Mesolithic environmental change at Cothill Fen, Oxfordshire

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Summary

Cothill Fen occupies a shallow valley 7 km SW of Oxford, in the parish of St Helen Without (NGR SU 461998). It was one of the first sites in England where peat deposits were investigated using the technique of pollen analysis (Clapham & Clapham 1939), and remains significant for reconstructing long-term vegetational change because suitable pollen-bearing deposits are rare in southern England.

Introduction

The present vegetation and hydrology of the site are discussed in this volume by Morris, and the purpose of this paper is to describe the nature of the fen peats and how recent re-analysis of the pollen sequence (incorporating advances in techniques since the 1940s), combined with charcoal particle analysis and radiocarbon dating, illustrates changes in vegetation and local human activity in the Mesolithic period, from the end of the last glacial to c. 5500 cal BC. Full details of the results have been presented by the present author elsewhere (Day 1991).

Site description

Cothill Fen lies on the Jurassic limestone and sand ridge of the Oxford Heights, which rises above the Oxford Clay vale. The deposits consist of up to 4 m of peat and marl, which have accumulated in an irregular 'basin' *c*. 600 m from west to east, and 300 m from north to south, at the confluence of the valleys of four small streams (figure 1). The largest of these streams, the Sandford Brook, runs along the eastern edge of the site and forms the only outlet. The deposits reach a maximum depth in the part of the site known as Morland's Meadow, where they survive despite partial drainage and ploughing in 1957, and subsequent use for pasture. A medieval mill leat runs along the southern edge of the site, and other evidence of probable medieval activity is visible in the form of peat cuts to the west of Morland's Meadow, on Parsonage Moor and the Ruskin Reserve.

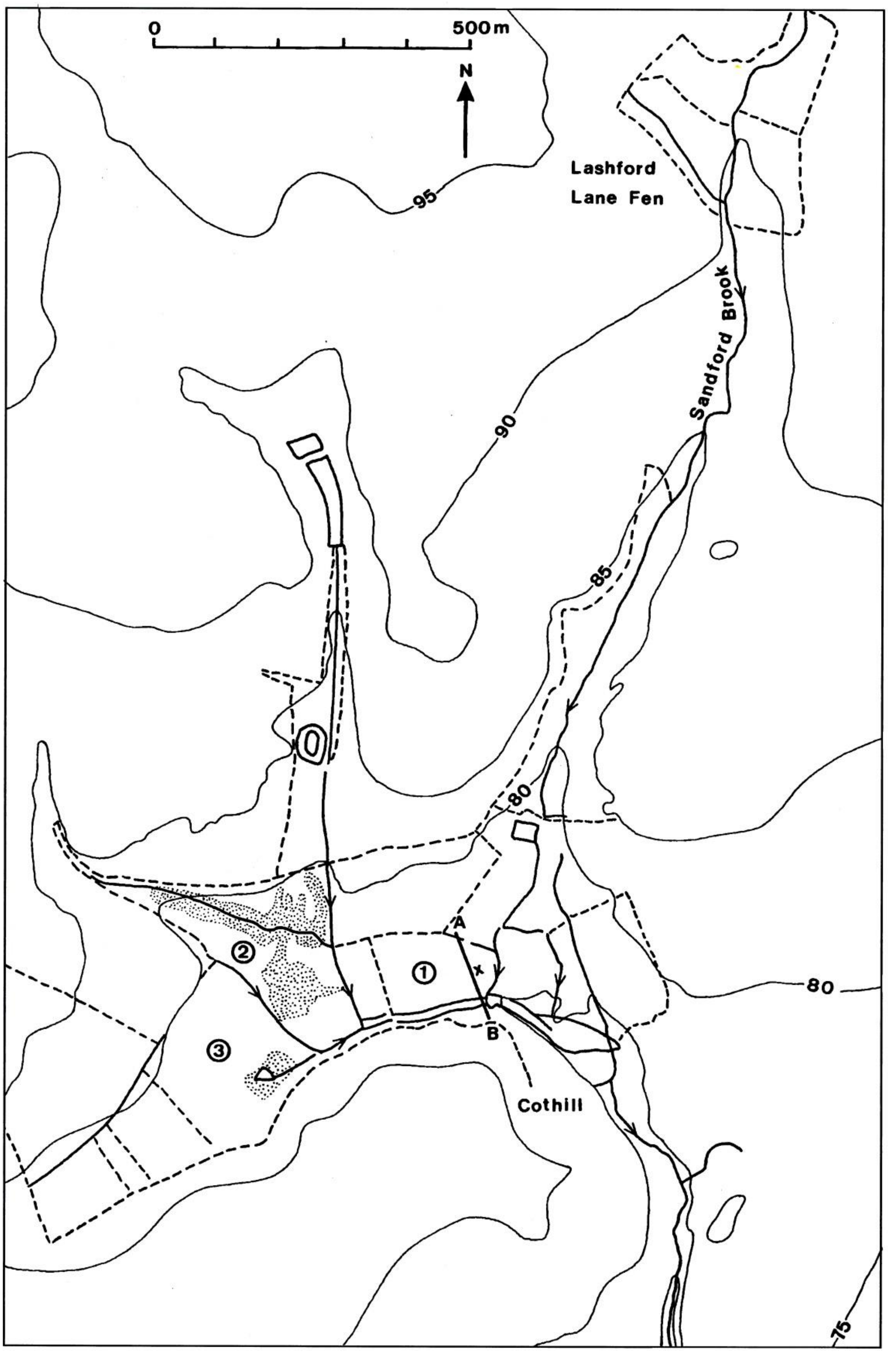

Figure 1. Topography of the area around Cothill Fen showing site of sediment core used for pollen analysis (x). 1 = Morland's Meadow, 2 = Parsonage Moor, 3 = The Ruskin Reserve. Peat cuts stippled; boundaries indicated by dashed lines; A-B = position of transect of borings originally made by Clapham & Clapham (1939). Contours at 5m intervals.

Clapham & Clapham (1939) originally interpreted the deposits as having accumulated in a lake, but the site is not a true basin and would not therefore have retained deep standing water. Furthermore, the nature of the deposits themselves is not consistent with accumulation in a lake.

Stratigraphy

A core for pollen and charcoal particle analysis was removed from Morland's Meadow, at a point assumed to represent the maximum depth of deposits. Coring involved use of a 5 cm diameter Livingstone piston corer, and the upper 30 cm of the deposits were discarded as they were dry and had been mixed by ploughing.

The deposits consist of a basal layer *c*. 60 cm thick of highly decomposed organic material with a variable sand content, overlain by *c*. 300 cm of heterogeneous bands of marl and peat (often rich in mosses) (figure 2). The upper part of the sequence consists of pure calcareous marl 10-20 cm thick, lying below topsoil.

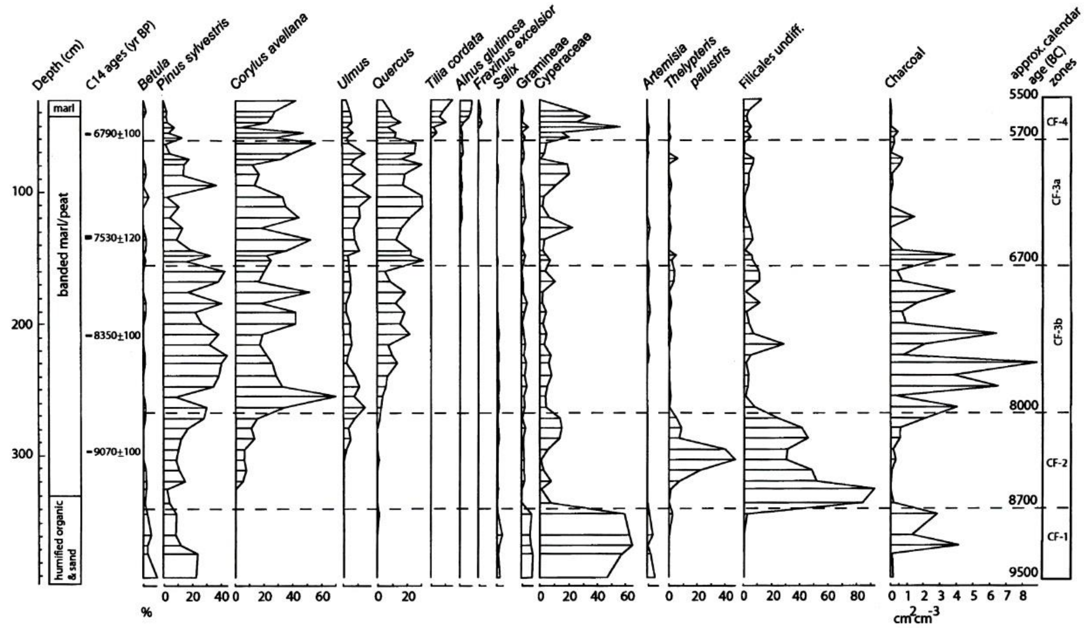

Figure 2. Pollen percentage and charcoal diagram from Cothill Fen, showing selected taxa only.

These deposits accumulated under swamp/fen conditions, and the thin alternating layers of peat and marl may have formed as a result of calcium carbonate deposition on the underside of moss mats, as described at Cothill and other Oxfordshire fens by Clapham (1940). The pure marl layer may represent a rise of the water table resulting in the formation of shallow pools on the fen surface.

Pollen and charcoal particle analysis

Samples for pollen analysis were 1 cm^3 in size and were prepared chemically following standard procedures (method b of Berglund and Ralska-Jasiewiczowa 1986). Pollen was counted at a magnification of 400x, with 1000x used for critical determinations. Identifications were made with the aid of the keys of Faegri and Iversen (1975) and Moore and Webb (1978). A minimum of 300 pollen grains was counted for most samples. Percentages for each pollen type were calculated on the basis of a sum including all identifiable pollen and spores, excluding obligate aquatic plants (those plants which are never found on dry land). The pollen diagram, figure 2, shows the main taxa only, and has been divided into zones to highlight key changes in the vegetation. The charcoal particle content of the deposits has been quantified by point counting.

The timescale shown on the pollen diagram is based on a set of four radiocarbon dates spaced at intervals through the sequence. Wood fragments and other plant remains were dated by accelerator mass spectrometry by the Oxford Radiocarbon Accelerator Unit, and the results converted to calendar ages using the program OxCal (Bronk Ramsey 1995), indicated by 'cal BC'.

Vegetational change at Cothill

Interpretation of pollen sequences is not straightforward because of the many factors involved in production and post-depositional modification of pollen assemblages (Faegri and Iversen 1975, Moore and Webb 1978). Space does not permit these to be discussed here, but a key issue is differences in pollen production and dispersal between species. Insect-pollinated plants (such as the lime tree, *Tilia*) produce much less pollen, which is dispersed much shorter distances, than wind-pollinated species (such as pine, *Pinus*). Thus insect-pollinated plants are under-represented compared to wind-pollinated species. The source of pollen to the deposits as also critical. Peat deposits will contain pollen from wetland communities growing *in situ*, as well as from vegetation on surrounding well-drained soils. In interpreting the sequence of vegetational change it is therefore important to try and separate pollen from these different sources, but this is made difficult by the fact that the pollen of many plants cannot be identified to species level, and may be distinguishable only to genus or family. These groups may obviously contain species with very different ecological characteristics. Additional clues to the *in situ* wetland vegetation may be provided by the presence of fruits, seeds or vegetative remains of plants growing on the peat, which ultimately become incorporated into it. In contrast to pollen grains, these remains are often identifiable to species level.

Taking into consideration the various factors mentioned, the key changes in vegetation illustrated by the pollen diagrams may be described as follows:

Zone 1, c. 9500-8700 cal BC

The deposits began to accumulate in response to the rapid climatic warming at the end of the last glacial period. Pollen assemblages are initially dominated by pollen of sedges with some grasses and other herbs such as mugwort (*Artemisia*), suggesting that the environment was predominantly open. The main tree types represented are birch (*Betula*) and pine (*Pinus sylvestris*), which would have formed open woodland on well-drained soils, while birch and willow (*Salix*) would have formed carr woodland fringing the wetland area. Note that different species of birch and willow are not distinguishable from their pollen.

Charcoal particles become abundant in this basal zone, but the source is uncertain. Possibly they represent natural fires, especially if the prevailing climate was more conducive to the spread of fire than it is today. Alternatively, the charcoal may derive from the campfires of local Mesolithic peoples.

Zone 2, c. 8700-8000 cal BC

This zone shows the spread of hazel (*Corylus avellana*) woodland into the area, replacing some of the birch stands. Elm (*Ulmus*) arrived soon after hazel, leading to the development of increasingly dense areas of woodland, but pine persisted locally. The wetland deposits themselves were colonised by the marsh fern (*Thelypteris palustris*), the spores of which come to dominate the zone. Note that the curve for 'Filicales undiff.' consists of fern spores which have lost the key features enabling specific identification. These probably consist of mixture of marsh fern and other species growing on the woodland floor.

Zone 3, c. 8000- 5700 cal BC

The first half of this zone (3a) is dominated by pollen of pine and hazel, with some elm. Oak (*Quercus*) appears at the base of the zone and soon becomes a significant component of the local woodland. The abundance of ferns diminishes markedly, and the wetland was probably dominated by rushes (the pollen of which does not survive, but which are represented by pith cells), with an increasing abundance of mat-forming mosses and stonewort (*Chara*). In the upper half of the zone (3b) pine declines and elm and oak increase in abundance, while alder (*Alnus glutinosa*) arrives in the area, accompanied by a sporadic presence of small-leaved lime (*Tilia cordata*).

Charcoal particles are again abundant in the lower half of the zone, and some can be identified as resulting from burning of rushes. This suggests fires in the wetland vegetation itself. While it might seem surprising that such plant communities would be subject to fire, recent research at the early Mesolithic site of Star Carr in Yorkshire has demonstrated the burning of reed-swamp associated with human activity at the site (Dark 1998). In that case reed-beds may have been deliberately burned to increase their productivity and so encourage concentrations of wild herbivores that could be hunted. It is possible that a similar strategy was applied to the fenland vegetation at Cothill, especially as a local human presence in the Mesolithic period is attested by flint scatters to the north of Parsonage Moor (J. Wallis pers comm.).

Zone 4, c. 5700-5500 cal BC

This zone marks the local population expansion of the lime tree, which appears to have replaced some areas of elm, oak and hazel woodland. Alder became dominant on poorly-drained soils, while pine had by now virtually disappeared from the area. The wetland is dominated by rushes. A single cereal pollen grain (resembling that of wheat, *Triticum*) occurs at 48 cm, at *c*. 5600 cal BC. This would be an early date for the onset of cereal cultivation in Britain – perhaps the earliest record currently available from England - (cf Edwards and Hirons 1984, Edwards and McIntosh 1988), but it would be unwise to attempt to draw firm conclusions from the presence of a single pollen grain!

Conclusions

The peat and marl deposits at Cothill preserve a record of woodland development and changes in wetland vegetation from a period immediately after the end of the last glacial to *c*. 5500 cal BC, spanning virtually the whole of the Mesolithic period. Indeed the first appearance of local cereal cultivation may be recorded by the single cereal pollen grain present near the top of the sequence.

The deposits have formed as a result of a high water table maintained by streams and springs, but the absence of post-Mesolithic deposits is puzzling. Clapham & Clapham (1939) suggested that a dry phase may have destroyed more recent deposits, or continued accumulation may have been prevented by seasonal falls in water level. Alternatively, later peat and marl layers may have been removed for agricultural purposes.

The successive arrival of different species of trees marks a response to the initial period of climatic warming, with each species varying in its rate of spread. Local populations of Mesolithic peoples would have had to adapt to the changing resource base as the environment was transformed from open land communities with an abundance of highly visible herds of game to closed canopy woodland, in which hunting became more difficult (but which provided a valuable food source in the form of hazel nuts). It is possible that burning of the wetland vegetation represents an attempt to keep these communities clear of encroaching fen carr woodland, and to increase their productivity and so attract grazing animals to one of the few areas in the landscape free of woodland.

The deposits at Cothill provide an invaluable archive of prehistoric environmental change in an area where similar deposits are rare. Maintenance of a high water table is critical for preservation of the pollen grains, which rapidly decay if the peat is allowed to dry out. Conservation here is therefore critical not only for the modern vegetation and fauna, but also to preserve these deposits, so that future advances in techniques will increase still further the environmental information that can be extracted from such sites.

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References

Berglund, B. E. and Ralska-Jasiewiczowa, M. 1986. Pollen analysis and pollen diagrams. *Handbook of Holocene Palaeoecology and Palaeohydrology* (ed. Berglund, B.E.), 455-84. John Wiley & Sons, Chichester.

Bronk Ramsey, C. 1995. Radiocarbon Calibration and Analysis of Stratigraphy: The OxCal Program. *Radiocarbon,* 37: 425-430.

Clapham, A. R. 1940. The role of bryophytes in the calcareous fens of the Oxford district. *Journal of Ecology*, 28: 71-80.

Clapham, A. R. and Clapham, B. N. 1939. The valley fen at Cothill, Berkshire. Data for the study of post-glacial history. II. *New Phytologist,* 38: 167-74.

Dark, P. 1998. Lake-edge sequences: results. *Star Carr in Context* (Mellars, P., Dark, P.), 125-46. McDonald Institute for Archaeological Research, Cambridge.

Day, S. P. 1991. Post-glacial vegetational history of the Oxford region. *New Phytologist,* 119: 445-70.

Edwards, KJ and Hirons, KR 1984. Cereal pollen grains in pre-elm decline deposits: implications for the earliest agriculture in Britain and Ireland. *Journal of Archaeological Science*, 11: 71-80.

Edwards, K. J. and McIntosh, C. J. 1988. Improving the detection rate of cereal-type pollen grains from *Ulmus* decline and earlier deposits from Scotland. *Pollen et Spores*, 30: 179-88.

Faegri, K. and Iversen, J. 1975. *Textbook of Pollen Analysis,* 3rd edn. Blackwell, Oxford.

Moore, P. D. and Webb, J. A. 1978. *An Illustrated Guide to Pollen Analysis*. Hodder & Stoughton, London.

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