Round Loch of Glenhead

V.J. Jones and A.C. Stevenson

Highlights

Pollen and diatoms preserved in the sediments of the Round Loch of Glenhead provide a valuable record of vegetational history and environmental change during the Holocene. The diatom record, in particular, allows the impact of lake acidification during the industrial period to be placed in the context of longer-term trends during the Holocene.

Introduction

The Round Loch of Glenhead [NX 450 804] is situated on the Loch Doon granite mass, some 5 km north-north-west of Loch Dee, at an altitude of 295 m OD. To the north and north-east of the loch steep cliffs rise up to Craiglee (531 m OD). The land to the south and south-west of the loch is less steep and the twin loch, the Long Loch of Glenhead, is separated by gently undulating land to the north-west.

The sediments in the Round Loch of Glenhead provide not only a detailed radiocarbon-dated history of Holocene vegetation for the Galloway hills in south-west Scotland, but also demonstrate the relationship between catchment vegetation change and lake water quality. A detailed study of the Round Loch of Glenhead and its catchment has been made by Jones (1987) and Jones *et al.* (1986, 1989).

Description

The majority of the catchment (area 0.95 km^2) is covered by a thin deposit of blanket peat. Peats, over 5 m deep in places, occur in small valley depressions. Two transects across the depressions were selected for a radiocarbon and palaeoeco-logical study into peatland initiation and development (Jones, 1987). As in the Loch Dungeon study, analysis of pollen from peat profiles enables a picture of local vegetational change to be contrasted with regional changes obtained from the lake sediment. At present, peat hags are found in the catchment.

A core (RLGH3) was obtained from the deepest part of the loch (13 m). A Lateglacial sequence of two clay layers separated by an organic mud corresponding to the Lateglacial Interstadial occurs below a depth of 2.27 m (Figure 18.7). The Holocene sediments above are relatively uniform, with loss-on-ignition values of 20–30%. However, there was a change in the sediment type above 0.47 m in the core to a blackish, fine detritus mud with higher loss-on-ignition values (40–50%). From the core, a series of 20 radiocarbon dates has been obtained (Figure 18.7) which shows a conformable sequence from 9280 ± 80 BP (SRR–2821) to 3970 ± 70 BP (SRR–2815). After the last date, erosion of organic material from the catchment occurred, resulting in reworking and ages older than expected. This problem was intensified at about AD 1600 with the onset of a major phase of peat erosion in the catchment (Stevenson *et al.,* 1990).

From the peat profiles, ten radiocarbon dates of the basal peats show that peat accumulation began in wet hollows early in the Holocene; for example a date of 9390 ± 60 BP (SRR–2865) was found at one site. On the better drained slopes peat accumulation began later, for example at 5450 ± 40 BP (SRR–2871), and it is probable that the shallow blanket peats which cover the majority of the catchment began to form at that time.

Interpretation

For the loch, six local pollen assemblage zones were defined (Figure 18.7) which can be correlated with the five regional zones of Birks (1972a). Early in the Holocene an open juniper-dominated community colonized the mineral soils, and birch and hazel invaded by about 9000 BP (Figure 18.7). Oak, elm and pine became much more important by about 8600 BP when it is likely that birch became restricted to the more acidic, wetter soils in the catchment. The importance of pine was short lived with values reaching a peak at about 7350 BP, a pattern characteristic of many pollen diagrams derived from sites in south-west Scotland. From 7650 BP there was a rise in *Alnus* pollen which remained important, along with *Quercus* and *Ulmus,* to about 5400 BP. From 5400 to 4200 BP there is evidence of progressive podsolization and peat expansion, although an elm, oak and alder woodland still persisted, with open areas of peaty soils and some *Calluna* as an understorey. There is also evidence of anthropogenic effects, as disturbance indicators such as *Plantago laeolata* and *Rumex* become more important. The elm decline is not clearly distinguished in this core, although *Ulmus* values fell at about 4200 BP.

In sediments deposited after 4200 BP the total tree pollen falls suddenly, marking the rapid disappearance of the forest cover from the area. The forest was replaced by a blanket mire community probably dominated by *Calluna, Molinia, Eriophorum* and *Trichophorum.* This change was associated with the erosion of catchment soils, possibly caused by anthropogenic activity. Peatland communities continued to dominate the vegetation of the area until the present day.

Pollen analysis on the peat in 10 cores and a 5.12 m profile (S18) was used to define 7 local pollen assemblage zones (Figure 18.8) (Jones, 1987). Organic sedimentation began early in the Holocene in wet hollows where nutrient-rich water existed. Aquatic taxa, such as *Nymphaea, Isoetes, Myriophyllum and Typha,* are found together with indicators of an open *Betula–Juniper–Salix* scrub (Figure 18.8). Hazel invaded the surrounding area shortly after 9400 BP. By about 8800 BP open-water conditions ceased to exist and there was an expansion of elm and oak woodland into which pine and alder later invaded. Initially, the rate of peat growth was slow, but as conditions became more ombrotrophic between 4700 and 3500 BP more rapid accumulation occurred. After about 4000 BP there was a major expansion of *Calluna,* and *Narthecium* pollen appeared in substantial amounts. Values of Cyperaceae and *Sphagnum* also increased as peatland growth swamped the woodland. The peatland community formed at this stage continued to be important until the present day.

A pH curve was constructed based on the analysis of diatoms in the lake sediments. The lake was acid in the Lateglacial (pH 5.3–5.7) and the early Holocene (pH 5.3–5.9) and remained at a pH of 5.3–5.7 until about 4000 BP. This is unusual since at most sites in the British Isles an early alkaline flora was found to be replaced by more acid-loving species as soil acidification took place. Because the lake is on granite bedrock with little till, the lake and catchment initially had a low buffering capacity, and soils formed in the catchment were probably low in cations and acidified rapidly. The initial development and the subsequent expansion of peats in the catchment also had no apparent acidifying effect on the lake, the pH of which remained between 5.3 and 5.8 (Jones *et al.,* 1986).

Modern changes in the pH of the Round Loch of Glenhead are quite clear. From about AD 1840, pH started to fall with a major decline from AD 1900 to the present-day pH of 4.7 (Battarbee and Flower, 1985). Both the diatom assemblages and the range of reconstructed pH values found in the recent period are unique in the history of the lake. The recent acidification is associated with heavy-metal and soot-particle evidence for the deposition of atmospheric pollutants, and the lake lies in an area known to be affected by acid deposition (Battarbee *et al.,* 1989; Jones *et al.,* 1990). As a naturally acid lake the Round Loch of Glenhead was unable to counter the effects of industrial emissions and acidified rapidly.

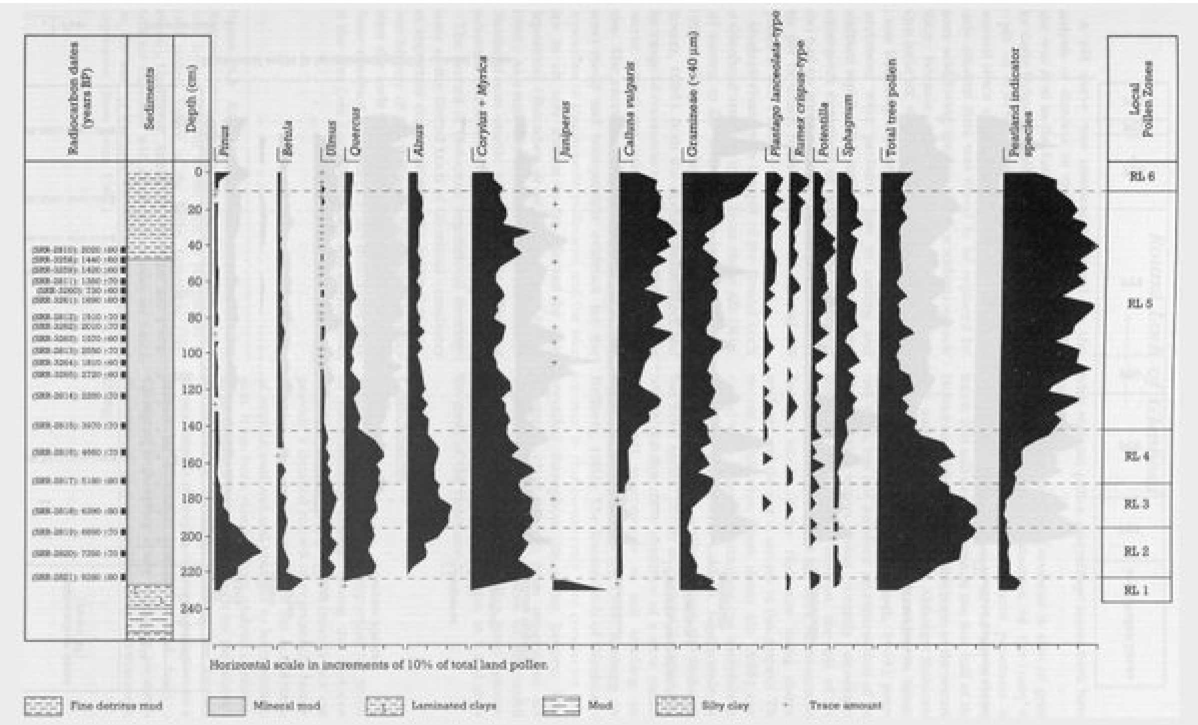
The record of Holocene vegetational development at the Round Loch of Glenhead constitutes an important contribution to the regional vegetation history of the Galloway hills. Pollen profiles from the loch and catchment peats complement those obtained by Birks (1972a) from other sites in the area (see Loch Dungeon), and correlations with regional pollen assemblage zones have been made.

The Round Loch of Glenhead is also of great importance in the evaluation of the role of vegetation and soil development processes *in* lake acidification. The history of the site involved forest and soil development in the first half of the Holocene, widespread paludification in the second half, and recent peat erosion. Although Holocene diatoms have been studied elsewhere in Britain (e.g. Round, 1957, 1961; Haworth, 1969), previous work has not involved reconstruction of the pH of lake waters using recently developed statistical methods. In contrast, the pH of the Round Loch of Glenhead has been reconstructed for the whole of the Holocene using diatom analysis, and the site is unique in this respect. The recent acidification (from about AD 1840) associated with industrial emissions can therefore be placed in a long-term context. Significantly, no trend of increasing acidity through the Holocene has been found. This is in contrast to other sites where diatoms show evidence of a slow natural fall in pH in response to soil leaching and acidification (Round, 1957, 1961; Renberg and Hellberg, 1982). The Round Loch of Glenhead is unusual in that consistently acid conditions have prevailed throughout its entire history. Thus, despite a clear change from mineral to acid organic soils in the catchment in the middle Holocene, feedback mechanisms have operated to maintain a loch with pH stable at 5 and above for most of the Holocene.

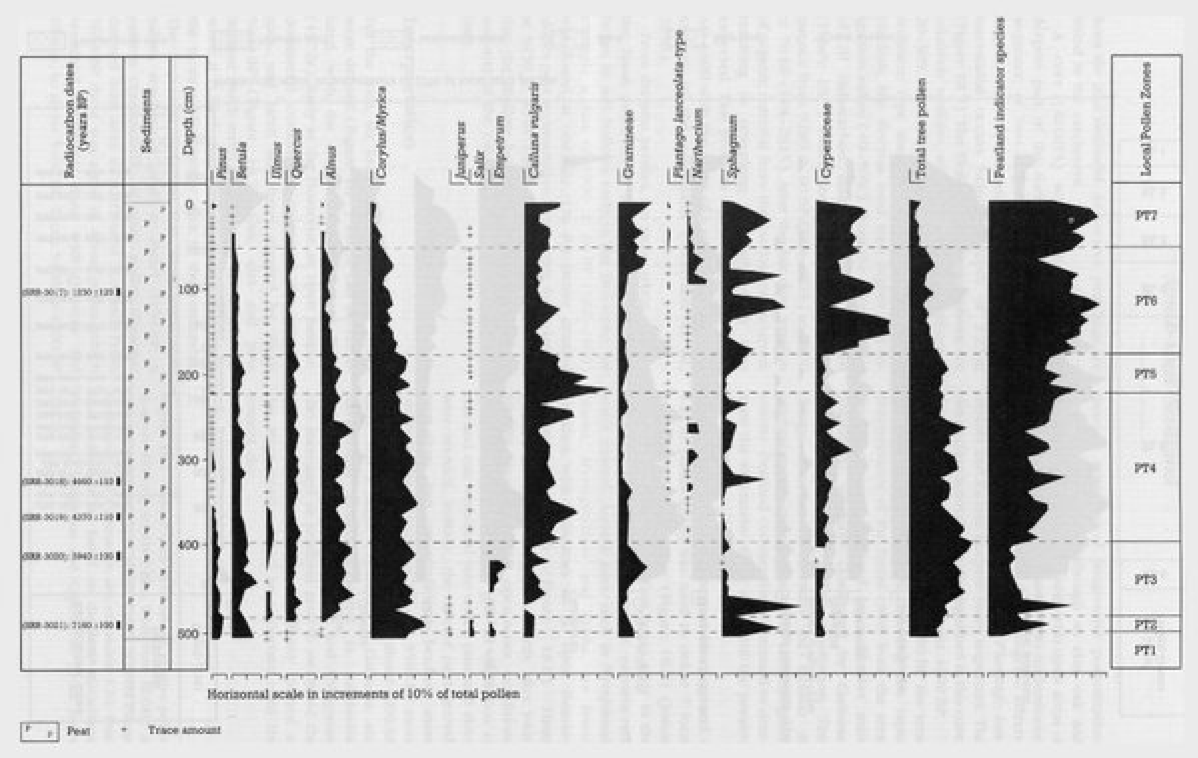
Conclusion

Round Loch of Glenhead is important for studies of environmental change during the Holocene (the last 10,000 years). The sediments not only provide a detailed record of vegetational history, but also allow an assessment of the contribution of vegetational and soil changes to loch acidification. It has been possible from analysis of diatoms to reconstruct the pH of the loch for the whole of the Holocene, therefore enabling the environmental impact of recent industrial pollution to be placed in a wider context. Round Loch of Glenhead is therefore a key reference locality in the network of sites for Holocene environmental change.

[References](#)



(Figure 18.7) Round Loch of Glenhead: relative pollen diagram showing selected taxa from core RLGH3 as percentages of total land pollen. Values of herbs except Gramineae and Cyperaceae are expanded X 10. Peatland indicators are based on the sum of Calluna, Potentilla, Sphagnum and Cyperaceae (from Jones, 1987).



(Figure 18.8) Round Loch of Glenhead: relative pollen diagram showing selected taxa from core S18, from a peat deposit adjacent to the loch, as percentages of total pollen. Values of the herbs, Gramineae (4049 p.m), Liguliflorae, Artemisia, Cruciferae and Potentilla are expanded x 10. Peatland indicators are based on the sum of Calluna, Potentilla, Sphagnum and Cyperaceae (from Jones, 1987).