Hawks Tor

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Highlights

The most complete record of Devensian late-glacial vegetational and climatic changes in South-West England comes from Hawks Tor on Bodmin Moor. This site was central to the development of pollen biostratigraphy in Britain in the 1930s/1940s and still provides the regional 'standard' with which sequences elsewhere in Britain, Eire and continental Europe are compared.

Introduction

Hawks Tor provides the most detailed and extensive record of Devensian late-glacial conditions in upland South-West England, as well as a partial record of Holocene environmental changes. Pollen, plant macrofossils, diatoms and radiocarbon dates from the site show unique evidence in the area for the Allerød Interstadial of the Late Weichselian (= Late Devensian). The kaolinized granite at Hawks Tor was discussed by Reid *et al.* (1910), and its origin and importance in landscape evolution were also mentioned in studies by Barton (1964) and Clayden (1964). The pollen biostratigraphy of the site has been studied in detail by Conolly *et al.* (1950) and Brown (1972, 1977, 1980), and radiocarbon dates for selected horizons were provided by Libby (1952) and Brown (1977, 1980). The site's importance is highlighted by its use as the reference locality for the Allerød Interstadial in the Geological Society's Quaternary correlation charts for South-West England (Stephens, 1973; Campbell *et al.,* in prep.), and by its continuing citation in both regional and national syntheses of Quaternary evidence (Te Punga, 1957; Pennington, 1974; Kidson, 1977; Caseldine, 1980; Bell *et al.,* 1984).

Description

Hawks Tor GCR site [SX 150 749] lies at *c.* 220 m OD on Bodmin Moor, and consists of a small peat bog situated at the northern end of the lake which now occupies the disused pit of the Hawks Tor China Clay Works (Figure 4.15). The bog lies in a depression flanked to the east by the Warleggan River and to the west and north by the rising slopes of Menacrin Downs and Hawks Tor itself. Up to 2.5 m of organic sediment is exposed in the valley bottom, thinning to less than 0.5 m on the surrounding hillslopes. The upper layers of peat, however, have been reduced by cutting, and the bog surface is much disturbed by spoil, trackways, embankments and ditches. The Devensian late-glacial and Holocene deposits are exposed in sections along the lake edge, at the margin of the former kaolin workings. These sections also expose the underlying growan or grus (the kaolinized granite). Similar stratigraphic relationships occur to the south of the GCR site and were exposed, temporarily, during widening of the A30(T) in 1987.

(Figure 4.16) shows the stratigraphic sequence exposed at the north-east end of the lake. This representation, based on the work of Brown (1977, 1980), is highly generalized: considerable lithological variations occur in the beds, the pattern of which is frequently disrupted by complex unconformities and cryoturbation structures. The sequence of vegetational development and inferred climatic changes given here is based principally on pollen analyses carried out on three separate monoliths by Brown (1977, 1980) (Figure 4.16) although a brief appraisal of the earlier work by Conolly *et al.* (1950) is also given.

Interpretation

Conolly *et al.* (1950) presented the results of pollen analyses carried out on the peat beds (beds 3, 5 and 6). Their 'upper peat' (beds 5 and 6) showed characteristic tree pollen assemblages from Pollen Zones V–VIII of the 'post-glacial' (Holocene), although there was some doubt as to whether deposits with a Pollen Zone IV flora (Pre-Boreal) were present at the site. With this exception, the 'upper peat' showed a pollen zonation similar to many other British tree pollen diagrams for the period.

The Pollen Zone V assemblage, found at the base of bed 5 in the wood peat, showed a preponderance of birch and hazel pollen with small amounts of pine, oak and willow. Such a pattern also characterizes the succeeding zone (also in bed 5), but with a decline in birch and hazel, and a corresponding increase in oak and alder. Pollen Zone VII (bed 5) was characterized by a significant reduction in tree birch pollen and by the continued rise of oak. Alder and hazel pollen values are maintained at a steady level throughout this zone. The Pollen Zone VIII assemblage, found in the non-humified peats of bed 6, showed a renewed peak in birch, a sudden expansion in oak and a corresponding decline in alder. Beech makes its first significant appearance in this zone.

Conolly *et al.* (1950) noted that Pollen Zone IV (Pre-Boreal) pollen might be present in the upper layers of the underlying silty peats, sands and gravels (bed 4). However, these dominantly minerogenic beds had lithological and stratigraphical characteristics suggesting a Younger Dryas (Pollen Zone III) age (Conolly *et al.,* 1950).

These workers also identified pollen, fruits and seeds from the organic sediments in bed 3 which was sandwiched between two dominantly inorganic layers (beds 2 and 4). The fossil flora from bed 3 was characterized by plants now restricted to more northern parts of Britain — for example, *Betula nana, Salix herbacea* and *Thalictrum alpinum.* Pollen from this bed revealed an open-tundra or 'park-tundra' vegetation and, although there was no clear evidence for tree growth (but see below; Brown (1977, 1980)), conditions were clearly warmer than when the underlying and overlying, dominantly minerogenic, beds were deposited. Organic lake muds at the base of bed 3 yielded a diatom flora indicative of cool-temperate, moderately eutrophic conditions. On the basis of this evidence, Conolly *et al.* (1950) confidently ascribed bed 3 to the Allerød oscillation (= Pollen Zone II) of the classic Danish sequence.

The gravelly silt, which contains some large granitic boulders up to 1 m across (bed 2), was interpreted as a solifluction deposit, probably ascribable to cold conditions in Pollen Zone I times (Conolly *et al.,* 1950). Likewise, the dominantly minerogenic deposits of bed 4 were considered to have accumulated by solifluction during a deterioration of climate represented by Pollen Zone III (Younger Dryas): Conolly *et al.* argued that the disturbance, cracking and contortions found in the underlying peats and lake muds (bed 3) had been caused by frost-action and cryoturbation at this time. The Hawks Tor sequence therefore provided a record showing the threefold subdivision of the Scandinavian Late Weichselian (= Late Devensian late-glacial), in addition to a comprehensive record of Holocene vegetation changes with the exception of detailed evidence in the earliest Holocene (the Pre-Boreal/Pollen Zone IV) (Conolly *et al.,* 1950). An early attempt by Libby (1952) to calibrate the Devensian late-glacial and Holocene sequence at Hawks Tor, using radiocarbon dating methods, provided ambiguous results (Libby, 1952; p. 75).

Brown (1977, 1980) re-investigated the pollen biostratigraphy of the Hawks Tor site, and provided radiocarbon dates from critical lithological and pollen assemblage boundaries (Figure 4.16). The oldest Quaternary sediments (bed 1) overlie kaolinized granite. These banded silts and alternations of silt and gravel appear to have resulted from cyclic sedimentation in still water. The pollen record shows that deposition occurred in a treeless, sparsely vegetated landscape, probably with hillside snowbeds. The occurrence of pollen in these beds from the arctic-montane species *Artemisia norvegica* and *Astragalus alpinus* indicates low mean annual temperatures and a degree of base-element enrichment caused by local solifluction (Brown, 1980). The oldest radiocarbon-dated organic sediment (13 088 ± 300 BP (Q–979)) comes from banded silt in bed 1, near its junction with the underlying kaolinized granite. These sediments may have accumulated in a clear, shallow water, mud-bottomed channel. In places, they are succeeded by gravel which contains some large boulders (bed 2) reflecting continued slope instability and solifluction.

This cold channel environment with local solifluction gave way to warmer conditions by about 12 600 BP, when organic muds and a sedge mire (bed 3) started to accumulate. These dominantly organic sediments accumulated on an irregular channelled surface ((Figure 4.16); unconformity 1) after a change in drainage had effected local removal of parts of beds 1 and 2 and, in places, the underlying bedrock. The pollen record from bed 3 shows that a tall herb fen and birch carr had developed by about 11 500 BP: these warmer conditions are correlated with the Allerød Interstadial (Brown, 1977, 1980). The Allerød deposits are succeeded unconformably in places by solifluction gravels (bed 4). Elsewhere, the peat is overlain by dominantly inorganic gravels, sands and silts, which contain bands of peat presumably reworked from bed 3. Radiocarbon dates show that this change from organic to dominantly minerogenic sedimentation occurred at around 11

000 BP. Pollen from these sediments (bed 4) shows a return to an open treeless vegetation with several cold-climate species. This climatic deterioration is correlated with the Younger Dryas event (Pollen Zone III), and was characterized by a return to solifluction, possibly wet-soil creep, in a cold, oceanic regime (Brown, 1977, 1980). Two notable botanic records occur in the Younger Dryas sediments: *Luzula arcuata* and *Epilobium alsinifolium* are arctic-montane species found now only at higher latitudes in northern England, Scotland and Scandinavia (Brown, 1980).

There is no pollen evidence for an unconformity between the solifluction/sheet-wash deposits of the Younger Dryas (bed 4) and the overlying Holocene peat (beds 5 and 6). The radiocarbon date of 9654 ± 190 BP (Q–1017) (Figure 4.16) from the base of the Holocene peat, however, does suggest an unconformity, much as Conolly *et al.* (1950) had suspected, since the date is too young to mark the start of the Holocene. The fact that the peat of bed 5 also directly overlies sediments of bed 3, and even granite in places ((Figure 4.16); unconformity 2), shows that some erosion took place between deposition of beds 4 and 5.

The Holocene sediments consist of highly humified *Sphagnum* and sedge peats (bed 5) which grade into *Sphagnum/Eriophorum* peats (bed 6) of decreasing humification. This shows that the Late Devensian sediments were covered by a wet *Sphagnum* mire which dried out progressively to fen carr. This part of the Hawks Tor pollen sequence (covered by Pollen Zone V; Conolly *et al.* (1950)) is, however, discontinuous and there has been some erosion of the bed (Brown, 1977, 1980). The development of the fen carr was followed by a return to wetter conditions, impeded drainage and the development of raised bog (bed 6); blanket bog developed at the site by about 3100 BP, and the subsequent effects of pastoral and, later, arable agriculture are also clearly evident in the pollen record (Brown, 1977, 1980).

The Hawks Tor deposits are of considerable significance as they have yielded the most complete record of Devensian late-glacial conditions known from upland South-West England. Although incomplete, the Holocene pollen record from the site complements that from nearby Dozmary Pool, collectively providing some of the best evidence for the vegetation history and climate of this period on Bodmin Moor. (The Holocene pollen record for Bodmin Moor has been supplemented recently by data from nearby Rough Tor (Gearey and Charman (1996).)

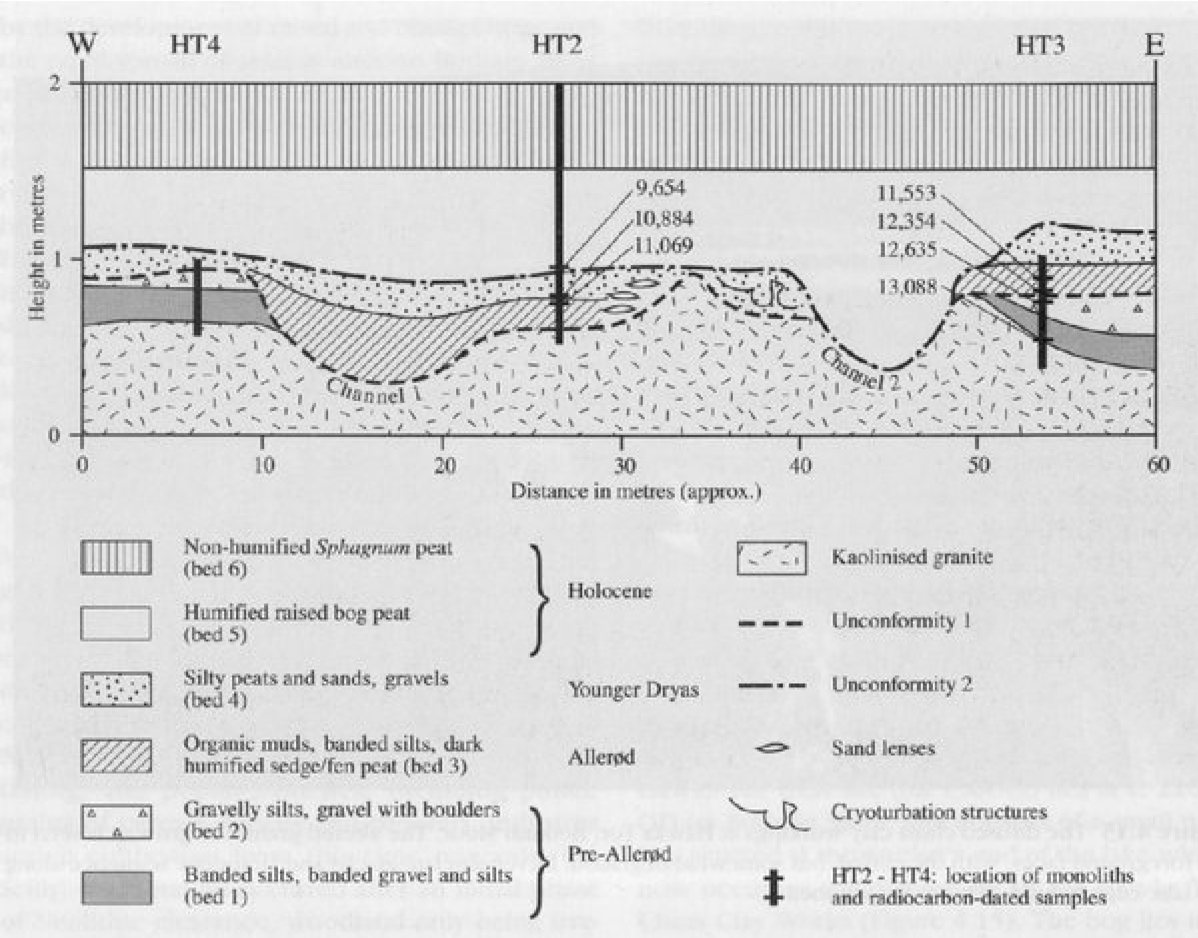
Hawks Tor is also important in the historical development of pollen biostratigraphy in Great Britain. Conolly, Godwin and Megaw's (1950) study was undertaken at a time, in the late 1930s/early 1940s, when little evidence for Devensian late-glacial conditions in Britain was known. Although strong evidence for recognizing the Allerød Interstadial had been made at Windermere in the Lake District (Pennington, 1947) and at Flitwick in Berwickshire (Mitchell, 1948), other British sites with comparable sequences had only been described and interpreted more speculatively (Godwin, 1947). The study by Conolly *et al.* (1950) at Hawks Tor is therefore a significant 'landmark' in correlating the British Devensian late-glacial record with more comprehensively studied sequences in Ireland, Germany and southern Scandinavia.

The pollen and stratigraphic evidence, including periglacial structures in the beds, is also of importance for demonstrating the considerable severity of Devensian late-glacial climate at latitudes well south of the Late Devensian maximum ice limit (Pennington, 1974).

Conclusion

The sequence of Quaternary deposits at Hawks Tor includes frost-weathered, reworked granitic deposits, peats, lake muds and silts. It has yielded pollen, plant macrofossils and radiocarbon dates which have enabled one of the most detailed reconstructions of vegetational and climatic changes in South-West England during the Devensian late-glacial to be made. Particularly significant is its unambiguous evidence for the Allerød oscillation of the Late Devensian — a discrete interlude of relative warmth, lasting some 1500 years, sandwiched between periglacial phases (equivalent to the Older and Younger Dryas) when the local landscape resembled tundra. In conservation terms, Hawks Tor is important because it provides the most complete record in the South-West for the climatic and environmental conditions of this time interval and shows, uniquely, that trees were established on the Peninsula during the Allerød at high elevation. Although its record of Holocene environmental changes is incomplete, it complements the fuller record at nearby Dozmary Pool: both can be regarded as reference sites for understanding changing climatic and environmental conditions in the latest Quaternary. Hawks Tor has the further distinction of being a significant 'landmark' in the development of British pollen biostratigraphy.

[References](#)



(Figure 4.15) The disused china clay workings at Hawks Tor, Bodmin Moor. The altered granite or growan is seen in the foreground faces, with the cliffed, but somewhat degraded, Devensian late-glacial and Holocene sequence along the lake edge behind. (Photo: S. Campbell.)

(Figure 4.16) A simplified composite section of the north-east face of the exposures at Hawks Tor as exposed in 1970–1971. Adapted from Brown (1977, 1980).