Gormire

[SE 503 832]

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Introduction

Gormire is a small lake on the south-western fringe of the North York Moors. It is important for preserving a long sequence of Late Devensian and Holocene sediments, which have been investigated by Blackham *et al.* (1981) using pollen and plant macrofossil analyses. Recent research has been undertaken under the Land Ocean Interaction Study (LOIS) research project (NERC, 1999; Oldfield *et al.,* 1999) on magnetic signals of sediment sources to the lake by Barlow (1998), on organic geochemistry by Fisher (1999) and on pollen analyses of recent sediments by Morriss (2001). The origin of the landform containing the lake has been discussed by Kendall and Wroot (1924).

Description

Gormire Lake, North Yorkshire lies at about 150 m OD at the edge of the Hambleton Hills escarpment of the south-western North York Moors at Whitestone Cliff, about 7 km to the east of Thirsk at the eastern edge of the Vale of York. It occupies a depression in probably morainic glacial deposits at the foot of the scarp slope of Sutton Bank and is enclosed to the west by the arcuate ridge of Gormire Rigg (Figure 8.47). The site's location corresponds exactly to the limit of Devensian glacial ice in this part of the Vale of York, as the ice stream, reaching to about 200 m OD, failed to overtop the major upland escarpment (Hemingway, 1993). The origin of the depression is uncertain, but Kendall and Wroot (1924) suggested that it probably represents a lateral drainage channel formed at the ice margin and dammed in the Late-glacial period by a landslip of glaciogenic material from the steep escarpment slopes. If so, the slumped material must today represent the lower sill at the southeast corner of the site. Smaller channels run parallel to the main one, and these probably also originated as meltwater drainage features. Gormire Rigg and Sutton Bank, the slopes that enclose the site, support dense deciduous woodland, with Garbutt Wood on Sutton Bank, a Nature Reserve, perhaps of great age.

Blackham *et al.* (1981) surveyed the lake and found the deepest, central area to have a flat muddy bottom at about 6 m in depth. They recovered three cores for analysis, two (A and B) from the deep central area and one (C) from an area of marginal swamp in the north-east corner of the basin. The short marginal core C was over 4 m in length but was used only to record stratigraphy. It contained alternating coarse detritus mud and brown lake mud with a layer of grey clay in the upper metre and a surface moss peat. Core A was 10 m in length, collected from beneath 6 m of water, and was used for stratigraphical, pollen and plant macrofossil analyses (Figure 8.48). Core B was 2.73 m long (Figure 8.49) and was used for stratigraphical, pollen and magnetic susceptibility analyses. Core A consisted of 6 m of brown lake mud overlying grey clay, whereas core B contained clastic elements within its brown lake mud sequence, in particular a high clay fraction between 1.00 m and 1.70 m depth and a sandy clay unit that occupied most of the upper 0.30 m.

Pollen analyses of the basal grey clay unit in core A showed the lower part to be dominated by Cyperaceae, with lesser frequencies of *Gramineae, Juniperus, Betula nana* and *Lycopodium selago. Juniperus* increases in frequency in the upper part of this clay and *Salix* becomes important, as do a range of herbs including *Artemisia, Filipendula* and Chenopodiaceae. No plant macrofossils were recorded in the clay. In contrast the overlying lake muds are characterized by post-glacial forest tree pollen. *Betula, Ulmus* and *Corylus/Myrica* initially are most abundant, and are joined at *c.* 5 m depth by *Quercus* and *Alnus.* High *Potamogeton* values occur. The upper 2 m of the core show declines in tree pollen values, including *Ulmus,* rises in Gramineae and Cyperaceae and the introduction of herbaceous indicators of forest clearance, such as Chenopodiaceae and *Plantago lanceolata* and, above *c.* 1 m, Cerealia type. Plant macrofossils in the lake mud were mostly *Betula, Quercus* and *Salix,* with some *Hypnum* and *Pohlia* mosses and many unidentifiable monocot remains.

The pollen record from core B also is dominated by tree and shrub pollen, although *Ulmus* is low from the start, until the clayey lake mud horizon in mid-profile, during which herbaceous pollen values increase considerably. Gramineae, Cyperaceae, *Plantago, Rumex,* Leguminosae and *Artemisia* all reach peak values. Tree and shrub pollen return to dominance in the upper profile, although less so than below the clay-rich horizon. Magnetic susceptibility values peak within the clay-rich layer and in the near-surficial sandy clastic unit.

Barlow (1998) has examined the recent sediments of Gormire lake in six cores that could be correlated consistently in detail using magnetic measurements. These, allied to ^{210}Pb and ^{137}Cs profiles, indicated a relatively undisturbed area of sedimentation over much of the bed of the lake, which allowed reliable estimation of mineral sediment accumulation and catchment yields using rates extrapolated from the ^{210}Pb chronology. Mineral sediment influx rates for the period since AD 1630 were measured in this way and showed a doubling of the rate of sediment input from erosion in the small lake catchment since 1949 (Oldfield *et al.,* 1999). During this project (NERC, 1999) the whole of the Holocene sedimentary record at Gormire has been subjected to a range of environmental analyses (Barlow, 1998; Fisher, 1999; Oldfield *et al.,* 1999) of its chemical, physical and magnetic properties and the microfossil record. A radiocarbon chronology has been established. Oldfield *et al.* (1999) have presented geochemical and pollen data plotted against 'Hard' IRM and ARM/SIRM percentage magnetic values. They found that peak ARM/SIRM values coincide with high concentrations of the biophilic elements calcium and bromine and maximum tree pollen percentages, whereas minimum values correspond to the main periods of forest clearance. The forest clearance episodes also correspond to higher values for the lithogenic elements potassium and strontium, as well as peak values for the haematite dominated 'Hard' IRM. The pollen data and radiocarbon dates (Oldfield *et al.,* 1999) show the major period of forest clearance and farming in Romano-British times, followed by forest regeneration and then further clearance continuing to the present. The great increase in grass pollen during the deforestation phases was matched by analyses of the organic matter content of the sediment. Oldfield *et al.* (1999) used qualitative and quantitative analyses of lipid biological markers and found a close relationship between the pollen signal and the organic matter sedimentary record. Depleted total organic carbon levels matched high-grass pollen frequencies and reflected organic-poor grassland soils as the dominant catchment material. Other molecular parameters supported this result (Oldfield *et al.,* 1999) and these biological markers have been shown to be valuable indicators of land-use change.

Understanding of the medieval and post-medieval environmental record from Gormire has been enhanced greatly by a detailed palynological investigation focusing on the top 70 cm of sediment (Morriss, 2001). The chronology of the profile is yet to be finalized but preliminary magnetic susceptibility data correlated to the ^{210}Pb-dated core from Gormire described above (Oldfield *et al.,* 1999) indicate that the base of the record may be assigned a date of *c.* AD 1350. Assuming that this basal date is correct, the beginning of the pollen record in this study would appear to occur in the middle of the medieval monastic period. There was much Cistercian activity in the vicinity of the lake, with a number of Abbeys established in the 12th century, including Rievaulx, Byland, Fountains and Jervaulx. These Abbeys held significant amounts of land and this may explain the relatively high levels of pollen taxa indicative of arable agriculture such as cereals and *Centaurea cyanus* and to a lesser degree taxa representing pastoral activity. The low arboreal pollen values suggest that cultivation and grazing took place in a largely open landscape.

The pollen profile then records a phase of *Cannabis* cultivation within the mixed farming economy. This is followed by a transitional period in the pollen record. Grazing indicators such as grasses and *Plantago lanceolata* begin to increase, accompanied by a large expansion of Lactuceae (*Taraxacum* type) pollen and *Pteridium* spores, whereas cereals decline. It would seem that pastoralism was expanding in the surrounding area at the expense of arable agriculture. In the later part of the profile, pastoral frequencies continue to rise, whereas arable indicators remain relatively subdued. There also is a very gradual increase in pine pollen in the top 25 cm of the record as a result of the plantations established in the 19th and 20th centuries. Further documentary research will be undertaken to correlate with the pollen evidence from this profile.

Interpretation

Whereas the most important feature of Gormire is the sedimentary record within the lake basin, the geological origin of the landform that the basin occupies is itself of interest and remains uncertain. The hypothesis that landsliding of material from the scarp slope of the upland plateau was involved in the process (Kendall and Wroot, 1924) remains favoured (Blackham *et al.,* 1981) but unproven. Such events are common and have created depositional basins in the Holocene (Simmons and Cundill, 1974b; Tarns and Johnson, 1980), assuming that sediment accumulation followed soon after stabilization. If a landslip event did create the Gormire lake basin, the pollen data from the grey clay at the base of core A of Blackham *et al.* (1981) show that this occurred at some stage in the Late Devensian Late-glacial period. The sampling interval in this core is very wide, but the clastic nature of the clay deposit and the dominance of a low shrub and herbaceous tundra-type pollen flora within it suggest a Loch Lomond Stadial age. With tree *Betula* virtually absent from the clay there are no indications that the deposits sampled extend to the Late-glacial interstadial. It cannot be assumed, however, that these lowest sediments sampled at Gormire are the oldest present in the basin and the pollen data can provide only a minimum age for the formation of the lake. It is possible that a full Late-glacial succession is present in the lake basin. As the basin at nearby Seamer Carrs in the Cleveland Lowlands was ice-free by at least 13 042 ± 140 years BP Oones, 1976a, 1999), and possibly rather earlier, the formation of the basin at Gormire could have occurred at any time after this local deglaciation and before the start of the Loch Lomond Stadial about 11 000 years BP.

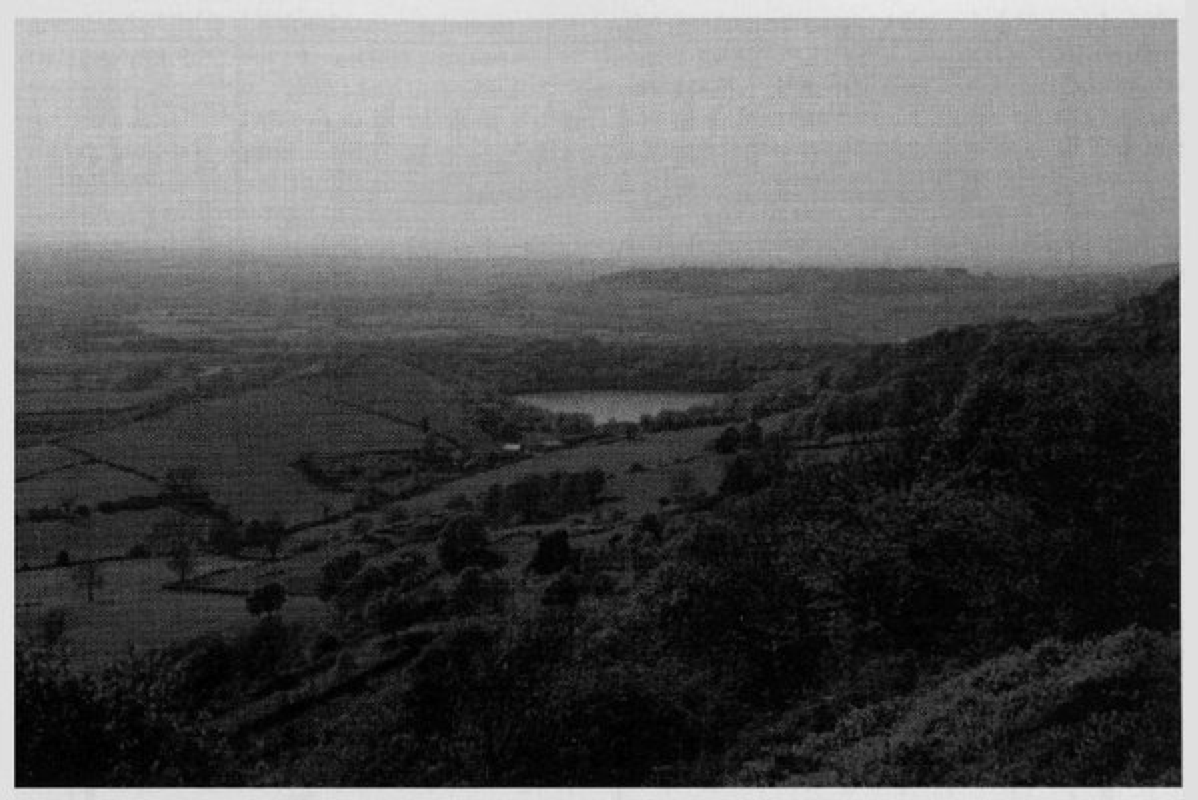
Blackham *et al.* (1981) recorded an almost continuous Holocene pollen record in their core A at Gormire, although the sampling interval was very wide and sediment was lost from three points in the core during its recovery. One of these sediment gaps occurs at the mud–clay boundary and so the earliest Holocene pollen record may be missing. The potential for a complete Holocene depositional record has been proven, however, and Gormire is an extremely important palaeoenvironmental resource, as sites with such potential are extremely few in this part of the region. Although there are sediment gaps in the upper part of core A, Blackham *et al.* (1981) were able to recognize two clear phases of forest clearance, with the later phase including substantial cereal cultivation. Their core B (Figure 8.49) also showed clear evidence of apparently almost total catchment deforestation, with clay mineral inwash and the temporary replacement of trees by open ground.

Blackham *et al.* (1981) were unable to date their two clearance phases, but it is likely that they correspond with the two phases recognized by the recent much more detailed multi-proxy investigations of the lake's sediments (NERC 1999, Oldfield *et al.,* 1999) . In this case the earlier of the two phases is of Romano-British date and the later corresponds to medieval times and after. These recent investigations are continuing, but already have established the great value of the site and the efficacy of the wide range of integrated techniques used there. Oldfield *et al.* (1999) have proven that at Gormire changes in sediment characteristics and flux can be linked to land-use changes, that sediment source types can be identified on the basis of magnetic properties, and that organic geochemical analyses are highly consistent with the other lines of evidence. These analytical techniques have been less effective at the few other lake sites in the region and their wider application remains to be proven (Oldfield *et al.,* 1999).

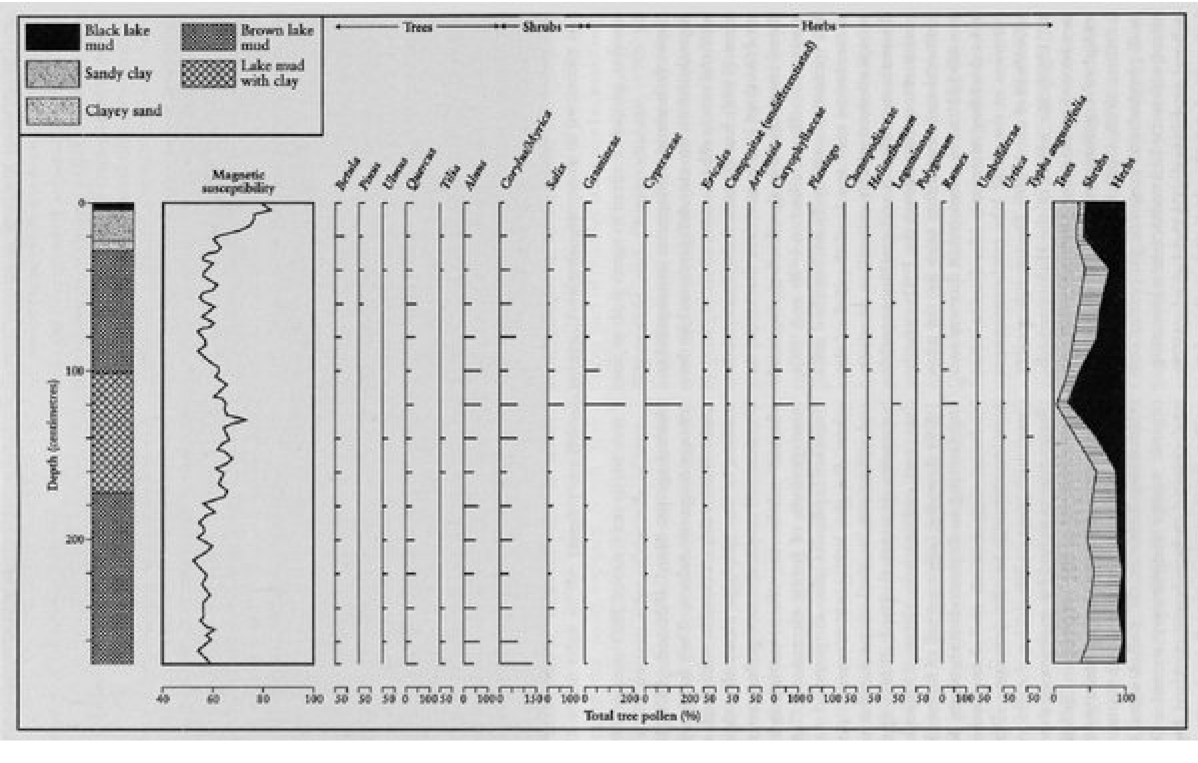
Conclusions

Gormire has been established as a key site for palaeoenvironmental research by the application of an integrated suite of innovative, sophisticated analytical techniques designed to characterize terrestrially derived deposits in lake sediment sequences. Its probable complete and well-preserved Late-glacial and Holocene depositional record makes it an ideal site for future research.

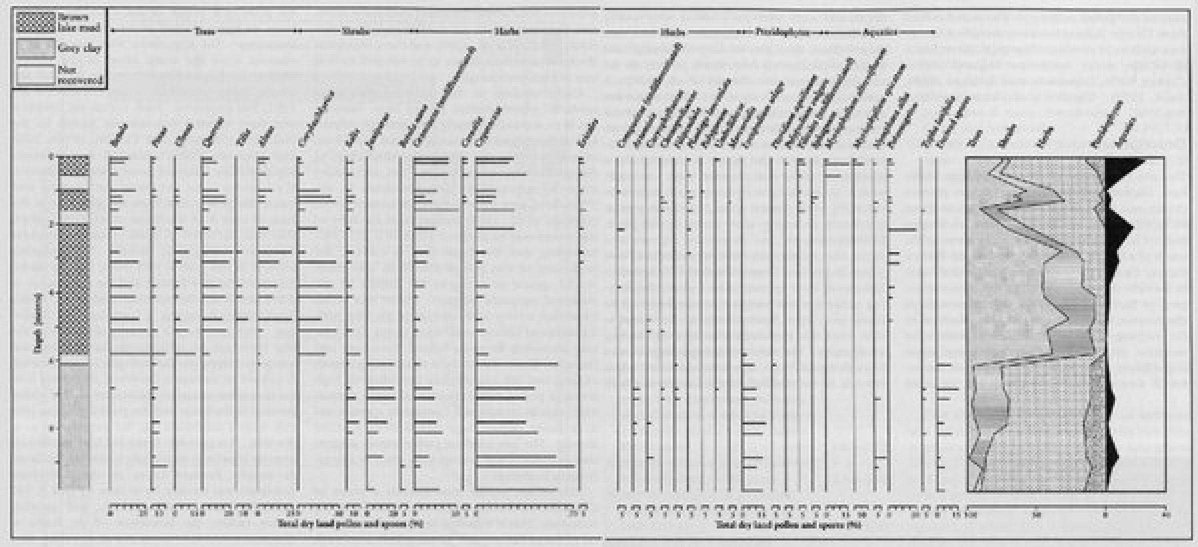
[References](#)



(Figure 8.47) Gormire Lake. (Photo: J. Innes).



(Figure 8.48) Stratigraphy and outline pollen analysis of core A, Gorrnire Lake (after Oldfield, 1999).



(Figure 8.49) Stratigraphy, palaeomagnetic susceptibility and outline pollen analysis of core B, Gormire Lake (after Oldfield, 1999).