Willow Garth

[TA 126 676]

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Introduction

Willow Garth is an area of carr woodland in the Great Wold Valley of the East Riding of Yorkshire that contains a shallow, discontinuous, succession of minerogenic and organic Late-glacial and Early and Late Holocene lacustrine and peat deposits. Detailed litho- and biostratigraphical studies and a series of radiocarbon dates from the site have been published (Bush, 1986, 1988a, 1993; Bush and Ellis, 1987; Bush and Flenley, 1987). These data and their interpretation have been debated (Thomas, K.D., 1989; Bush, 1989) and discussed in reviews of regional palaeoenvironmental history (Flenley, 1990; Day, 1996; Greig, 1996). Bush (1988b, 1993) also has completed modern molluscan and pollen studies. Willow Garth sediments have been classified within the Bingley Bog and Ringinglow formations by Thomas (1999). Bush and Hall (1987) have discussed the significance of Late-glacial and early Holocene *Alnus* records from the site, which is notified as an SSSI under the name 'Boynton Willow Garth' and is also a nature reserve sustaining a very rich and important flora and fauna.

Description

Willow Garth is an area of wet fen-carr woodland 200 m in diameter at about 18 m OD and a kilometre to the west of Boynton village in the Great Wold Valley, the main drainage system for the chalk upland of the Yorkshire Wolds. The valley is occupied by a small stream, the Gypsey Race, which is the only major example of surface drainage in the northern Wolds. The site lies just within the east coast Devensian ice limit, and till is present within the valley. Brown silty clay in the valley may be till-derived or reworked Devensian loess. Sands present around the site are probably derived from outwash material from Vale of Pickering ice, which just overtopped the northern Wolds scarp (Can, 1982, 1987a; Foster, 1987). Willow Garth is a rare example of wetland sediment deposition in the chalk area and has been sustained by several springs in the woodland and by periodic flooding of the stream (Bush and Flenley, 1987). The wooded wetland area is surrounded by arable land and the presence of peaty soils in the cultivated valley bottom suggests that the wetland was once greater than today, and has been much reduced by drainage. Drainage ditches, cut through the modern wetland, and the Gypsey Race, bound the dense carr woodland on the northern side.

An extensive lithological survey of the deposits at Willow Garth was undertaken, comprising over 60 boreholes at less than 10 m intervals and two ditch sections, and the results (Bush and Ellis, 1987; Bush and Flenley, 1987; Bush, 1988a, 1993) have been published as a three-dimensional diagram (Figure 8.34). On this diagram transects A–B and B–K are the two ditch sections where continuous stratigraphical records were recorded. The borehole survey identified some small hollows, about 20 m by 30 m in size, in which the deepest sediments were preserved and these were investigated by cores at 1 m intervals.

A brown silty clay, structureless and without sand or gravel inclusions, is recorded in transect B–K as the lowermost unit at the site. It may be derived from nearby deposits of till in the valley but must have been transported as its characteristics indicate deposition under a low-energy fluvial or lacustrine regime (Bush and Ellis, 1987; Bush, 1993). It may well represent reworked loessic material, which covered most of the higher Wolds surface in the later Devensian but was then weathered and eroded, some being redeposited in the Wolds valleys (Cat, 1990b). A small moss peat fragment with attached organic silt was discovered resting upon it in transect B–K. This basal silty clay is overlain by a complex suite of gravels and gravelly sands, which comprise the lowermost unit recorded across most of the site. Bush and Ellis (1987) show these to have had a down-valley fluvial origin and they contain large sand lenses. In places a coarse angular gravel occurs, which is interpreted as a solifluction deposit and it is probable that the main sand and gravel suite is fluvially reworked soliflucted material. A thick coarse sand body containing small chalk and flint clasts overlies the gravels in transect B–K, banked against the valley side slope. Lack of bedding and structure suggested to Bush and Ellis

(1987) that this sand was aeolian coversand, its grain size is similar to coversands found elsewhere in the northern Wolds (Foster, 1987) and Vale of York (Matthews, 1970). Overlying these clastic gravelly sand deposits, within the small, wet hollows detected by the borehole survey, were various organic sediments. A core for pollen and radiocarbon analyses was collected from the location with the deepest organic sediment, 1.18 m, with a 7 cm-diameter Livingstone Piston Sampler. Its location on (Figure 8.34) is at the intersection of transects C–D and I–J. From 0.48 m to 1.18 m the organic sediment is a moss peat composed mainly of *Amblystegium riparium, Calliergon* sp., *Drepanocladus* sp. and *Scorpidium scorpioides.* A wood-rich band occurs within the moss peat between 0.76 m and 0.82 m. From 0.07 m to 0.48 m is a gyttja of low organic content (Bush and Ellis, 1987). The gyttja merges laterally into the subjacent sandy stratum, which accounts for most of its content, although Bush and Ellis (1987) considered that the finer-grained mineral component of the gyttja probably derives from flooding episodes of the Gypsey Race stream. Shells are present throughout the gyttja, which includes a thin layer of chalk fragments at about 34 cm. The top 0.07 m is undecomposed, surface organic matter. A monolith of sediment for macrofossil analyses was recovered from beside the pollen core and was found to have an identical lithostratigraphy. The small moss peat lens found beneath the gravelly sand and above the basal clay near the south end of transect B–K was also recovered for palaeoecological and radiocarbon analysis.

The results of pollen analysis of the Willow Garth organic core and the small peat lens (Bush, 1993) are reproduced as (Figure 8.35), the latter shown detached as the lower part of the diagram. Some pollen taxa are aggregated into ecological groups. Frequencies are percentages of dry-land pollen. The 13 radiocarbon dates from the core and peat lens are shown on (Figure 8.35). Frequencies of seeds and fruits (propagules) of selected taxa recovered during macrofossil analyses are shown as (Figure 8.36), expressed as percentages of total propagules (Bush, 1993), with rarer taxa assembled into ecological groupings. Local pollen (WGP) or macrofossil (WGS) zones are established and shown on the respective figures, but their zone boundaries rarely fall at the same levels. Full taxa listings for all fossil and modern pollen and macrofossils recorded at Willow Garth are available for reference (Bush, 1986, 1993).

The oldest sample recorded ((Figure 8.34), pollen zone WGP1) is the detached moss peat lens, which has radiocarbon parameters of 11 400 ± 120 years BP and 10 700 ± 70 years BP. The most abundant pollen and spore types were Cyperaceae, *B. nana, Pinus, Juniperus, Selaginella,* Liguliflorae and a range of cold-tolerant herbs including *Helianthemum. Corylus* is recorded. Macrofossils are not available from this deposit. Zones WGP2 to WGP4, ending about 9380 ± 80 years BP, are characterized by high values of Gramineae and *Pinus* with lower frequencies of Cyperaceae, *Equisetum,* Liguli-florae and low *Juniperus* and cold-tolerant herbs. Tree *Betula* pollen values are low. At the corresponding levels in the macrofossil stratigraphy, tree *Betula* seeds are abundant. Seeds of *B. nana, Salix repens, Alnus, Rosa, Lychnis alpina, Cladium mariscus* and *Saxifraga* sp. are prominent.

Pollen zones WGP5 and WGP6 are dominated by tree *Betula* and Cyperaceae, with lesser Gramineae, *Pinus* and *Filipendula. Corylus* increases late in WGP6. Tree *Betula* and *Carex* dominate these levels in the seed and fruit diagram, with *Alnus, Urtica dioica, Chenopodium album, Ranunculus* sect. *Batrachium* and the aquatic herb group important. In pollen zone WGP7, from about 3970 ± 80 years BP, *Betula, Pinus* and Cyperaceae are greatly reduced. *Alnus, Corylus* and Gramineae characterize the assemblage, with *Plantago lanceolata*, Liguli-florae and other grassland herbs important. *Tilia* and *Quercus* become significant. In these levels seeds and fruits of arboreal taxa are scarce. Cyperaceae are most common, mainly *Carex*, with wetland taxa *Menyanthes, Hydrocotyle, Ranunculus* sect. *Batrachium, Potamogeton* and the marshland herb group. *Potentilla reptans* and *Urtica dioica* show brief peaks. The two upper pollen zones, WGP8 and WGP9, beginning about 2120 ± 50 years BP, have reduced arboreal percentages, with Gramineae dominating the assemblage and Cruciferae initially in peak values. Cerealia and the marshland herb group also rise in frequency. In WGP9 *Pinus,* Liguliflorae and Cyperaceae rise to high values and Cerealia remains consistently important. Many herbs show peaks in propagule frequency in these upper levels of the core. *Urtica dioica, Chenopodium album, Stellaria media, Atriplex patula, Carex* sp. and the marshland herb group all reach peak values. Disturbed ground herbs replace marshland herbs nearer to the surface. In the highest levels peaks of *Alnus, Salix* and *Lychnis* occur.

Other palaeoecological data from the Willow Garth core include studies of insect assemblages by Dr H. Kenward (Bush and Ellis, 1987; Bush, 1988a, 1993). Of significance are the 'cold indicator' taxa *Notaris aethiops, Otiorhynchus nodosus* and *Olopbrum fusca* in the lowest part of the core and the detached moss peat lens. These cold-tolerant taxa give way to *Patrobus* cf. *assimilis,* and above 84 cm *Philopertha borticola, Cantharis rustica* and *Serrica brunea,* insects that are indicative of grassland or forest disturbance, occur regularly. Mollusc data were also recovered from the core (Bush, 1988b, 1993). These indicated a major change in the upper half of the sequence, with wetland genera such as *Pisidium, Anisus, Bathyomphalus* and *Planorbis* replaced by shade tolerant taxa such as *Aegopinella nitidula, Carychium minimum, Euconulus fulvus* and *Vitrea crystallina.* Obligate hydrophiles decline from 91% at 34 cm to 2% at 12 cm. The same environmental trend is apparent in the bryophyte flora in the upper part of the core, as taxa favouring damp shady conditions, such as *Aulocomnium androgynum, Hypnum cupressiforme* and *Eurynchium* spp., replace the previous assemblage dominated by *Calliergon* spp. and *Amblystegium riparium.*

To assist the interpretation of the palaeoecological record from Willow Garth, Bush (1986, 1993) collected modern pollen rain samples from a wide range of habitats on the chalkland that seemed most closely representative of the fossil communities, recognizing that no exact modem counterparts may be available. Plant propagules (Bush, 1993) and mollusca (Bush, 1988b) also were collected from these modern sampling points.

Interpretation

The major importance of Willow Garth is that it is the first detailed, multi-proxy palaeoecological history from a site on the chalk of northern England, although previous pollen or mollusc work had been undertaken in chalk areas of the south, where recent research is increasing knowledge of chalkland vegetation history (Bennett and Preece, 1998; Waller and Hamilton, 2000). The insects and pollen from the lowest sediments at Willow Garth record a dry, open, cold-climate grassland flora with substantial bare ground at a date from 11 400 years BP, covering the latter half of the Late-glacial interstadial and much of the Late-glacial (Loch Lomond) stadial. Both the detached peat fragment and the lower part of the core contain this rich arctic–alpine tundra community. Cold-element components absent from modern chalk grasslands grew around Willow Garth, such as *Armeria maritima, Saxifraga oppositifolia* and *Botrychium lunaria. Gentiana verna* and *G. pneumonanthe* are unusual and microfossils of *Diphasium alpinum* are the first records for the British Quaternary. There are temperate elements in the earlier part of this phase, with *Corylus* pollen present. The presence of this thermophilous taxon may result from contamination, but Bush (1993) suggests that a plant and animal community without modem analogue may have included temperate types. Many Late-glacial pollen assemblages in north-east England include *Corylus* pollen, which routinely is dismissed as intrusive or the result of long-distance transport (Blackburn, 1952; Bartley, 1962; Bartley *et al.,* 1976; Flenley, 1984). Actual local growth of *Corylus* at this early stage should perhaps be considered. The *Corylus* pollen ceases to be recorded in the colder, stadial levels. Less easily dismissed is the presence of *Alnus* wood, catkins and pollen throughout the Late-glacial levels at Willow Garth (Bush and Hall, 1987), a record continuing well into the early Holocene until about 9460 ± 80 years BP and then with alder almost continuously present from about 8910 ± 80 years BP onwards. Several large, horizontally bedded pieces of alder wood from the Late-glacial sediment appeared *in situ* and are considered by Bush and Hall (1987) to be good evidence of very early local growth of alder in the Great Wolds Valley, perhaps favoured by unusual local environmental conditions. Other sites in Humberside exhibit Late-glacial *Alnus* pollen, as at The Bog, Roos and The Old Mere, Hornsea (Beckett, 1981), at Skipsea Bail Mere (Flenley, 1984) and at Brandesburton (Clark and Godwin, 1956), which seems to support the early context of these alder remains at Willow Garth. Tallantire (1992), however, finds the Willow Garth evidence for Late-glacial *Alnus* unconvincing, citing difficulties in identification of *Alnus* seeds and wood in comparison with *Betula* if preservation conditions are less than perfect. Although Bush and Hall (1987) record the alder wood as horizontally bedded stem wood, Tallantire (1992) points out that alder stem wood is not easy to tell from root wood and the latter may be intrusive, penetrating through sediments from above during times of lowered water tables. Further research is required to resolve the significance of the early *Alnus* records at Willow Garth, including radiocarbon dating of the wood itself.

As with other sites in the region in the early Holocene, at Willow Garth there is a start of the spread of woodland trees and shrubs, but this process is delayed and it is not until after about 9380 ± 90 years BP that tree *Betula* pollen increases substantially and suggests the establishment of woodland around the site. The tree expansion was not maintained, however, and high Gramineae and the persistence of taxa records such as *Helianthemum, Campanula, Lotus, Vicia, Teucrium* and *Geranium* show that dry grassland was not displaced by woodland. Temperate forest trees such as *Quercus, Corylus* and *Ulmus* never expanded in the early to mid-Holocene as they did at pollen sites elsewhere. *Betula* remained the dominant woodland component at Willow Garth, with *Pinus* pollen possibly contributed mainly via long-distance transport. Whether this apparent persistence of dry grassland was a natural process is conjectural. Bush (1989) suggests that the records of plant and insect taxa favoured by disturbance indicate that from *c.* 8900 years BP onwards Mesolithic hunter–gatherer activity was preventing forest closure and enabling the survival of species-rich grassland. As charcoal records are low, this would have been achieved without the major use of fire. There are many Mesolithic cultural sites within the Great Wold Valley (Bush, 1989). Whether the maintenance of dry grassland was confined to the vicinity of Willow Garth or was true of the wider Wolds is unknown.

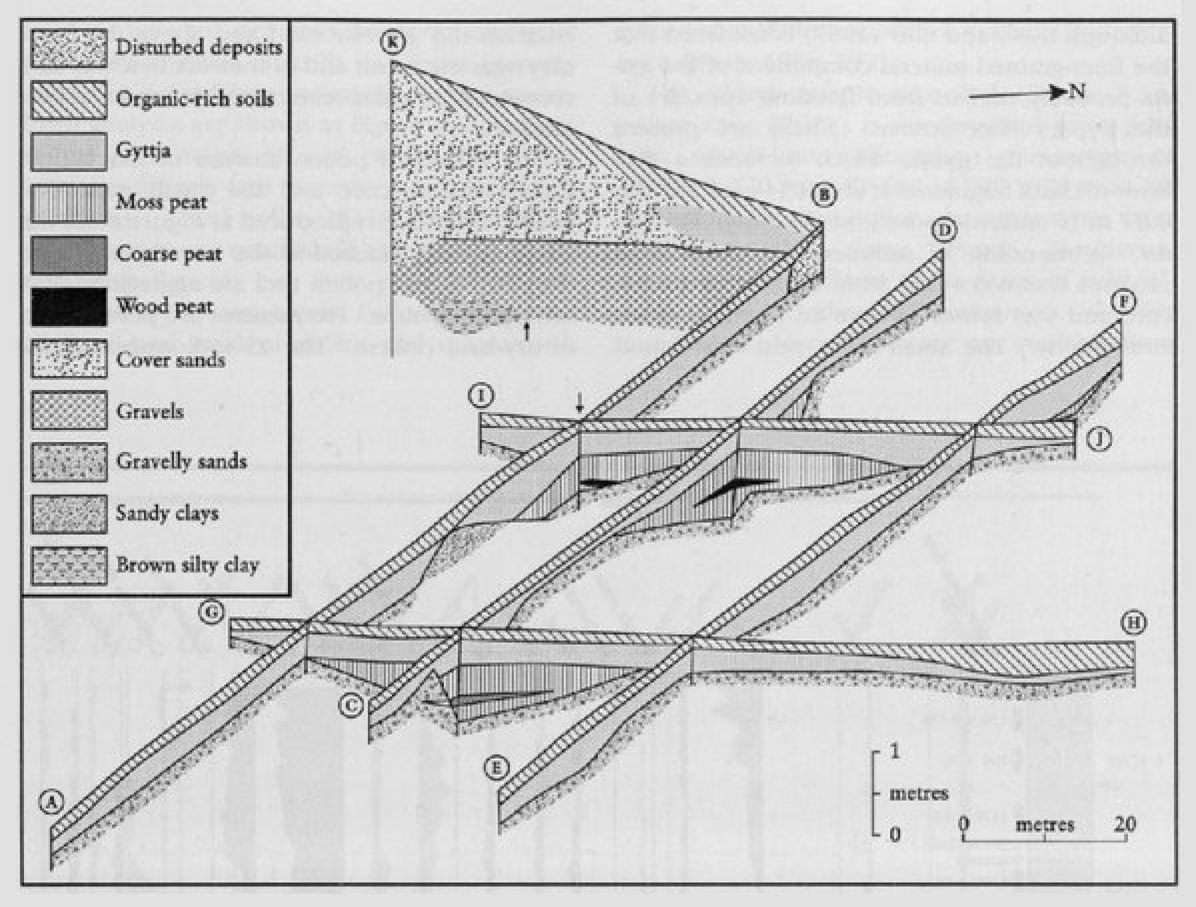
The value of Willow Garth for determining the status of the chalk grasslands is much diminished by the presence of sedimentary discontinuities, caused probably by standstill levels in sediment accumulation rather than erosion. Younger and McHugh (1995) have shown that peat accumulation in this area may be linked closely to variations in spring flows and thus water table fluctuations. This may have been the mechanism governing the history of peat formation at Willow Garth, where no evidence is available between *c.* 8000 and 4300 years BP, the entire mid-Holocene period. Grassland was certainly present after *c.* 4300 years BP, with high *Plantago lanceolata* suggesting major pastoral land use, but relatively substantial *Alnus, Corylus, Quercus* and *Tilia* could indicate that a deciduous forest phase may have occurred during the depositional hiatus. Palynology of buried soils beneath nearby Kilham Long Barrow (Evans and Dimbleby 1976) showed that before *c.* 4900 years BP on the chalk upland there was open grassland and evidence of arable cultivation. Persistence of chalk grassland throughout the mid-Holocene forest phase seems likely.

A second discontinuity between *c.* 3300 and 2200 years BP further reduces the value of the environmental record, but the later Holocene at Willow Garth was a dominantly open grassland landscape. Intensive grazing characterizes land use before the hiatus, but greatly increased arable cultivation occurred after it, with cereals being important. There are almost no other later Holocene pollen records from the Wolds chalk with which to compare Willow Garth, but a similar grassland and cultivated landscape was recorded in pollen data from sediments associated with a later prehistoric field boundary at Foxholes in the northern Wolds (Innes, 1989). The silty gyttja of the upper deposit at Willow Garth probably incorporates much mineral soil eroded after local ploughing, a common feature in the history of the Wolds landscape (Ellis and Newsome, 1991). An important change at Willow Garth occurred after *c.* 1300 years BP when the wetland became much drier, with aquatic pollen being replaced by that of disturbed dry-ground weeds and *Salix* pollen increasing greatly. Bush (1993) suggests that the site became managed as an osier bed, which has saved it from later major drainage and preserved the important environmental record.

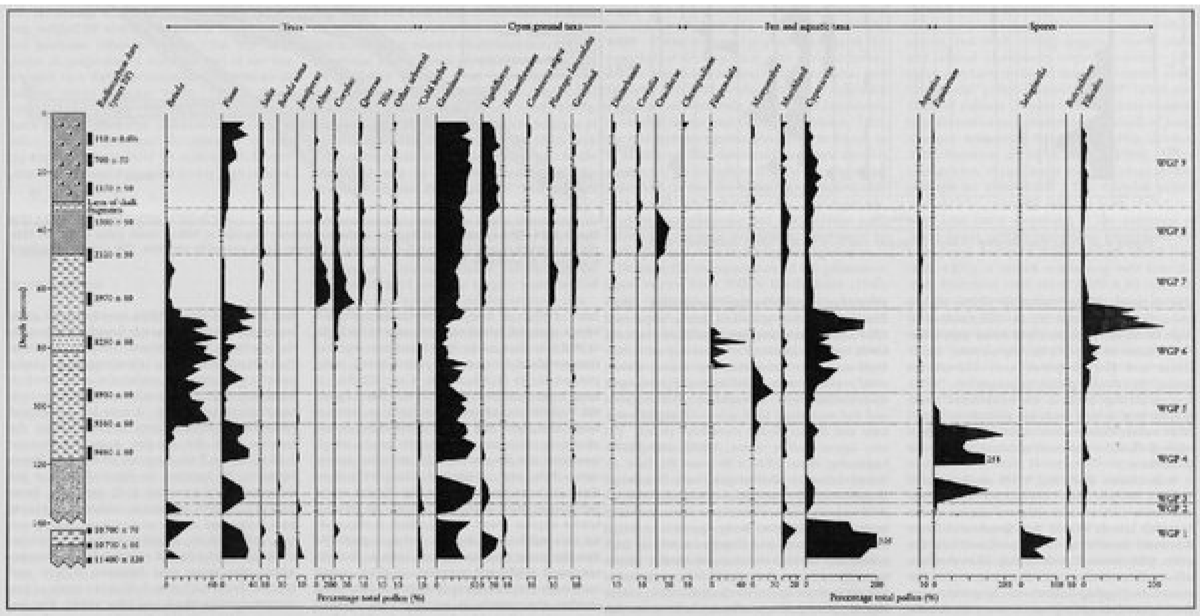
Conclusions

The Willow Garth sediments are an important but incomplete archive for the environmental history of the chalk Wolds. If the major discontinuities in the sampled core result from localized erosion, oxidation or failure to form peat because of irregular flooding by the stream or variation in spring flow, it may be that the gaps in the environmental record are specific to that core only. Sediment covering the missing periods may exist at other locations, and other cores could provide a more complete data record. The site is complex and controversial and requires further research.

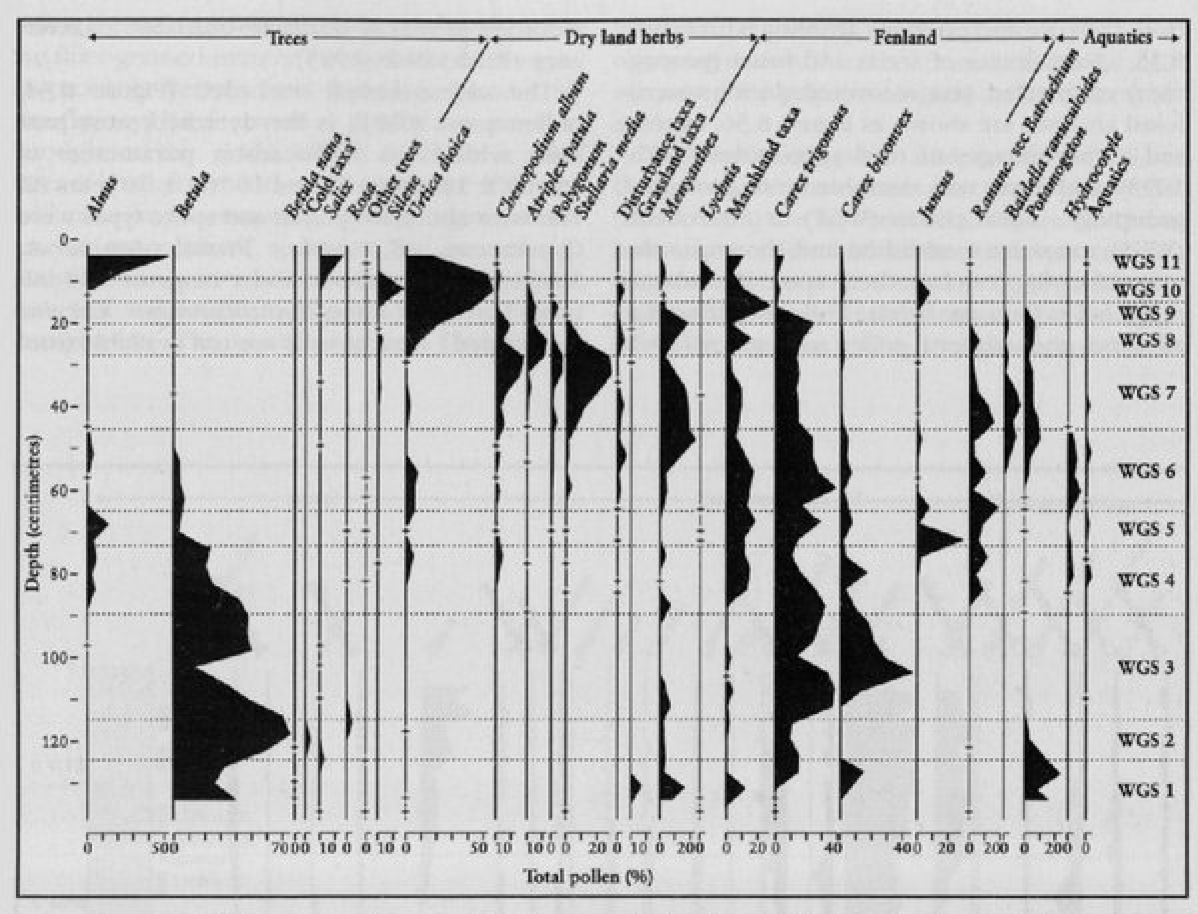
References



(Figure 8.34) Three-dimensional diagram of the sedimentary deposits at Willow Garth (after Bush and Ellis, 1987). The lens of peat on section K–B is too small to show and is marked by an arrow. The main core analysed is arrowed on section A–B.



(Figure 8.35) Percentage diagram of fossil pollen data from Willow Garth (after Bush, 1993). See (Figure 8.1) for key to the stratigraphical log.



(Figure 8.36) Percentage diagram of fossil propugale data from Willow Garth (after Bush, 1993).