however, readvance limits have been identified (Sissons, 1974b) relating to outlet glaciers from a later ice-cap which developed on the Gaick Plateau. The most clearly defined of these limits occurs some 13 km to the south of Loch Etteridge, where a series of hummocky moraines terminates abruptly and is succeeded by outwash. A deep kettle hole within the hummocky moraines on the Drumochter Pass contains only Holocene sediments (Walker, 1975a). The pollen records from sediments 'inside' and 'outside' the glacier limits, therefore, suggest that these readvance limits date from the Loch Lomond Stadial (see Mollands and Tynaspirit).

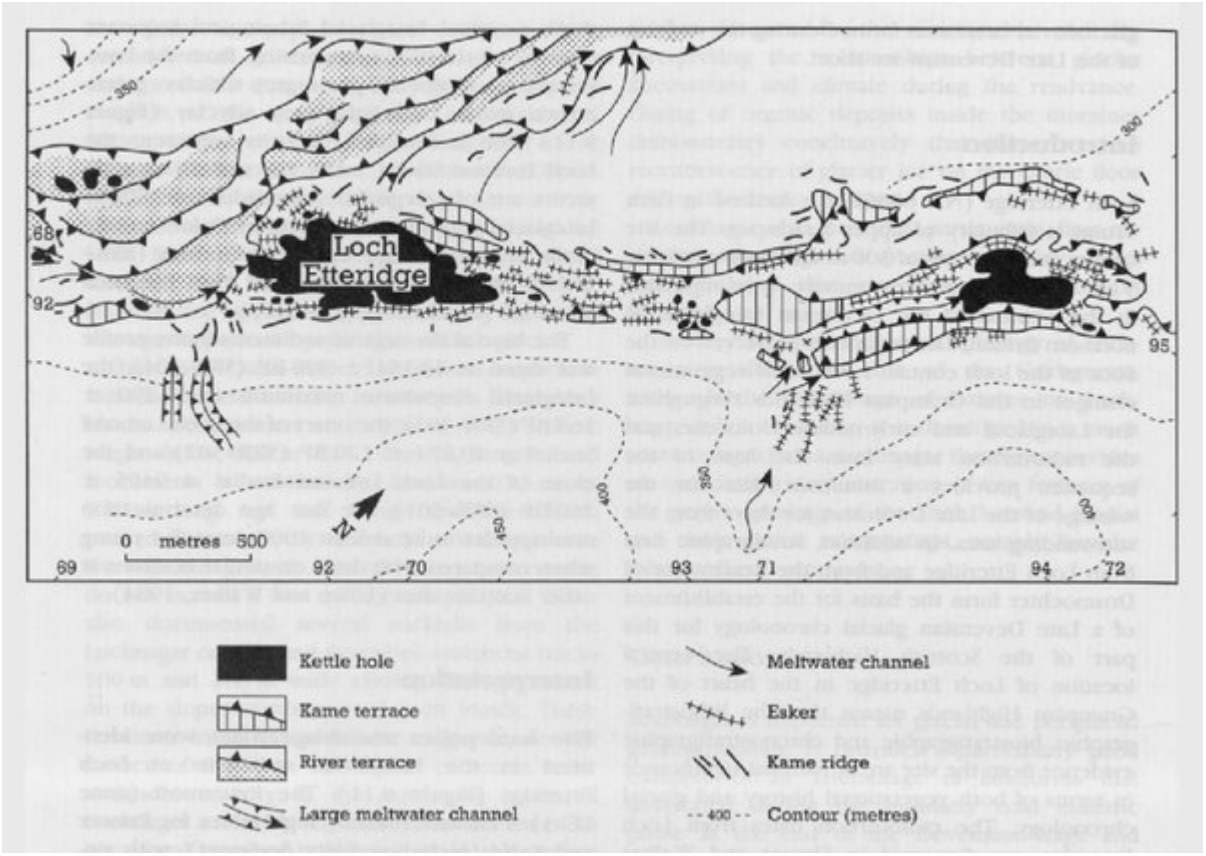
Loch Etteridge contains a record of environmental change in the central Grampians throughout the Lateglacial period, the palynological data providing the basis for both vegetational and climatic reconstructions. The site occupies a critical position immediately to the north of the Highland watershed and is a key element in a network of sites that together provide a regional pattern of landscape change in the Grampian region throughout the Lateglacial. Loch Etteridge is also an important element in the establishment of a glacial chronology for the Grampian Highlands, the radiocarbon date from the base of the profile providing a minimum age for the disappearance of Late Devensian ice from much of the Scottish Highlands and, by implication, from the British Isles as a whole.

The site is also notable for glacial geomorphology. It provides an excellent assemblage of glaciofluvial landforms associated with the de-glaciation of the Late Devensian ice-sheet. In a relatively compact area eskers, kame terraces, kames and kettle holes are all represented.

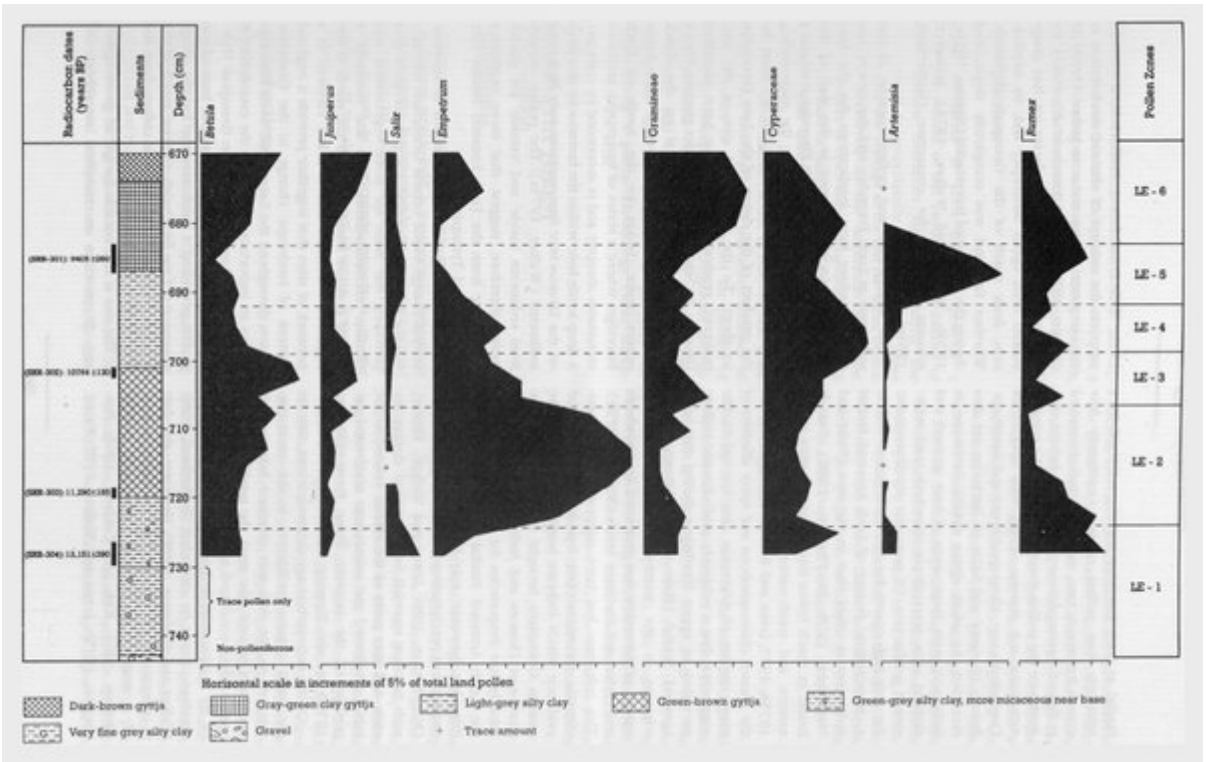
Conclusion

The sediments at Loch Etteridge provide a valuable record of the environmental history of the eastern Grampian Highlands during the Lateglacial (approximately 13,000–10,000 years ago), after the wastage of the last ice-sheet. Pollen grains preserved in the sediments show the development of open-habitat vegetation, followed by the spread of heath and shrubs with some tree birch. Open habitat species then became dominant again as climate deteriorated during the Loch Lomond Stadial (about 11,000–10,000 years ago). Loch Etteridge is an important member of the network of sites that record the pattern of landscape changes during the Lateglacial, providing valuable comparisons with sites in the southern and eastern Grampians. It is also significant for the evidence it provides for establishing a glacial chronology (time framework) for the area.

References



(Figure 9.10) Geomorphology of the Loch Etteridge area (from Young, 1978).



(Figure 9.11) Loch Etteridge: relative pollen diagram showing selected taxa as percentages of total land pollen. The samples for radiocarbon dating were taken from comparable lithostratigraphic horizons in an adjacent core.