PALYNOLOGICAL ANALYSIS AND EVALUATION OF VEGETATION AND LANDSCAPE FROM MESOLITHIC TO ROMANO-BRITISH TIMES

by Pat Wiltshire

Introduction

As requested by the archaeologists responsible for the excavation and interpretation of this complex site, this report will not follow the usual conventions of presentation. Details of site description, background, and methodology will be omitted (see print vol.) and descriptions of pollen zones and the minutiae of variation in the pollen spectra will be kept to a minimum. This will enable the salient features of the vegetation history and land use of the area to be emphasised. Very large numbers of samples and sub-samples of sediment were assessed and analysed for palynological status, and this approach has been productive; a more comprehensive mosaic of pictures has been produced than would have been possible if the usual minimalist sampling strategy had been applied.

Either during or subsequent to accumulation, many of the sediment sequences had been subjected to conditions that were not conducive to good palynomorph preservation. However, even where there had been considerable differential decomposition, it was possible to glean useful information. These fragmentary data have augmented the landscape picture obtained from the sequences where results are more comprehensive. The caveats that need to be applied to such partial information are understood and will be stressed appropriately.

It must be borne in mind throughout that the palynological record from any set of "on-site" archaeological features will tend to indicate a cleared landscape. It is implicit that society could not function within dense woodland; even in predominantly pastoral economies, people need space for themselves and their animals. Furthermore, woodland resources would be exploited for domestic use, and areas of grazing would necessitate removal of canopy cover. This is particularly true when an economy includes true grazers such as sheep. Cattle are naturally woodland animals and would thrive on browse, but their management would also involve exploitation of trees and shrubs and inevitable reduction of canopy cover.

With increasing population, woodland would be removed further from the centre of activity. Management (coppicing and pollarding) of the woodland resource would also result in reduced flowering potential of trees and shrubs. These combined effects would result in diminished pollen influx into sediments and soils in the settlement itself and, if only "on-site" deposits were investigated, the impression gained would be of a largely cleared landscape. To gain a better understanding of the nature of the prehistoric landscape beyond the epicentre of human activity, it would be necessary to analyse deposits which accumulated at sites removed from the settlement areas. This is not always possible so every caveat must be applied in the interpretation of the palynological data where only archaeological features are analysed.

In spite of the inevitable bias inherent in deposits from pits, ditches, and waterholes, it is possible to gain information on the environment within which people lived. Obviously, if pits and ditches in the settlement indicated heavily wooded conditions, it is highly probable that they were being used in such an environment. The difficulty comes when a feature is marginal to woodland and the pollen spectra becomes dominated by trees. There is little doubt that irrespective of taphonomic factors such as variable pollen production and dispersal, most pollen produced by any plant falls near the parent (personal observation). This means that any plant adjacent to a feature might be over-represented and distort the wider picture.

The wider landscape

Compared to other parts of Britain, the geology and Holocene climate of southern England has resulted in a dearth of uninterrupted sequences of sediments that would be suitable for producing records of past vegetation and land use. The landscape around modern Heathrow Airport is singularly lacking in a well-dated palynological record. Most results have been obtained from riverine deposits or from archaeological features, and most information remains unpublished and is inaccessible. Although generally useful, a very broad summary of the geographical and environmental background to Surrey in the Holocene up to about AD 1500 (Macphail and Scaife 1987) does not give enough detail to characterise the area around Perry Oaks for the periods under review. The nearby site of Runnymede (Greig 1991; Greig 1992) has provided information on the landscape from the Neolithic to the late Bronze Age, while a relatively crude pollen diagram is also available from Staines Moor (Keith-Lucas 2000) which covers the period from the early Holocene to possibly the Bronze Age. A detailed assessment on Church Lammas at Staines (Wiltshire 1998) and a full analysis of peat from a waterhole at Staines Road Farm (Wiltshire forthcoming) have been produced. Both these sites produced sediments which overlap some of the period covered by the analysis of Staines Moor and Runnymede and, when all are considered, they may yield some useful information on spatial variation in the region. However, from existing published literature, it is very difficult to obtain detailed information about the nature of vegetation in and around archeological sites, and about the variability in agricultural practices. Although extensive work was done at Runnymede (Greig ibid..), and it is valuable for some degree of comparison, there is insufficient provision of very detailed information from a large number of features to enable a detailed comparison with the landscape at Perry Oaks.

Other sites that have been investigated in Surrey within the last few years, and whose records overlap that of Perry Oaks, include Home Farm, Laleham (Wiltshire 1997), Eashing Mill (Wiltshire 1998), Thursley Common (Wiltshire 1999), and Frensham Common (Wiltshire 2000). It is perhaps unfortunate that resources were not available for full analysis of these excavations since they mostly yielded richly polleniferous sediments. However, they were assessed in detail and some valuable environmental information was gained. Results from these sites will be used in discussion as appropriate.

In this report, the results will be discussed chronologically, as defined by archaeological dating. The rather fragmentary data provided by the less polleniferous sediments are included along with those from detailed analysis. The results of analyses are presented in conventional pollen diagrams which have been divided

subjectively into zones for convenience of description. In each case, a summary diagram and fuller diagram are provided. The summary diagrams show the relative proportions of arboreal pollen to dwarf shrubs, crops, herbs, ferns, and plants of we soil. Also shown are curves for microscopic charcoal and fungal and algal remains.

Mesolithic (137021, 120028 and 160021)

Three samples of Mesolithic deposits were obtained from Perry Oaks (137021, 120028, and 160021). Only 160021 yielded pollen and then only *Pinus* (pine), Poaceae (grasses), and monolete Pteropsida (fern). It is impossible to interpret much from these depauperate data but the preponderance of pine might be indicative of the pine woods known to have been extensive in southern England in Mesolithic times. The pollen diagrams from Staines Moor (Keith-Lucas ibid.), Church Lammas (Wiltshire ibid.), and Uxbridge (Lewis *et al*., 1992) indicate that this area of southern England was dominated by extensive pine and *Corylus* (hazel) woodland for a period before 8000 years ago. In fact all these sites show the classic Holocene woodland succession (see Godwin 1975) and there is no reason to suppose that the area around Perry Oaks would have been substantially different.

Early to Late Neolithic Transition

Microscopical examination showed a high level of differential decomposition in a range of deposits from this period, but a crude picture of the surrounding landscape might be gleaned from the sparse data. A pit associated with the Neolithic Cursus (150011) and a linear ditch (134011) show a spatially variable palynological record. Some comparisons with results from other sites in the region have been included for the purposes of general comparison.

Assessed deposits (150011, 134029 and 134011)
Feature 150011 (samples 1012, 1013, 1016) is a pit cutting through lower silts in cursus, this was assessed alongside features 134011 and 134029 (sections through two of the cursus monuments) but only sample 1013 in 150011 was sufficiently polleniferous to warrant full analysis.

Analysed deposits (150011: Sample 1013)
The results are shown in Figures 1(a) and 1(b). The three pollen zones were designated 150011/1-3 respectively. Changes in the pollen spectra in this sequence are rather subtle and indicate that only moderate changes were happening in the landscape around the feature. It must be stressed, however, that pits can become infilled very quickly and the sediments might represent a single generation of trees. Many forest trees are potentially long-lived; a healthy specimen of *Quercus* (oak) can live for at least 600 years (Mitchell 1974), and managed trees (pollarded and coppiced) can live even longer (Rackham 1986).

Zone 150011/1: The deposits represent a period some time after the elm decline of approximately 5000 years ago. The soils around the waterhole were wet enough to support occasional Cyperaceae (sedges) and some *Sphagnum* moss but there is no evidence of the feature having had an aquatic and emergent community in or around it. People were certainly active in the environs of the site since microscopic charcoal levels were relatively high throughout the zone. Furthermore, occasional cereal-type

pollen grains were found. Considering the nature of the palynological assemblage, these grains are unlikely to be those of *Glyceria* species. These aquatic grasses produce pollen grains within the size range of some cereals and their presence at riverine sites can cause confusion. It is more likely that the cereal-type grains recorded here are of cereals.

There is little doubt that there were many trees near the waterhole when these deposits were accumulating, and arboreal pollen accounts for up to 80% of total land pollen and spores (TLPS) throughout the zone. This area appears to be more heavily wooded than at Runnymede. Whether this is due to natural spatial heterogeneity in tree distribution or whether it actually reflects the density of the woodland canopy is difficult to assess. But *Hedera* (ivy) was abundant, especially towards the end of the zone where total arboreal pollen falls and that of Poaceae (grasses) actually rises. This suggests that the canopy was becoming open enough to support flowering ivy and, indeed, the high tree/shrub pollen values might be the result of some degree of tree clearance creating the edge effect outlined above. The woodland community included ferns such as *Polypodium* (polypody fern), monolete Pteropsida (possible *Dryopteris* spp. - buckler ferns), and *Pteridium* (bracken) but all these respond favourably to openings in the woodland canopy.

The suggestion that the feature was close to a woodland edge or in a glade is supported by the presence of Poaceae (grasses), Rosaceae (hawthorn, bramble, rose), *Salix* (willow) and a range of weeds and ruderals such as *Artemisia* (mugwort), Chenopodiaceae (goosefoot), *Rumex* (docks), Lactuceae (dandelion-like plants), and *Plantago lanceolata* (ribwort plantain). There were also herbs such as *Lotus* type (bird's foot trefoil), *Prunella* type (e.g. self heal), *Silene* type (e.g. red campion), and *Epilobium* type (e.g. greater willowherb). All these could have been growing in grassy areas and places where the soil was disturbed.

Oak and hazel dominated the local woodland although *Alnus* (alder) was well represented and probably growing on the wetter soils near the river. *Betula* (birch). *Pinus* (pine), and *Fraxinus* (ash) were growing in the catchment but were either some distance away or present in small numbers. *Tilia* (lime) and *Ulmus* (elm) were both growing in the vicinity but their relatively low abundance suggests that they might have been already been subjected to management. Both plants produce highly nutritious foliage and they could have been exploited for cattle fodder. Lime is also the source of many other useful commodities (Bates and Wiltshire 2000) and was probably targeted by early settlers.

Zone 150011/2: This zone is characterised by small but discernible changes in the local vegetation. The relatively high levels of microscopic charcoal attest to a continued human presence. Both *Tilia* and *Alnus* declined slightly and there was a drop in *Quercus* in the middle of the zone and this may have been the result of pollarding trees close to the feature. The fall in *Quercus* was reciprocated by a rise in Poaceae and ferns, and *Acer* (maple) was recorded. Rosaceae were also consistently represented at fairly high level and *Hedera* increased at the end of the zone. There was very little change in the herbaceous plants other than the rise in grasses as described above. It would seem that the local oaks were being exploited and that this allowed more light to reach shrubs and herbs. Cereal-type pollen was found which shows continued (though very small-scale) arable activity nearby.

Zone 150011/3: The amount of microscopic charcoal accumulating into the feature declined in this zone and the centre of activity might have moved away slightly. *Corylus* (hazel) continued to be a dominant member of the woodland while *Alnus* and *Tilia* both declined. *Quercus* also declined towards the top of the zone but the more light-demanding shrubs (*Salix*, *Acer*, *Hedera* and Rosaceae) were all well represented. Some light-demanding herbs flowered more prolifically than before, and ferns certainly increased. This suggests that there was more light available to the area so that marginal shrubs and herbs were able to flower more profusely. It is tempting to suggest that animal grazing played some role in these changes at the site and the drop in Poaceae might be a function of grazing of flowering heads. Certainly, arable agriculture seems to have increased, and the canopy was open enough to allow *Calluna* (heather) to grow in the area.

Summary
The pit (150011) shows that the Neolithic landscape supported mixed, deciduous woodland, dominated by oak and hazel at the site. However, some impact was being made on the wildwood. Because of the relatively short life of the feature, the picture presented here may represent a brief period, certainly within a single generation of oak, lime, and alder trees. There appear to have been relatively small areas of grasses and herbs, and the environs of the pit had moist soils. There seems to have been some arable agriculture being carried out locally and it is possible that cereals were being grown in the woodland glades, the so-called practice of "forest farming" (Coles 1976; Göransson 1986; Edwards 1993).

General Regional Comparisons
There is little doubt that a post elm decline Neolithic long barrow site at Redlands Farm in Northamptonshire (Wiltshire forthcoming) was clear of trees when the barrow was constructed between 3800-3640 cal BC at 95% probability (see Healy and Harding forthcoming). Subsequently, the monument appears to have been neglected and woodland invaded the clearing. Analysis of palaeochannel deposits from the River Nene, close to the barrow (Brown and Keough 1992) showed that the catchment was extensively wooded during the late Neolithic. This implies early Neolithic clearances eventually healed over, and evidence from the barrow ditch itself demonstrated the recovery of trees and shrubs. However, it is also possible that the wider landscape consisted of woodland with a mixed mosaic of newly created and neglected clearings that simply were not reflected in the more regional record provided by the palaeochannel sediments. It is unlikely that a clearing some distance away would be reflected in the pollen record of a site which, itself, was fringed with trees.

At Staines Moor (Keith-Lucas), the earliest Neolithic landscape also appears to have been extensively wooded but there was low resolution in the sampling and the sequence was poorly dated; it is unclear when extensive woodland clearance began there. Woodland clearance began at Runnymede in the earliest Neolithic, but arboreal pollen consistently had values of about 50% of total land pollen (TLP) until Bronze Age people started their incursion into the woodland. According to Heim (1962), this might indicate that woodland covered about half the landscape. Although this model is crude, it is a useful tool for spatial and temporal *comparison* of woodland cover. However, it must be remembered that there can be higher arboreal values for pollen in

an open canopied woodland, or at the woodland edge, than in the dense interior (see Tauber 1965). Certainly in some mixed woodlands, the canopy component does not seem to fall through to the woodland floor when trees are growing densely, but it *does* seem to reach the ground beneath the parent trees where they are more spaced or the branching is relatively open (personal observation). It is also of interest that considerable amounts of herbaceous pollen can find their way into deposits well within the heart of woodland if there is adjacent open ground (Wiltshire 2002; Wiltshire 2003).

The proximity of Runnymede and its relatively abundant woodland in the Neolithic suggests that the data from the Perry Oaks earlier Neolithic features are, either too impoverished to be reliable, or reflect a period when Neolithic people had, indeed, created extensive clearings in the vicinity of the features in question. To get low arboreal pollen values, the woodland edge would have had to have been some (unknown) distance away from a feature, or the local trees would have had to have been very heavily exploited so that flowering was suppressed.

Middle Bronze Age

Assessed deposits (159200)
Feature 159200 (Samples 998 and 999) yielded very sparse information but it seems that the landscape was very open with weedy grassland dominating the area. *Alnus, Pinus*, and *Quercus* were recorded and *Salix* must have been growing in the near vicinity.

Analysed deposits (124100, 135071, 156031, 178108)

Feature 124100 (Samples 1382/1378/1381)
The results for Feature 124100 are shown in Figure 2(a) and 2(b).

Zone 124100/1: Early in its history the soils around the feature were wet and probably supported a sparse tall herb community of Cyperaceae, *Filipendula,* and *Mentha* type (water mint). There was certainly standing water in the hole since iron pyrite framboids were recorded and green algae are recorded. The relatively high levels of fungal hyphae might also indicate that considerable amounts of organic matter were finding their way into the water. Certainly the byproducts of bacterial fermentation of organic debris are necessary for iron and sulphur reducing bacteria to be able to form iron pyrite (Wiltshire *et al*., 1994). The fairly high levels of microscopic charcoal attest to local burning.

The waterhole was set in a cleared, agricultural landscape with both arable and pastoral farming being important in the immediate area. All woody plants were relatively sparse although as already discussed the low percentages for tree and shrub pollen might be a function of management of the renewable resources they offered. The most frequent taxa were *Alnus, Corylus* and *Quercus* but *Betula, Pinus, Tilia* and *Ulmus* were growing in the catchment. There is little doubt that the waterhole was situated fairly close to a species rich hedge which would have provided food, construction materials, wood for domestic utensils, fuel, medicine, dyes, and aesthetically pleasing plants. It is, of course, possible that the plants normally considered to be tall woodland trees could themselves have been maintained in

hedgerows in a pollarded or coppiced form, but *Cornus* (dogwood), *Hedera* (ivy), *Lonicera* (honeysuckle), *Rhamnus* (purging buckthorn), *Crataegus* type (hawthorn), *Prunus* type (sloe and damson), Rosaceae indet (e.g. wild rose, bramble), *Salix* (willow), and *Sambucus* (elder), were all available. And, of course, *Corylus* was present, yet another plant valuable for food, fodder, and (along with willow) making wattle panels and baskets

Cereals were being grown or processed nearby, and many of the herbs such as *Solanum nigrum* type (black nightshade), *Anthemis* type (mayweeds), Apiaceae (hogweed family), *Artemisia* (mugwort), *Lotus* type (bird's foot trefoil), Fabaceae indet (clover family), *Rumex* (docks), Chenopodiaceae (goosefoot), *Polygonum aviculare* (knotweed), *Plantago lanceolata* (ribwort plantain) and many others, could have been exploiting the open, broken soils of the ploughed fields or, of course, edges of pathways. Many of the same plants could have been growing in the grassy hedge bank, particularly *Galium* type (bedstraw), *Potentilla* type *(e.g. silver weed)*, *Ranunculus* type (buttercups), and *Stachys sylvatica* type (hedge woundwort). Certainly *Mercurialis* (dog's mercury) would have been associated with the hedge and indicates the antiquity of the hedgerow; even today, it is an indicator of ancient woodland and a frequent member of herbaceous communities associated with ancient hedges. *Pteridium* too might have been confined to the unploughed and ungrazed area immediately adjacent to the hedge. This is often where it is found in agricultural landscapes today in lowland England.

Many of the herbs in the diagram were probably growing in the grazed pasture, particularly those that are resistant to trampling such as *Plantago major* (greater plantain), *Ranunculus* type, *Trifolium* type (clover) and *Cerastium* type (chickweed). It would be unwise to try to envisage most of these being confined to any one microhabitat; although a species might favour particular conditions, it can often exploit less favourable sites where competition is less intense.

Zone 124100/2: The feature continued to contain standing water but the higher frequency of green algal spores (*Spirogyra* and others) suggests that there were occasions when the water table was low or it actually dried out from time to time. The sporulation of *Spirogyra* and other green algae is known to be stimulated by drought stress (Round, 1981). Wetland plants growing around the edges also increased, particularly Cyperaceae and *Filipendula*. But *Sphagnum* moss and *Iris*, and floating aquatics such as *Lemna*, *Potamogeton* (pondweed), and *Batrachium* type *Ranunculus* (e.g. water crowfoot) were growing in the water. This indicates that the feature was probably less used than previously.

Fungal remains declined quite markedly as well as microscopic charcoal. This might indicate that less organic debris was finding its way into the waterhole, and that there was slightly less activity locally. Poaceae increased and crop plants declined. This also suggests that both arable and pastoral activity was less intense at the site. Certainly, plants such as *Ophioglossum* (adder's tongue fern) and Thalictrum (meadow rue), which are characteristic of meadows and damp pastures today, were able to grow and it is possible that the sward close became longer and damper, creating ideal conditions for these taxa. There was a small overall increase in woody plants, particularly *Quercus*, and this may be reflecting a slight relaxation of management of the local trees and hedgerow. It must be emphasised, however, that

Linum usitatissimum (flax) was found in this zone. This plant is well known to produced tiny amounts of poorly dispersed pollen (values of less than 2% TLPS have been recorded within the crop fields) so a single pollen grain could, actually, represent a considerable area put to this crop.

At about 112cm, Poaceae declined and continued to do so until the end of the zone. There was also a decline in some of the herbs that might have been abundant in the local grassland such as Fabaceae (clover family), *Potentilla* type (e.g. silver weed), and *Ranunculus* type (buttercups). It is possible that grazing intensity increased locally but it might also mean that the grassland was being managed for hay production. The lack of response of some of the herbs that were probably growing in the pasture community might simply reflect the relative flowering times at hay cutting. This interpretation is conjectural but quite feasible.

Zone 124100/3: The area around the waterhole seems to have been the focus of renewed agricultural pressure in this zone. Microscopic charcoal increased very greatly and fungal remains declined massively. There was also a very marked increase in algal spores and decline in floating aquatic plants, and it is possible that the waterhole held relatively little water, or dried out seasonally.

There was little change in the larger woody taxa other than a slight but consistent lower representation of *Alnus*. However, *Acer* and *Viburnum* (guelder rose) were recorded and *Salix* increased while Rosaceae indet (probably bramble) declined. Nevertheless, the hedgerow remained diverse and was probably being managed carefully. Cereal pollen was more frequent along with ruderals such as *Artemisia* (mugwort), Chenopodiaceae, and Lactuceae (dandelion-like plants) which could have been growing at the field boundaries, on paths, or even in the crops themselves. Poaceae recovered slightly but not to the levels of the earlier part of the previous zone. There was a marked decline in *Plantago lanceolata* and a reciprocal (quite large) rise in *Pteridium.*

The varying fates of these taxa must relate to relatively small scale changes in local land use practices. It is feasible that brambles were being cleared from the hedgerow, freeing bracken from competition. It is also possible that more intense grazing allowed the unpalatable bracken to flourish. Stock animals often seek out the longer and more succulent herbage along field boundaries and hedgerows but grazing is selective. It is, of course, possible that a different stock animal was being grazed in the pasture, possibly sheep rather than cattle. They have a very different effect on the sward from cattle by virtue of close nibbling rather than tongue pulling. Generally, they cannot cope with long vegetation and, today, are usually pastured when the grassland sward has been reduced in height (Bacon, 1990). They can cope with a very short sward, and even crop stubble after harvest, whereas cattle need fairly lush, long grass (Owen, 1980). Sheep will nibble young bramble and flowering heads of rosette plants (personal observation), but will usually avoid bracken; and they are not effective as effective as cattle at trampling down this invasive pastoral weed. Sheep are also less dependent upon waterholes and get much of their water from vegetation. It is feasible that drier conditions and repeated drying out of the waterhole favoured sheep over cattle in this particular field system.

Stocking densities and duration of grazing in any one area is known to affect the species composition of pasture very markedly. However, certainly in calcareous grassland, high species richness is maintained when sheep are kept at 1 animal ha^{1} yr^{1} on swards of low productivity, but at 7 sheep $ha^{1}yr^{1}$ where there is high productivity (Bacon, *ibid.*). The species richness in herbs in Zone 124100/3 certainly changed, and taxa such as Fabaceae (e.g. bird's foot trefoil, hop trefoil, clover), *Galium* type (e.g. bedstraws), *Plantago lanceolata*, and *Potentilla* type declined. It is possible that sheep grazing was responsible for this effect. Some of the shrub taxa growing locally certainly indicate that the soil was moderately calcareous (at least in patches) and, considering the rich assemblage of plants growing in the sward, it is possible that the grassland was at least moderately productive. Although it is highly conjectural, perhaps a stocking density of about 7 sheep ha^{1} was being maintained.

It is very difficult to define precisely the nature of the stimulus to vegetation change, but any of the above suggestions is possible. In any event, none of the shifts in the relative performance of the plant communities created dramatic transformation of the local landscape. The effects were probably caused by relatively small scale changes in husbandry and land management such as selective cutting of different plants in the hedges, attempts at removing troublesome "weeds", crop rotation, rotation of the use of areas for arable and pastoral husbandry, and moving sheep and cattle around to cope with varying states of herbage in the pastures.

Feature 135071 (Samples 642, 1004 and 1008)
The pollen diagram for these samples is given in Figure 3(a) and 3(b). There might have been an hiatus of unknown size in the record between each set of samples.

5.2.1.1 Zone 135071/1: Early in the life of the feature, the adjacent soils were wet and supported Cyperaceae and *Mentha* type (c.f. water mint), but there is no evidence of a tall herb community at its margins and no direct evidence for the presence of standing water. This might imply that it was heavily used so that aquatics and emergents were suppressed.

Towards the top of this Zone, SG 135067 (Specifically, Context 135040, beneath the log-ladder 135042) yielded four radio-carbon dates (WK1030, 1530-1310 BC; NZA14903, 1438 – 1132 BC; WK10035 1420-1120 BC and WK9374, 1220 – 890 BC). Deposit SG 135041, directly beneath the log-ladder 135042 contained the wooden beater (objectr 323) which gave a radiocarbon date of 1502-1116 BC (NZA 14906).

The summary diagram shows quite clearly that the landscape was extensively open during this phase of the site's development. Arboreal pollen did not exceed more than about 20% TPLS. The most frequent tree pollen was that of *Alnus* and, although the mix of woody plants was fairly rich, no tree appears to have been abundant. *Betula* (birch), *Corylus*, *Fraxinus*, *Pinus*, *Quercus*, and *Tilia* were all growing in the catchment but either they were some way from the waterhole, or they were being suppressed by exploitation. However, the relatively large number of woody taxa with characteristically poor pollen production and pollen dispersal such as *Acer* (maple), Rosaceae indet., c.f. *Crataegus* (hawthorn), *Salix* (willow), *Sambucus* (elder), and (found in the original assessment) *Rhamnus* (purging buckthorn), strongly suggests

the proximity of an old hedge. Indeed, all the trees mentioned above (except possibly for *Pinus*) might have been growing in a hedgerow although cutting would have had to have been fairly light for them to appear in the pollen record. The species richness of woody plants and the frequent occurrence of *Acer* strengthens the contention that the hedge was old. Today, this shrub is rarely found in young, species poor hedgerows and there is common consensus that its presence indicates an age of at least 400 years (Dowdeswell, 1987). Hedges can form in a variety of ways (Dowdeswell, *ibid.*) but it is probable that Bronze Age ones were remnants of old woodland edge, or possibly long-maintained boundaries, protected from ploughing, and offering perches for birds.

There is little doubt that the hedgerow is a resource, not only for fuel and construction materials, but also for the wildlife it encourages (such as birds which provide eggs). The plants that grow in them, and associated with them, provide food (nuts and berries), medicinal, and dye plants. It is likely that Bronze Age people were well aware of the value of hedge boundaries and they probably exploited them with care. There would have had to have been a balance between cropping for wood and for food, and retention of the hedge as a functional boundary.

Cereals were probably being grown fairly closeby and open soils are evidenced by the frequent representation of ruderals such as Chenopodiaceae, Rumex (docks), *Polygonum aviculare* (knotweed), and Apiaceae (hogweed family). However, pasture also seems to have been very important in this area and herb-rich grassland dominated the site. Most of the herbs shown here are common plants of pasture, and their varying fates throughout this zone could simply be a response to differential grazing patterns of stock animals. *Pteridium* appears to have infested the well-drained, more acidic areas and the presence of *Calluna* (heather) hints at a degree of soil impoverishment locally.

Zone 135071/2: There is an hiatus in the record between the previous zone and this one. During the period of sediment accumulation in this zone, the marginal soils had become wetter and there were floating aquatics in the feature. Cyperaceae, *Filipendula , Lythrum portula* (water purslane), *Mentha* type, *Sphagnum* moss, *Lemna* (duckweed), and algae were all recorded. Their presence indicates that the waterhole might have been somewhat neglected. *Glomus* type indicates that soils were eroding into the feature. These fungal bodies are found associated with living plant roots.

There was certainly some impact of human activity around the site since there are marked changes in the pollen spectra of dryland plants. Although *Alnus* was at a very low level in the basal level in this zone, it increased dramatically (up to 40% TLP). However, a considerable amount of alder wood and bark was found in the deposit, as well as artefacts made of this wood. It is highly likely that the increased pollen percentage for alder is an anomaly due to deliberate emplacement of its bark and wood in the feature. Pollen is known to adhere tenaciously to bark and it is highly likely to be the origin of the high pollen percentages in this zone.

Tilia declined to extinction but other woody plants seem to have been little affected. There was certainly a large increase in microscopic charcoal concentrations and whatever the nature of the change in land use in the locality, fire might have played a role in it. The herbaceous flora was also affected with some herbs like *Plantago lanceolata* being enhanced while others such as *Potentilla* type (e.g. silver weed),

Senecio/Bellis (ragwort/daisy), and *Pteridium* declining. The marked increase in *Ranunculus* type (buttercups) could be related to the increased wetness around the waterhole since *R. lingua* and *R. flammula* are commonly found growing on wet soils.

Although these changes appear fairly dramatic in the pollen spectra, they might only represent a fairly short period of different land management. For example, there might have been some attempt to burn off dead biomass in the winter and active removal of bracken and ragwort from pasture. A release of nutrients from the burnt dead sward could result in enhancement of growth of other herb species. Interpretation of these events is certainly not easy. As regards the dramatic increase in *Alnus*, it might simply reflect a relaxation of the local cutting regime so that pollarded trees were able to flower prolifically. *Tilia* seems to have been adversely affected and *Quercus* and *Pinus* were less well represented. But, their values were so small in the previous zone that it is difficult to know whether these changes are meaningful.

There is little doubt that herb-rich pasture continued to dominate the area around the feature, and that the nature of the hedgerow seemed to have been little affected by any of the land use changes. Cereals were a little less well represented in this zone but this might simply mean that crops were being grown slightly further away. Crop weeds such as *Centaurea cyanus* (cornflower), and *Anthemis* type (e.g. mayweed) and plants characteristic of open soils were certainly growing locally.

Zone 135071/3: The feature contained standing water in this zone; *Lemna* was very abundant on the water surface, and *Menyanthes* (bog bean) was also growing in the waterhole. Microscopic charcoal levels fell back to nearly the same as those in Zone 135071/1 and, apart from the increase in wetland and aquatic plants, the local vegetation reverted to that prevailing in Zone 1.

Spot sample 135071 (642): This sample was taken from deposits above those described above. It is possible that by the time these sediments were accumulating, the feature had filled-in and was dry. Palynomorphs were very sparse and only 129 grains were counted in the sample. There was no indication of wetland or aquatic plants and, apart from a rather diminished pollen assemblage, the vegetation appears to have been somewhat similar to that in the more polleniferous deposits of Zone 3. The main difference was that microscopic charcoal levels were very low and the tree/shrub assemblage was reduced. *Alnus*, Rosaceae (c.f. hawthorn), and *Tilia* were the most frequently recorded and there were just traces of *Betula* and *Quercus*. No other woody taxa were found. However, cereal production and pastoral husbandry still seem to have been practised.

Feature 156031 (Samples 1369,370,1423)

The three samples making up this sequence were not obtained contiguously so that there is an hiatus between 1369 and 1370 (i.e. between zones 156021/3 and 156031/4). It must also be noted that there were marked differences in the some of the pollen spectra between samples 1370 and 1423 and an unconformity might be expected even though they are presented as a continuous sequence in Figures 7(a) and 7(b). It is possible, therefore, that there is some temporal discontinuity between zones 156031/1 and 156031/2 but no estimate can be made of the length of time involved. The results for the well deposits (156031) are shown in Figures 4(a) and 4(b). Four pollen zones were differentiated for convenience of description (156031/1-4).

Zone 156031/1: There was no palynological evidence for the feature containing standing water in this zone. However, the soils around the edges were wet enough to support tall herbs such as sedges, meadow sweet, and water mint. It is also possible the undifferentiated ferns recorded in the zone were of *Dryopteris carthusiana* (narrow buckler fern). This is often found in mixed, tall herb communities on wet soils today. The absence of any record of obligate aquatics might be due to the fact that the well was in constant use so that water plants could not get established. The very high representation of fungal remains suggests that the feature dried out and became aerated but they could also have been derived from leaf litter and other organic material finding its way into the feature.

Like several of the Bronze Age features already described, this waterhole seems to have been situated close to an old hedgerow with maple, *Prunus* type (cf sloe), *Sorbus* type (e.g. rowan), willow, and *Viburnum* (guelder rose) growing with hawthorn, and possibly bramble. The values for *Hedera* (ivy) were particularly high and this suggests that the climber was growing very close to the well and supported by the hedge shrubs. The higher representation of woody taxa may have been a function of more relaxed management so that flowering was more prolific than before. If they are to be maintained as effective boundaries, it is imperative that hedges are cut from time to time but, if this management regime is too frequent or stringent, flowering shoots are removed and no pollen is produced. This is true of all the woody plants described in this report.

The relatively high levels of microscopic charcoal indicate that people were active close to the feature but, in addition to the woody taxa, the herbaceous pollen spectra also suggest a relaxation in activity in the vicinity of the waterhole. Grass pollen was relatively high and reached values of 40% in the middle and towards the end of the zone. Grazing pressure seems have been reduced so that herbs such as *Hypericum perforatum* type (St. John's wort), *Polygala* (milkwort), *Potentilla* type (tormentil/silverweed), *Prunella* type (self heal), buttercups, ribwort plantain, *Trifolium* type (clover), *Lotus* type (bird's foot trefoil) and others were able to flower. Ruderals such as goosefoot, docks, dandelion-like plants, hogweed/fool's parsley, and *Sinapis* type (e.g. charlock), and *Artemisia* (mugwort), were very well represented and this suggests that open ground was infested with these waste ground weeds. *Centaurea cyanus* (corn flower), a plant so associated with cereal crops, was also growing locally and many of the herbs could have been growing at the margins (or even within) crop fields.

Cereals were certainly being grown and/or processed in the vicinity although they declined towards the end of the zone. Grasses and herbs such as mugwort, goosefoot, dandelion-like plants, and bracken also declined towards the end of the zone while alder, birch, and oak increased and *Fagus* (beech was also recorded). However, the representation of shrubs that were probably growing in the hedge seemed to be relatively unaffected. It is possible that the rise in tree pollen is more apparent than real and might have been the result of statistical reciprocity in the percentages. Grasses regained high values at the end of the zone and it is possible that stock animals had been brought into the area for a time and that the pollen spectra reflected the effects of their grazing. Their subsequent removal would have allowed the grasses

and other herbaceous plants to recover their pollen production, as recorded at the end of the zone.

Zone 156031/2: The soils around the feature continued to be wet and the presence of *Lythrum portula* (water purslane) might indicates standing water, although this plant can also grow on waterlogged soils. There are very marked changes in the pollen spectra between this zone and the lower one. Woody taxa continued to be well represented although alder and hazel declined slightly the middle of the zone. The hedge seems to have continued to flourish although the fall in ivy pollen suggests that some shrubs had been cut. Certainly *Prunu*s type (e.g. sloe) disappeared from the record and Rosaceae (hawthorn/bramble) was diminished.

Cereal pollen was less frequent, grass pollen percentages dropped, and other herbs such as *Ranunculus* type (buttercups), mugwort, and ribwort plantain declined. These changes were reflected in a marked increase in dandelion-like plants, bracken and other ferns and suggest that animals had brought in again to graze the local pasture. There are many dandelion-like plants included in the pollen taxon "Lactuceae" and a great number have a flowering peak early in the season. Dandelion (*Taraxacum officinale*) starts flowering in April while grasses reach their peak in June. It is possible, therefore, that animals were being brought into these pastures after the main flowering peak of the Lactuceae but before the main flowering peak of grasses. The high levels of bracken might indicate preferential grazing since sheep have little effect on this fern. They tend to avoid it and so it would not even get trampled.

The vegetation on managed land is never in equilibrium and even small changes in agricultural practice can result in large alterations in plant communities (see Stapledon, 1936). Differences in numbers of stock animals, the timing and length of grazing period, and certainly the timing of hay cutting will all have a large effect on the nature of the grazing sward and other vegetation. It is probable that the changes between Zones 56031/1 and 56031/2 are probably the result of such alterations in local land use.

Zone 156031/3: This zone is characterised by a significant drop in woody plants and bracken, an increase in cereal type, dandelion-like plants, ribwort plantain, and buttercups. The hedge seems to have been intensively exploited although there was still some maple and Rosaceae (hawthorn/bramble) and *Prunus* type (e.g. sloe). Grazing still seems to have been important and grass pollen percentage changed very little. Microscopic charcoal levels increased markedly and there might have been some burning close to the feature. Indeed, the hedge itself might have suffered fire damage since the drop in hedgerow taxa was significant.

Zone 156031/4: The hedge seems to have been largely removed by the time these sediments were accumulating, although it is possible that it was cut so frequently and extensively that the constituent plants failed to flower. Alder birch, and oak were still growing in the catchment and there was a marked rise in hazel pollen. It is possible that, unlike the other shrubs, hazel was less exploited for wood and was allowed to flower for nut production.

Cereal pollen markedly diminished along with grasses and some ruderals such as goosefoot. Bracken also declined and it is possible that herbaceous plants growing in

the hedge were badly affected by hedge cutting. There was a temporary rise in ribwort plantain and buttercups although they later declined. The high representation of *Ranunculus* type (buttercups) might suggest a temporary decline in the quality of the grazing sward. Like bracken, the growth of buttercups can be encouraged by grazing since animals tend to avoid them, particularly when flowering. The fresh plant contains an acrid, compound (Ranunculin) which becomes converted to the highly toxic proto-anemonin when the plant is bruised. Amongst other symptoms, it causes burning and blistering of the animal's buccal mucosa. The compound is at its highest concentrations in the plant during flowering and the flowers are avoided. The quality of hay is not lowered by the presence of buttercups, however, because when the plant is dried, proto-anemonin becomes converted to the inert anemonin (Cooper and Johnson, 1998; Harborne *et al*., 1999).

Feature 178108 (Samples and 1420/1375)
The results for Feature 178108 are shown in Figures 5(a) and 5(b).

It must be noted that throughout much of the history of the feature, the immediate vicinity must have been dominated by *Sambucus nigra* (elder). It is so overwhelmingly over-represented that it has had to be removed from the pollen sum so that the relative importance of other taxa could be evaluated. Elder, itself, was expressed as a percentage of TPLS whereas other taxa were expressed as percentage TPLS minus elder. Elder is insect-pollinated and produces relatively little pollen and, its over-representation indicates that the plant's branches overhung the feature directly. The close correlation between the abundances for fungal remains and elder also suggests that the fruits were falling directly into the pit (see Table 5a). There would have been high concentrations of carbohydrates being incorporated into the sediment and these would have provided an excellent substrate for microfungal growth and sporulation.

Whereas there appears to be a positive correlation between fungal remains and elder pollen abundance, there seems to be a negative one with microscopic charcoal. This implies that the elder bush(es) were being checked by fire in some way, and the observed relationship might be a function of management of the area around the pit.

There is no palynological evidence for standing water in the feature at any time during the period of sediment accumulation. The presence of *Sphagnum* moss, *Mentha* type (e.g. water mint), *Equisetum* (horsetail), and sedges suggests that the immediately local soils were wet and acidic, but no obligate aquatics or tall herbs, typical of ponds and wet ditches, were recorded. It is possible that the feature was kept clear by management but it is equally feasible that water was not perennially present.

Zone 178108/1: The low levels for grass pollen and relatively low levels of ruderals and pasture herbs might indicate fairly high grazing pressure in the environs of the feature. However, cereals were well represented throughout the zone and these indicate the importance of arable farming in this area of the site. *Cannabis* type (hop/hemp) pollen was also found, and it is tempting to suggest that hemp might have been grown for its fibres. But it is difficult to differentiate hemp pollen from that of hop (*Humulus lupulus*) and, although wild hop is largely a plant of fens, it can grow as a weed in hedgerows. No claim is being made here either hop or hemp cultivation and, indeed, if hemp were, indeed, being grown then the record at Perry Oaks would

be the earliest in Britain. It is generally thought to have been promoted in Roman times but reached extensive production only in the Saxon period. There is evidence for flax (*Linum usitatissimum*) in Bronze Age sites in Britain (Greig, 1991) and, indeed, at Perry Oaks (see above), and pollen of Cannabaceae was frequent in Bronze Age occupation deposits from nearby Runnymede (Greig, 1992). Grieg interpreted its presence as representing hop rather than hemp on the basis that hop was found by Devoy in the Thames Estuary (Devoy, 1979). Furthermore, macrofossils of hemp have never been found in Bronze Age deposits. It must be stressed, however, that perhaps an open mind should be kept rather than routinely adopting the oft-quoted literature which invariably invokes the lack of macrofossil evidence as representing the absence of a crop plant.

Oak, alder, and ash were growing in the catchment along with hazel, pine, lime, and elm. However, they were either being very intensively managed, were growing some distance away, or were present as few individuals. Elder dominated the immediate site but bushes (or even a single bush) may have been part of an old hedgerow growing very close to the feature. Maple and rosaceous pollen was relatively abundant and, indeed, hazel, ash, elm, and lime could all have been growing in the hedgerow. For them to be able to flower, however, their management must have been fairly lax. The presence of *Hedera* (ivy) indicates that it was growing well above the ground and might have been exploiting the taller woody plants in the hedge.

The presence of *Calluna* (common heather) and the abundance of *Pteridium* (bracken) implies that there were areas of acidic soils, but the plant taxa represented in Figure 5b suggest that other areas supported relatively base-rich soils. Plants of varying ecological requirements (even calcicoles and calcifuges) can be found growing close to each other today, but it is sometimes the case that further investigation reveals they are rooted in soils of very different character (Rodwell, 1991). This is particularly the case in river flood plains where base-rich silts can lie over other soils, or on slightly higher ground where superficial leaching of previously base-rich soils can occur. Examples today are seen in places in the flood plain of the River Gade near Rickmansworth (about 16 km from Perry Oaks); they support vegetation composed of both calcicolous and calcifuginous plants growing in mixed communities (personal observation).

Bracken, *Polypodium* (polypody fern), and monolete Pteropsida might all have been growing at the base of the hedge and so protected from grazing animals and ploughing. Amongst other herbs, plants that might have been growing at the base of the hedge include Apiaceae (e.g. cow parsley or hogweed), *Silene* type (e.g. campion), *Succisa* (devil's bit scabious), *Rumex* spp. (docks), Lactuceae (dandelion type flowers), and *Plantago lanceolata* (ribwort plantain). This assemblage is often seen along the field boundaries of field systems today although, of course, they these could also have been growing in grassland or on open, disturbed soils associated with ploughed fields. Other typical ruderals are Chenopodiaceae (goosefoot family), *Polygonum aviculare* type (knotweed) and these are often found on bare and compacted soils.
In summary, the feature was set in an open, agricultural landscape, very close to a mixed hedge, and overhung by the branches of elder bushes. The base of the hedgerow probably supported a fairly rich mixture of herbs and ferns; the ground

around the feature was a little soggy, and there were probably compacted, trampled, and broken soils nearby. Cereal fields were situated in the vicinity.

Zone 178108/2: There appears to have been more intensive activity in the vicinity of the feature in this zone. *Mentha*-type diminished and there was a very marked decline in elder which was correlated with a decline in fungal spores and a marked increase in microscopic charcoal. Maple, ash, and oak also declined while there were slight increases in other woody plants, and birch and *Prunus* type (e.g. sloe) were recorded for the first time. Grasses and ribwort plantain increased slightly while plants such as *Senecio/Bellis* type (e.g. ragwort/daisy) and ferns (undifferentiated) declined while there was very little change in other taxa.

These changes suggest that ~~there~~ a local fire had affected some of the hedgerow plants so that their flowering was reduced, but that this had had the effect of allowing the pollen of other plants to be recorded. There seems little doubt that the pollen diagram is recording some small-scale local disturbance, probably caused by the fire. The hedge itself might have been burned or it might have been coppiced with the wood loppings being burned closeby.

Zone 178108/3: It is clear from the pollen diagram (Figure 5b) that the effects of the perturbation soon diminished and the elder quickly re-established its dominant effect in the pollen record. Other woody plants also recovered, and there is little doubt that the effects of the fire had allowed a better representation of *Prunus*-type (e.g. sloe) and other rosaceous plants such as bramble and hawthorn. It is interesting to see that *Fagus* (beech) was recorded since this was not recorded at Runnymede until about 830 BC (Greig, 1992), It was growing at Home Farm, Laleham in the Bronze Age (Wiltshire, 1997) but seemingly absent at Staines Road Farm (Wiltshire, forthcoming), It is also interesting to note that *Viscum* (mistletoe) was found in this zone since it was also found in Bronze Age deposits from Home Farm, Laleham. This parasitic plant commonly grows on trees in the dampness of the Thames Valley today, but it is also currently growing on hawthorn bushes on Box Hill on the brow of a hill where conditions are exposed and dry. Again, it is dangerous to make too strong environmental inferences from a single taxon.

Bracken declined after the fire whereas some ruderals such as ragwort/daisy, hogweed/cow parsley, *Ranunculus* type (buttercups), and *Rumex* (docks) increased while *Artemisia* (mugwort), *Cirsium* (thistle), *Trifolium* type (e.g. clover), and *Plantago major/media* (greater plantain/hoary plantain) were represented. This implies that there was greater availability of disturbed and broken soils. The wetness around the feature also increased and *Sphagnum* moss was recorded for the first time while sedges and *Mentha*-type were well represented throughout the rest of the zone.

The local burning event did not affect local cereal growing and these crops actually seem to have increased throughout the zone. All other taxa exhibit relatively minor fluctuations and these are probably functions of variable taphonomy rather than any meaningful management of the site.

Zone 178108/4: This zone is characterised by another decline in elder and fungal remains, and increase in microscopic charcoal. Again, the local woody plants (possibly those in the hedge) were adversely affected by the fire. Maple, *Crataegus*

type (hawthorn), and *Prunus* type (sloe) also declined but *Viburnum* (another shrub commonly found in hedgerows today) was recorded for the first time. *Cannabis* type pollen also failed to be recorded and this gives added weight to the contention that it had been growing as a hedgerow climber.

Cereal type pollen was a little less well represented and there was a marked drop in grass and dock pollen towards the end of the zone. It is possible that there was more intense grazing in the immediate locality, or even that management of the hedge involved cutting away the taller herbs along the hedge line. This might account for the slightly better representation of smaller herbs such as the plantains, buttercups, polypody fern, and *Galium* type (bedstraw). Meadow/pasture plants such as *Valeriana officinalis* type (e.g. common valerian), *Thalictrum* (meadow rue) were also recorded and these may also have had better pollen dispersal when grasses and other tall herbs were cut away. These effects in the herb flora might also suggest that the impact on grasses (whether it be due to active management or grazing) occurred before the main grass flowering period in June; the later-flowering plants are thus better represented.

Zone 178108/5: In this zone there seems to have been even greater impact on the hedgerow and any other trees and shrubs growing in the catchment. Most either declined or were not represented. Values for cereal type pollen also dropped while grasses and some other herbs seem to have been enhanced by events. Certainly *Silene* type (campion), and *Succisa* (devil's bit scabious) were better represented along with the grasses, although bracken declined.

It must be remembered that the timing of plant management can affect the palynological record very dramatically. The cutting of spring and summer flowering woody plants at any time will result in a diminishing of flowering in the following year and even for a few years. Cutting grasses and many herbs in late spring, and cutting bracken at any time between April and late July, will result in poor pollen and spore representation. The pollen spectra in this zone are probably reflecting the effects of small scale management although there is little doubt that cereal production had either moved away slightly, or had declined in areal extent in the immediate locality.

Zone 178108/6: There was a very marked increase in microscopic charcoal and decline in both fungal remains and elder pollen in this uppermost part of the sediment sequence. The elder bushes seem to have been severely cut and/or burned, but attention seems to have been directed mainly to this one taxon. Cereal production also declined in the vicinity of the feature. The increase in herbaceous pollen, particularly that of plantain, campions, dandelion-like plants and, eventually, bracken and hogweed/fool's parsley suggest that the sward at the base of the hedge remained lush. It is possible that they were actually growing in the ditch and out of reach of stock animals. There is little doubt that there small-scale changes in the area but it is doubtful that there were meaningful alteration in the landscape further afield.

Summary interpretation of middle Bronze Age features

The large waterhole represented by Feature 155144 was situated within a farmed landscape with few woody taxa in the locality other than, perhaps, a *Tilia* tree (or trees). There was no evidence of hedgerows and the small amounts of rosaceous pollen might have been derived from brambles growing nearby. The relatively abundant *Tilia* pollen might have been derived from dung deposited by leaf-foddered

stock animals or, indeed, a flowering tree that had been preserved nearby. If so, the reasons for its presence are puzzling, but this plant provides many resources (fodder, bast, and nectar). Indeed, it is a plant favoured by bees and although it is pure conjecture to say so, honey production might have formed part of the agricultural endeavour.

Both cereal growing and grazing seem to have been important and there was a later period when the vicinity was more heavily used than before. Grazing seems to have become more intense. The large increase in weeds might indicate that either an area near the feature was allowed to remain fallow for a while, or that crop husbandry became rather poor. Later still, farming seems to have been less intensive around the feature and the hole eventually dried out. The local trees (particularly *Quercus*) were obviously under great pressure and, apart from *Tilia*, and some growing further away, the local landscape was very open indeed.

One of the striking characteristics of Feature 135071 was evidence of hedgerow close to the waterhole. The area supported cereal fields and herb-rich pasture throughout its history. However, there was a period when land use changed locally and this might have involved fire as a management tool. It resulted in an apparent neglect of the waterhole and *Alnus* seemed to have responded very favourably to the change in management. However, the area eventually reverted to its former character although the waterhole itself appeared to become rather overgrown with aquatics.

The assessed deposits from various features show some degree of variation in the pictures they provide of their surrounding landscapes. Whether this is a function of spatial or temporal variation is difficult to assess in the absence of greater resolution in the dating. However, Feature 135055 was cut into the top of 135071 and dated to the late Bronze Age although there was no record of arable farming. It is unfortunate that palynomorphs were too sparse for a closer comparison.

Feature 156031 was situated close to a wide range of trees and shrub taxa. The assemblage could be interpreted as scrub vegetation (or woodland edge) but, considering the presence of a waterhole, and the proximity of cereal fields or cereal processing sites, it is more likely that it represents an old hedge. In the earlier life of the feature, the high frequency of ivy pollen and that of other woody plants, suggests the trees and shrubs making up the hedge were able to flower. This implies a fairly lax management with infrequent cutting. The relatively high values for grass and other herbs indicate that grazing at the site was fairly light and that the sward was fairly species rich. However, cereals were certainly being grown and/processed in the vicinity.

The marked changes in the pollen spectra between the zones are probably the result of fairly small scale changes in local land use. As stated above, even small alterations, such as a drop in stocking density, or timing of grazing and/or hay making, can result in very marked responses of the various plants in the community.

Deposits that accumulated in the later life of the feature show that the shrubs and trees were exploited very intensively, and possibly even removed. This implies a considerable need for wood by local people, and hedgerows often provided a community with many of its resources. Even cutting the hedge down to the ground

need not destroy it; there are reports of whole woodland areas having been cut down as many as 70 times without them disappearing. The hedge or woodland will only disappear if it is deliberately destroyed for a different use of the land or if it is subjected to long-continued browsing and grazing (Rackham 1986).

Comparison with other sites in the region

As already emphasised, from existing published literature it is very difficult to obtain detailed information about the nature of vegetation in and around archeological sites, and about the variability in agricultural practices. Although extensive work was done at Runnymede (Greig ibid.), there was insufficient provision of really detailed information from a large number of features to enable a close comparison with the landscape at Perry Oaks.

An assessment of Bronze Age waterholes and pits from Home Farm, Laleham (Wiltshire 1997) indicated that very similar activities were being carried at that site as at Perry Oaks. As at Perry Oaks, the site was also largely cleared of trees and shrubs, but the composition of the remnant woodland differed. The most frequent taxa at Laleham were *Quercus, Corylus*, and *Betula* but*Tilia* was less well represented. *Fagus* (beech) was recorded from Laleham, Runneymede, and Perryoaks. The Bronze Age landscape at Laleham was dominated by herb-rich pasture but cereals were being grown. Unfortunately, no refined phasing was provided for the features so that any comparison with Perry Oaks must be crude. Nevertheless, it is possible to recognise some difference in woodland composition between the two sites.

Detailed assessment and analysis of turf stacks within Bronze Age mounds at Thursley and Frensham Commons both approximately 22 miles south-east of Perry Oaks(Wiltshire 1999: Wiltshire 2000) indicated that these monuments could be tentatively dated to the middle Bronze Age. The construction turves must have been collected locally and they recorded the spatial variation in the local landscape.

When the barrow was made at Thursley, the local landscape was dominated by woodland which was quite dense in places, and arboreal pollen percentages varied between 60-80%. The most abundant woody plant was *Corylus* while *Alnus* and *Pinus* were also important in the local woodlands. *Quercus*, was much less frequent but the percentages for *Tilia* suggested that this tree (which is usually under-represented by virtue of it pollination strategy) was the dominant woodland species in the local landscape. There were open areas but these were dominated by Poaceae and *Calluna.* This suggests that areas had been cleared long enough to allow podsolisation of local soils. It is interesting that *Pteridium* was not recorded from the site so the nature of the heathland type vegetation that was becoming established was very different from that of today. There was no evidence whatsoever for farming activity within the environs of the monument. The results from the barrow at Frensham Common also showed that construction had taken place in woodland with *Corylus* and *Tilia* being the most abundant trees, but *Quercus* was more abundant here than at Thursley. Again, there was no evidence of extensive human activity or farming although there were glades. These were much less extensive than at Thursley and the monument appears to have been constructed in deciduous mixed woodland. Principal components analysis of the data showed that the various woody taxa were not growing as an homogenous mix in the landscape. They were probably exploiting the variety of soils that were available and that had developed locally.

Late Bronze Age

Assessed Deposits (124091, 136075 and 135055)

Assessment of sediments in Feature 135055 (Sample 1002 and 1003) gave an impression of fairly dry conditions around the feature early in its history, and there was certainly no palynological evidence of it being a pit. It was situated in an open landscape, dominated by weedy pasture. *Tilia* and Rosaceae (cf hawthorn) were growing near the feature and, although there was a mixture of trees growing in the catchment, *Alnus* being the most frequently recorded, they were either intensively managed, or growing some distance away. No arable activity was recorded but local soils were bioactive and eroding into the hole, as evidenced by *Glomus* type fungal remains.

Later in the sequence (Sample 1002) local soils appear to have been much wetter, and Cyperaceae and *Filipendula* (meadowsweet) were recorded. However, there was no direct palynological evidence for standing water in the feature and these plants, which are typical of high water table, could have been growing in nearby damp ditches. Again, *Alnus* was the most frequently recorded tree although *Fraxinus, Pinus, Quercus,* and *Tilia* were also growing in the catchment. It is interesting that no *Corylus* was recorded and this may have been due to intense management of this valuable resource. Again, the local landscape was very open and dominated by weedy grassland but grazing intensity seems to have been less than around Sample 1003. Cereal pollen was frequent and it is possible that cereal growing became more important closeby.

Palynomorphs were sparse and poorly preserved in most features but the fragmentary data suggest an open landscape with broken soils supporting weeds and ruderals. Some woody taxa were certainly growing in the catchment with alder, hazel, ash, and pine being found. Plants characteristic of open grassland were found but no cereal-type pollen was recorded. The assessed features suggested that the landscape was even clearer of trees and shrubs than it was in the middle Bronze Age.

Analysed Deposits (155144, 156031)

Feature 155144 (Samples 1181/1171)

The results are shown in Figures 6(a) and 6(b). The palynological assemblages in the sediments at the base of this waterhole (Sample 1171) are certainly different from those of Late Neolithic/Early Bronze Age waterhole (150011).

Zone 155144/1: The soils immediately around the waterhole were wet and Cyperaceae (sedges), *Sphagnum* moss, and *Mentha* type (e.g. water mint) were probably growing at the water's edge. *Lemna* (duckweed) was also floating on the surface of the pond but there does not appear to have been a well developed emergent plant community around the margins of the feature. Such growth would certainly hamper access and the edges of the feature were probably kept clear.

Arboreal pollen was highest in the basal sample and values ranged between 20-25% TLPS. The best represented taxon was *Alnus* , and the *Corylus* and *Quercus* which

characterised the landscape of earlier times were much diminished by the time these sediments had accumulated.

Both had either been exploited so extensively that their flowering was massively depressed, or they had been largely removed from the site for some considerable distance. *Pinus* and *Betula* were still growing in the catchment and *Salix* was growing not too far away. *Ulmus* (elm) had been exploited to extinction but the relatively high levels of *Tilia* throughout the zone are quite surprising. In view of its poor pollen production and dispersal, its pollen percentages suggest that it must have been growing locally. However, it is also possible that faeces from stock animals fed on lime leaf fodder were finding their way into the feature. Ferns (undifferentiated) were growing locally and may have been species such as *Dryopteris carthusiana* (narrow buckler fern) that are, today, often found on the wet soils at the margins of ponds . *Polypodium* was also well represented and its spores may have been derived from ferns growing on field banks.

There is little doubt that the site was quite open and most trees were probably some distance away. The local area supported herb-rich grassland (probably pasture) and it is possible that the relatively abundant *Pteridium* (bracken) spores were derived from plants infesting drier areas of grazing; the presence of *Calluna* (heather) also suggests that heathland plants were starting to invade the acidic soils. Today, many of the herbs in the assemblage are certainly characteristic of lightly grazed pasture. These include *Plantago lanceolata* (ribwort plantain), *Ranunculus* type (buttercups), and Lactuceae (dandelion-like plants). However, the presence of ruderals such as Chenopodiaceae (goosefoot family), *Artemisia* (mugwort), *Senecio/Bellis* type (ragwort/daisy and others), and *Polygonum aviculare* (knotweed) indicate that there were open, broken, and possibly trampled soils around the site. Indeed, the high value for cereal type pollen suggests that ploughed arable fields were either very close to the feature or that the waterhole was situated close to the boundary between arable and pastoral land. It is interesting that a spore of *Anthoceros* (hornwort) was found since this is often an indicator of fallow ground.

Zone 155144/2: The soils around the feature continued to be wet in this zone, with *Sphagnum* moss and Cyperaceae still growing nearby. The presence of *Lemna* also indicates that the waterhole still contained standing water, at least periodically. *Quercus* declined almost to extinction in the record while there was little change in the record for other trees and shrubs other than the slightly enhanced values for *Salix* and the appearance of Rosaceae (e.g. hawthorn or bramble). However, ferns declined briefly as well as the *Quercus* and it is tempting to suggest that exploitation of the oak somehow had some impact on the ferns. Nevertheless, apart from *Pteridium* which did not recover, fern values increased later in the zone.

The most dramatic change in the record is due to the massive representation of Chenopodiaceae and enhanced representation of ruderals and weeds often associated with crop fields. These include *Achillea/Anthemis* type (e.g. yarrow/mayweeds), *Arenaria* type (sandwort), *Artemisia* (mugwort), Lactuceae (dandelion-like plants), *Solanum nigrum* type (black nightshade), and others. However, Poaceae declined quite markedly while cereal type pollen reached values similar to the earlier period in the life of the feature. These results suggest that this area of the site was being used more intensively. The lowered grass and eventual higher fern values might suggest

higher grazing intensities since flowering heads of grasses would be removed by animals. By the same token, bracken might have been purposefully removed because of its toxic effect on stock animals while other ferns could have thrived because of their lack of palatability. The values for *Tilia* remained high and whether the pollen was derived from dung or from local trees must remain an enigma.

The high levels of Chenopodiaceae and other ruderals might have been a response to the neglect of an area close to the feature. Weeds would be quick to capitalise on the open, fallow ground. On the other hand, the enhancement of weeds might simply be due to poor crop husbandry.

Zone 155144/3: Apart from *Tilia*, which continued to be represented at before, the local landscape was clear of trees other than those that were probably growing some distance away such as *Alnus, Betula*, and *Corylus*. *Quercus* seems to either have been removed altogether from the immediate area, or it was so intensively managed that it never flowered.

There appears to have been some relaxation of land use in this zone and this continued for some time. The pollen spectra are reflected in the lower sediments of Sample 1181 above 1171. The area certainly seems to have become drier and no evidence of aquatics or plants of wet soils was found. The rise in Poaceae and the decline of many ruderal weeds also indicates that grazing was somewhat relaxed. Cereal pollen also declined but crops were still being grown in the area. Again, these conditions continued into the sediments above this zone.

The assessment results from Sample 1181 showed that the waterhole may have been abandoned or neglected and that the centre of farming activity had moved slightly further away. *Tilia* pollen continued to find its way into the feature until the upper part of Sample 1181 (not shown on the diagram). Apart from a single grain of *Quercus* (showing that it was not, actually, extinct from the site), no tree or shrub pollen was found in the upper level of 1181. The landscape was dominated by open, weedy ground

Feature 157243 (Sample 1099)

Feature 157243 was situated approximately 50 m away from the pit designated Feature 178108 described above. Both were close to a boundary and it is possible that they might share some degree of contemporaneity, with Feature 157243 recording the local environment slightly later than Feature 178108. Thus, the similarities and differences between the palynological records of these features might give a meaningful picture of spatial variation in the vegetation in this part of the site during the later Bronze Age.

As already stated, the proximity and broadly shared chronology with Feature 178108 suggests that consideration of the results from these two features might give some idea of spatial and temporal heterogeneity at the site. The results for this feature are shown in Figures 7(a) and 7(b).

Zone 157243/1: The area around the features supported wet, acidic soils and *Sphagnum* moss and sedges were growing nearby. Towards the end of the zone,

Menyanthes (bog bean) was recorded, and this plant usually requires a very high water table, even standing water. However, there are no other palynological indicators of water having been in the well and it is possible that the bogbean was growing in very soggy, waterlogged ground at the edges of the feature.

The landscape appears to have been very open, just as in the earlier Bronze Age, and the woody plants recorded in this zone appear to have been growing in an old hedge. Oak, alder, birch, lime, elm, and ash were growing in the catchment (some possibly as components of the hedge) but elder, maple, hazel, purging buckthorn, ivy, willow, *Prunus* type (sloe), and other members of the Rosaceae, seem to have dominated the woody plants in the immediate locality. Apart from hazel, most of these are insect - pollinated and produce very small amounts of poorly dispersed pollen so they are likely to have been growing very close the feature. *Cannabis* type was also recorded but it is likely that this represents male hops scrambling through the hedgerow. Cereals were being grown in the vicinity but only reached significant amounts towards the end of the zone. The very low representation suggests that the cereal-growing areas were situated a little distance away although the abundance of ruderals such as members of the goosefoot family (Chenopodiaceae), nettle, and knotweed suggest that there were open, bare soils available locally.

The herbaceous flora was dominated by dandelion-like plants, plantains, ragwort/daisy, goosefoot, hogweed/fool's parsley, mugwort, nettle, Potentilla type (tormentil/silverweed), and bracken. Grass pollen did not exceed 20% and this suggests that grazing pressures were fairly high. There is little doubt that the area was dominated by pasture and open, trampled soils. However, many of the herbs could have been growing under the protection of the hedge or ditch.

Zone 157243/2: This zone is characterised by drop in maple and oak and a marked rise in rosaceous pollen (probably bramble and/or hawthorn). Elder also exhibited an increase later in the zone while nettle ~~also~~ seemed to have responded favourably. Elder grows and matures very quickly indeed, and its expansion might have been due to the removal of other woody taxa locally. The low percentages for grass pollen and the relatively low record for cereal type pollen indicates that the area was being subjected to fairly high grazing intensity. The relatively high values for *Stachys* type (e.g. hedge woundwort), nettle, plantain, dandelion-like plants, campion, mugwort and others might suggest that these were protected from grazing either by their lack of palatability, or by growing in protection of the ditch. Others such as *Potentilla* type (silverweed/tormentil), *Lotus* type (bird's foot trefoil), and goosefoot could probably cope with trampling and were growing in less protected areas of the local grassland.

Zone 157243/3: The local landscape seems to have changed very little throughout the rest of the life of the feature. There was a progressive decline in elder while maple also declined to extinction. There was a marked increase in ragwort/daisy and mugwort a the beginning of the zone while other ruderals and grasses increased in representation. Grass pollen was the most abundant taxon towards the end of the zone while the major ruderals and bracken declined slightly. Cereal pollen was frequent but only represented at very low levels.

The hedge seems to have continued to grow alongside the feature but the area seems to have been somewhat neglected in the period represented by this zone. The increase

in grasses and ruderals, and the low record for cereals, suggests that there was less agricultural pressure on the land around this feature during the later period of sediment accumulation. The decline of some of elder and the increase in "wasteland" ruderals seems to have been gradual. Elder certainly loses its productivity with age and needs to be pruned to maintain vigorous flowering and fruiting. Unlike in the sediments of Feature 178108, there seemed to be no correlation with burning and fungal remains. It is possible, therefore, that the elder bush(es) were not overhanging the feature in the same way as in Feature 178108. These shrubs may have been growing just a little further along the hedge and so did not have such a direct influence on deposits in the well.

Summary of the Bronze Age landscape

Woodland clearance was well advanced by the middle Bronze Age at Perry Oaks; people had developed a mature agricultural landscape and there is evidence that soil acidification had at least already started. Although there were some small differences in the composition of woody vegetation, this landscape seems to have extended at least as far as Laleham some distance to the south of Perry Oaks. The pictures presented by the data from the Perry Oaks features are also remarkably similar to those formed from analysis of shallow peat deposits from a pond at Staines Road Farm, Shepperton. However, about 22 miles to the south, the landscape in which monuments were constructed (around Thursley and Frensham Commons), supported abundant trees and monuments were built within the woodland. Even there, however, glades had been kept open long enough to enhance soil acidification and the beginnings of heath.

In both the middle and late Bronze Age, fields seem to have been separated by hedges. It is often difficult to differentiate between scrub and hedgerows in pollen diagrams but when the range of taxa are considered here, hedges seem likely. These were species-rich and must have functioned as effective boundaries as well as providers of food and domestic materials. Plants such as hawthorn, sloe, and bramble would have acted as a barbed wire fence does today, while careful management would ensure a source of wood, berries (for food and dyes), nuts, twine, medicines, and birds' eggs. Hedgerows would also provide shelter for stock animals in summer and winter, and act as windbreaks for delicate crops. The presence of certain woody species in the hedgerow assemblage, and the species-richness, indicates that they were already old boundaries by the middle Bronze Age.

Although the sediment sequences are likely to have recorded relatively short periods of time, the deposits were deep enough to give some idea of changes in local land use. The palynological results suggest that people were managing their farmland carefully, moving animals to optimise grazing, and probably varying the centres of cultivation to prevent soil exhaustion. The pollen spectra also give hints that sheep might have been important in this Bronze Age economy. Impoverishment of the soil is indicated by the records for bracken and heather. But, soil reaction seems to have been patchy and many of the plants recorded in the pollen diagrams are ones which demand more nutrient-rich soils. It must be remembered, however, that the heterogeneity of soil nutritional status (and, therefore, vegetation patterning) could have been a function, to some extent, of careful animal management and consequent manuring.

Earliest Iron Age

One feature from the early Iron Age were assessed and analysed. A pit (146048) was situated about 230m to the south east of the middle-late Bronze Age feature 124100.

Assessed deposits

Feature 146048: (Sample 1021)
Palynomorphs were very sparse and poorly preserved in this feature and only a slight impression of the local landscape can gained from the assessment data. The area was very open and dominated with herb-rich grassland although some trees were growing in the catchment. Birch, hazel, pine, oak, lime, willow, and pollen of rosaceous plants (e.g. bramble) were recorded. Bracken and other ferns were present and moist soils are suggested by sedges. Cereal type pollen was also recorded and this suggest some arable farming locally.

Middle Iron Age

This phase is represented by sediments from a waterlogged pit Feature 178015 (Sample 981) and the base of Feature 137114 (Sample 921). The results for Sample 921 are discussed here rather than being included in a discussion of the later period represented by the upper sediments of Feature 137114.

Assessed deposits : Feature 137114 (Sample 921)
The very sparse palynomorphs in this sample indicated that the local landscape was dominated by weedy grassland and ruderal weeds. Some cereal type pollen was found and this indicates some arable activity, but the relatively large amounts of grass and ribwort plantain pollen suggest that the area was not subjected to intense grazing pessure. The feature seems to have contained standing water and the ground around it was probably quite soggy. There were trees growing in the catchment but there was no evidence for hedges or scrub locally.

Analysed deposits: Feature 178015 (Sample 981)
The results for this feature are shown in Figures 8(a) and 8(b).

Zone 178015/1: This zone is characterised by very high levels of microscopic charcoal and an exceedingly open landscape. The feature itself was wet although there is no palynological evidence for standing water in this zone. Sedges, water mint, and meadow sweet were growing very close, probably at the wet edges of the pit. Fungal spores were also high in this zone and that might indicate that the pit dried out from time to time so that deposits became aerated enough to allow fungi to grow on organic debris falling into the feature. The area around the feature seems to have been very open, with woody taxa accounting for only about 5% of TLPS. Alder, pine, hazel, and oak were recorded but they were probably some distance away as single trees, or else all the trees and shrubs in the catchment were severely coppiced or pollarded. The presence of heathers and bracken indicates that some areas had acidic soils but there is no evidence of heathland development here. The major components of the plant community were goosefoot, dandelion-like plants, ragwort/daisy, and *Silene* type (campion/catchfly). Other weeds such as thistle, yarrow/mayweed, knotweed,

charlock, and docks are also well represented. Some could have been growing on grassy banks between fields where the sward tends to be more lush. Certainly, this would be a good habitat for devils's bit scabious, polypody fern, *Vicia* type (vetch), and *Galium* type (bedstraw). Grasses were poorly represented but the rest of the herbaceous flora was diverse and rich. This suggests that grazing pressure was particularly heavy during this time and the weeds that are very well represented were probably avoided by stock animals, or may have been growing at arable field edges and on open, broken ground.

Zone 178015/2: There was a slight increase in woody taxa in this zone and scrub/hedge plants such as Rosaceae and elder were represented. Grasses also increased along with ribwort plantain while there was a slight decline in some of the ruderals, particularly in goosefoot, dandelion-like plants, and ragwort/daisy. This indicates that grazing pressure was relaxed around the waterhole to some extent. Microscopic charcoal levels were much lower than in zone 178915/1 and this might add weight to the contention that there seems to have been some shift of activity. Cereal pollen was present at low level as before but there does appear to have been some relaxation of management at this site.

Zone 178015/3: Vegetation around the feature did not change to any marked degree in this zone. Again cereals continued to be grown in the area but there seems to have been an even greater relaxation of grazing and managment. Goosefoot, dandelion-like plants, campion/catchfly, and devil's bit scabious all declined while grasses increased, and more woody taxa were represented. As grasses became more established, ruderals and other plants of open ground were probably out-competed. *Typha* (reedmace) was recorded and this suggests that the feature or its margins were very wet.

Zone 178015/4: The landscape remained very open indeed in this zone although trees and shubs did increase slightly. The most dramatic change was the very large increase in grass pollen, the increase in cereals, and the decline of goosefoot, and dandelion-like plants. The assemblage seems to suggest that grazing pressures were even lighter than before. The decline in some of the weeds might be accounted for by competitive grasses overgrowing them so that they did not flower prolifically. It is also possible that hay-making was responsible for the effects. If the cut were made *after* grass flowering but *before* the main flowering season of the grassland weeds, it is not difficult to see how this activity could affect the palynological record. Grass must be viewed as a crop (Lockhart and Wiseman 1983) and there is no reason why these Iron Age peoples should not have been making hay for overwintering animals or for some other domestic purpose.

It is unfortunate that the resolution in palynological identification is not higher because circular arguments can be put forward to promote various hypotheses when actual species cannot be defined. However, the pollen spectra in zone 178015/4 do lend themselves to alternative interpretation. Light grazing would allow grasses to proliferate at the expense of broad leaved herbs in the sward. On the other hand, hay-making after grass flowering, and before the flowering peaks of other herbs, could lead to the same effects in the pollen diagram.

Summary
The middle Iron Age settlement was set in a very clear landscape with very few trees and shrubs. If they were present, then they must have been pollarded and/or coppiced very regularly so that woody taxa were not able to flower. Cereal growing /processing was being carried out at the site but marked changes in the pollen spectra showed that either grazing pressure was lower than before or that the timing of hay making influenced the sward. There was no convincing evidence for hedges in this part of the site in the middle Iron Age and boundaries might have consisted of earth/grassy banks. These banks would have provided havens for many of the herbaceous plants found in the sample.

Romano-British

Analysed Deposits

Feature135087 (Samples 1007 and 1006)
The results for Sample 1007 are shown in figures 9(a) and 9(b). The deposits for 1006 were too sparse in palynomorphs for analysis but they will be discussed in relation to the rest of this feature.

Zone 135087/1: As in so many of the other features interpreted as waterholes or wells, there is little evidence for the pit having contained standing water. However, the soils at the edges were probably quite wet since water mint, sedges, and meadowsweet were growing locally. Microscopic charcoal was moderately high so people were actively burning material in the vicinity, and the landscape was exceedingly open with very few trees and shrubs. Alder, hazel, oak, lime, Rosaceae (hawthorn/bramble), and *Prunus* type (e.g. sloe) were recorded so there was probably some scrub or a hedgerow nearby. The presence of hazel and, more particularly, maple might indicate that the hedge was of considerable antiquity. The area around the pit was overwhelmingly dominated by weedy grassland and ruderal weeds. Cereals were being grown or processed somewhere near to the pit and many of the weeds could have been infesting the crops as well as growing on banks, in ditches, and in the grassland itself. The most abundant herbaceous taxon (even more so than grass) was Lactuceae (dandelion-like plants). There are many species in this pollen taxon and it is easy to understand how they have such a high representation when so many are rosette plants and adapted to withstanding grazing.

Zone 135087/2: Woody taxa increased in this zone and maple, ash, willow, elder, and elm were found as well as the ones that were found in the previous zone. This rich assemblage of woody plants suggests that there was a hedge closeby that had been severely coppiced previously. Heather was also growing nearby and was probably colonising the acid grassland. Although no cereal pollen was found in this zone, the weed most commonly associated with arable fields in past times, *Centaurea cyanus* (cornflower), was present. It is possible, however, that this weed persisted in the area after the main focus of cereal growing shifted elsewhere. Grass pollen increased slightly in this zone while dandelion-like plants and ribwort plantain declined slightly. This suggests that there was slightly less grazing pressure on the sward and grasses might have been out-competing other pasture herbs.

Zone 135087/3: There was a marked increase in alder, hazel, oak , and Rosaceae (hawthorn/bramble) in this zone while *Hedera* (ivy) and *Ilex* (holly) were recorded. Cereal pollen was more frequent but was still at low level. The biggest change in the pollen spectra was in the relative proportions of grasses and dandelion-like plants. Their abundances behaved in a reciprocal fashion.

Along with the grasses, other herbs such as plantain, docks, and ragwort/daisy declined slightly. These effects suggest that grazing pressures were a little higher in the part of the site during this period. The reason for the rise in woody taxa in such a cleared landscape is enigmatic but it is possible that there was simply a period of lax management. If there were indeed a hedge present, it would have provided a valuable resource; but to continue being useful, the plants would have had to be allowed to recover their growth in order to provide the resources that were normally exploited. There seem to have been hedges in the Roman settlement at Farmoor in the Thames valley (Lambrick and Robinson 1979) so it is not surprising that hedges might have existed at Roman Perry Oaks.

Zone 135087/4: There was a rise in sedges in this zone and *Sphagnum* and *Iris* were found. This suggests that the area was wetter than before although the poaching of animal hooves can have the effect of puddling which can eventually provide microsites for plants. All the trees and shrubs declined slightly in this zone and those normally associated with hedgerows were markedly affected. These include hawthorn/bramble while holly, ivy, *Prunus* type (e.g. sloe), and elder failed to be recorded. Heather increased slightly along with bracken but the main differences in the pollen spectra were, again, due to the decline in grasses and plantain, and the rise in dandelion-like plants. The overall increase in weed species and the reciprocal pattern of grass/dandelion-like plant pollen suggests that the site was subjected to higher grazing pressure. Plants such as knotweed, devil's bit scabious, buttercups, and knapweed could all have evaded grazing by virtue of their growth form and phenology and this would account for their slight increases in the record.

Romano-British Summary

The Romano-British landscape at Perry Oaks was virtually cleared of trees and shrubs, or else they were so heavily exploited that flowering was a relatively rare occurrence. There seems to have been some remnants of previous boundaries but these were also probably cut severely or consisted of gappy, impoverished hedgerows which were, nevertheless, probably very old. It is even possible that only occasional shrubs and trees were left standing. The site was still being farmed and there are indicators of both arable and pastoral activities, but pasture and "waste ground" seems to have characterised the landscape.

Discussion

The analysis of a large number of features from the Mesolithic to Romano-British times has given a picture of the spatial and temporal variation in the landscape at Perry Oaks. It is inevitable that different parts of the site would suit different kinds of activity, but the overwhelming impression is gained of a long and continued tradition of mixed farming at the site. During the Neolithic and early Bronze Age, the landscape contained mixed woodland which seems progessively to have diminished as human activity intensified. During early settlement, the plants of woodland edge

and glade were growing close to features and it seems that with intensification of land use, these gradually became incorporated into boundaries. Shrubs such as elder, holly, hazel, Rosaceae (hawthorn /bramble), sloe, *Viburnum*, purging buckthorn, and even plants normally thought of as woodland trees such as ash, oak, elm, and lime could all have been managed to form resource-rich boundaries. Hedgerow formation can happen in a variety of ways (Dowdeswell 1987), but cutting down areas of woodland to create a series of "woodland edges" as in the Normal practice of assarting, could easily have been carried out in the Bronze Age. The palynological record indicates that hedges were, indeed, very important elements of the Bronze Age landscape and might have persisted right through to Romano-British times.

Cereals were grown for thousands of years at the site, and arable agriculture seems to have started in the Neolithic period at the site. Flax was also recorded in later deposits as well as weeds that were (and still are) weeds of arable fields. The various areas of the site also seem to have favoured grazing and there are suggestions from the palynological record that animals were moved from site to site, presumably to maximise sward productivity. Modern grazing practices involve rotational grazing (Lockhard and Wiseman 1983) and there is no reason to suppose that pehistoric farmers had a lesser understanding of maximising the potential productivity of pasturage and managing it to best effect.

Most of the results from this study have been obtained from on-site features which, by their very nature, must have had relatively short productive lives. Thus, each set of deposits probably record a relatively short (but unknown) period of time and yet changes are seen in the pollen diagrams. None of these changes were very marked and were probably due to the impact of small scale impacts but, nevertheless, they do seem to reflect a shifting or rotational pattern of management.

By the latter part of the Roman occupation of Britain, the site seems to have been very highly exploited and most woody taxa were either removed or managed very severely. Grazing seems to have been very important latterly although crop production was still going on.

It is striking that the area of Perry Oaks extending to Laleham seems to have been an area of intense settlement and activity. This contrasts considerably with areas further south in Surrey and in Sussex where woodland persisted for much longer periods.

References

Bacon J.C. (1990): The use of livestock in calcareous grassland management. In: Hillier S.H., Walton D.W.H. & Wells D.A. (Eds): *Calcareous grasslands: Ecology and management.* Bluntisham Books, Huntindon: 121-127.

Bates S. & Wiltshire P.E.J. (2000): Excavation of a burnt mound at Feltwell Anchor, Norfolk, 1992: *Norfolk Archaeology **43** (3)*: 389-414.

Coles J.M. (1976): Forest farmers: Some archaeological, historical and experimental evidence. In: *Acculturation and Continuity in Atlantic Europe* (ed. S.J. De Laet), IV Atlantic Colloquium, Brugge, 59-66.

Cooper M.R. & Johnson A.W. (1998): *Poisonous plants and fungi* (2nd Ed): The Stationery Office, London.

Devoy R.J.N. (1979): Flandrian sea level changs and vegetational history of the lowe Thames estuary. *Philosphical Transactions of the Royal Society., London Series B,* 285: 355-406.

Dowdeswell W.H. (1987): *Hedgerows and Verges*. Allen & Unwin, London.

Edwards K.J. (1993): Models of mid-Holocene forest farming for north-west Europe, in F.M. Chambers (ed.), *Climate Change and Human Impact on the Landscape,* London, 133-145.

Godwin H. (1975): *History of the British Flora: A Factual Basis for Phytogeography (2nd Ed):* Cambridge University Press, Cambridge.

Göransson H. (1986): Man and the forests of nemoral broad-leaved trees during the Stone Age. *Striae* **24**: 143-152

Greig J. (1991): The botanical remains. In: Needham S.P. (Ed): *Excavation and salvage at Runnymede Bridge, 1978*: 234-261.

Greig J. (1992): Deforestation of London: *Review of Palaeobotany and Palynology **73***, Elsevier Science Publishers, B.V. Amsterdam, 71-86

Harborne J.B., Baxter H. & Moss G.P. (1999): *Phytochemical Dictionary: A handbook of bioactive compounds from plants* (2nd Ed): Taylor & Francis Ltd., London.

Healy F. & Harding J. (forthcoming): *Raunds Area Project. The Neolithic and Bronze Age landscapes of West Cotton, Stanwick and Irthlingborough, Northamptonshire.*

Heim J. (1962): Recherches sur les relations entre la vŽgŽtation actuelle et le spectre pollinique recent dans les Ardennes Belges. *Bulletin SocietŽ Royale Botanique Belgique **96*:** 5-92.

Keith-Lucas M. (2000): Pollen analysis of sediments from Moor Farm, Staines Moor, Surrey. *Surrey Archaeological Collections **87*:** 85-93.

Lambrick G. & Robinson M. (1979): Iron Age and Roman riverside settlements at Farmoor, Oxfordshire. *Oxfordshire Archaeological Unit Report 2 (CBA Research Report 32).*

Lewis J.S.C., Wiltshire P.E.J. & Macphail R.I. (1992): In: Needham S. & Macklin M.G. (Eds): A Late Devensian/Early Flandrian site at Three Ways Wharf, Uxbridge: environmental implications. *Alluvial Archaeology in Britain: Oxbow Monogaph **27*:**235-247.

Macphail R.I. & Scaife R.G. (1987): The geographical and environmental background. In: Bird J. & Bird D.G. (Eds): *The Archaeology of Surrey to 1540:* Surrey Archaeological Society, Castle Arch, Guildford: 31-51.

Mitchell A.F. (1974): Estimating the age of big oaks. In: Morris M.G. & Perring F.H. (Eds): *The British Oak*: Botanical Society of the British Isles: E.W. Classey Ltd., Berkshire.355-356.

Owen J. (1980): *Feeding Strategy*. Oxford University Press. Oxford.

Rackham O. (1986): *The history of the countryside.* J.M. Dent & Sons Ltd., London.

Rodwell J.S. (Ed)(1991): *British Plant Communities Vol. 2: Mires and heaths.* Cambridge University Press, Cambridge.

Round F.E. (1981): *The ecology of algae*. Cambridge University Press, Cambridge.

Stapledon R.G. (1936) (Ed): *A survey of the agricultural and waste lands of Wales*. Faber and Faber Ltd., London.

Tauber H. (1965): Differential pollen dispersion and the interpretation of pollen diagrams. *Geological Survey of Denmark. Series II, **89**: 1-69.*

Wiltshire P.E.J., Edwards K.J. & Bond S. (1994): Microbially-derived metallic sulphide spherules, pollen, and the waterlogging of archaeological sites. In: Davis O.K. (Ed): Aspects of archaeological palynology: methodology and applications. T*he American Association of Strtigraphic Palynologists Foundation. AASP Contributions Series **29*:** 207-221.

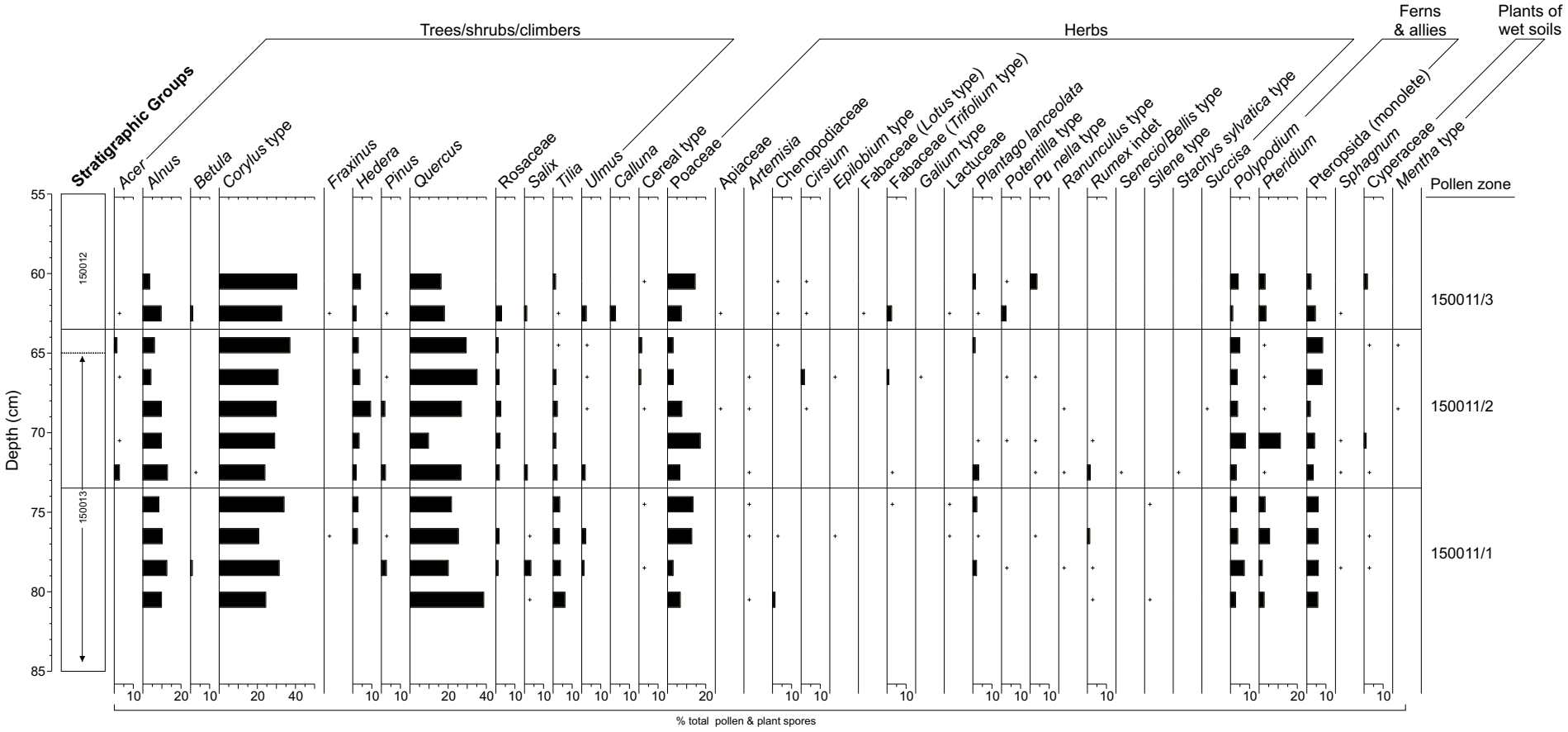
Wiltshire P.E.J. (2000): Heath End Sand Pit, Duncton, Sussex: Preliminary palynological analysis of sediments from inner and outer ring ditches and a shallow on-site feature. *Unpublished report for South Eastern Archaeological Services.*

Wiltshire P.E.J. (2002): Palynological assessment. In: Graham D. & Graham A. Investigation of a Bronze Age mound on Frensham Common. *Surrey Archaeological Collections*: 111-116.

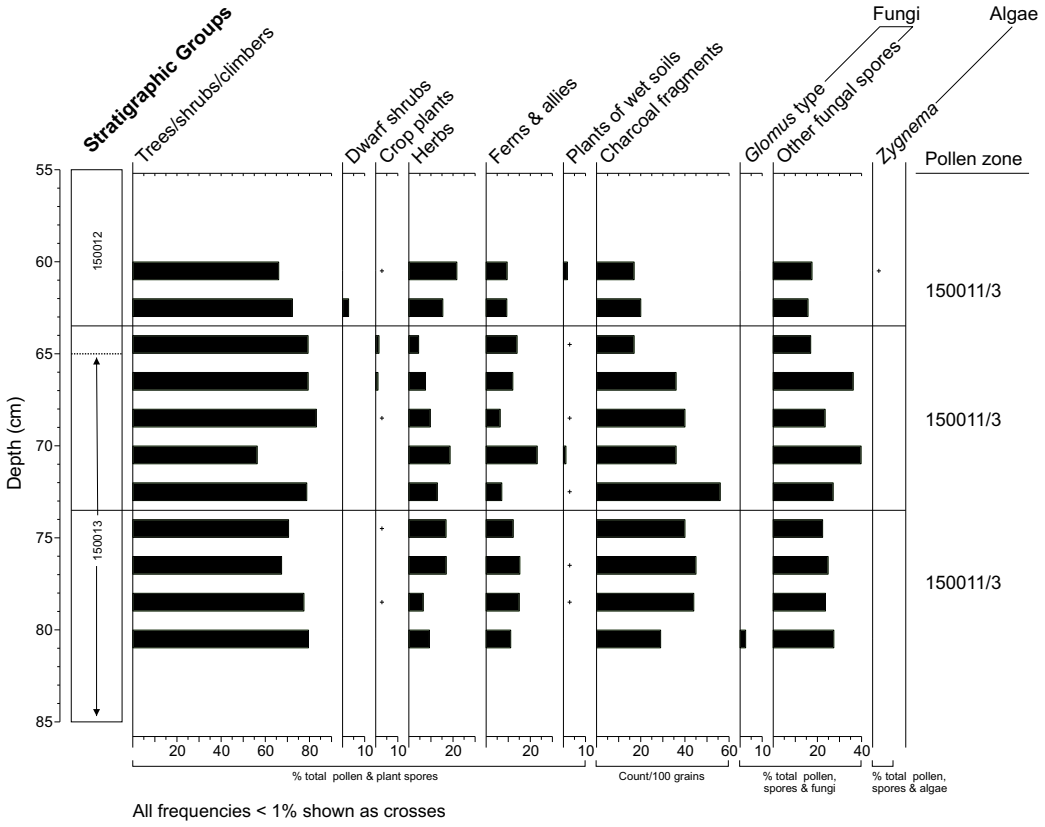
Wiltshire P.E.J. (2002): Operation Becton: Palynological analysis. *Unpublished report for Hampshire Constabulary.*

Wiltshire P.E.J. (2003): Palynological analysis associated with human remains in woodland. *Unpublished report for Surrey Constabulary.*

Wiltshire P.EJ. (forthcoming): Palynological analysis of organic sediments in the Long Barrow ditch. In: *Healy F. & Harding J. Raunds Area Project. The Neolithic and Bronze Age landscapes of West Cotton, Stanwick and Irthlingborough, Northamptonshire.*

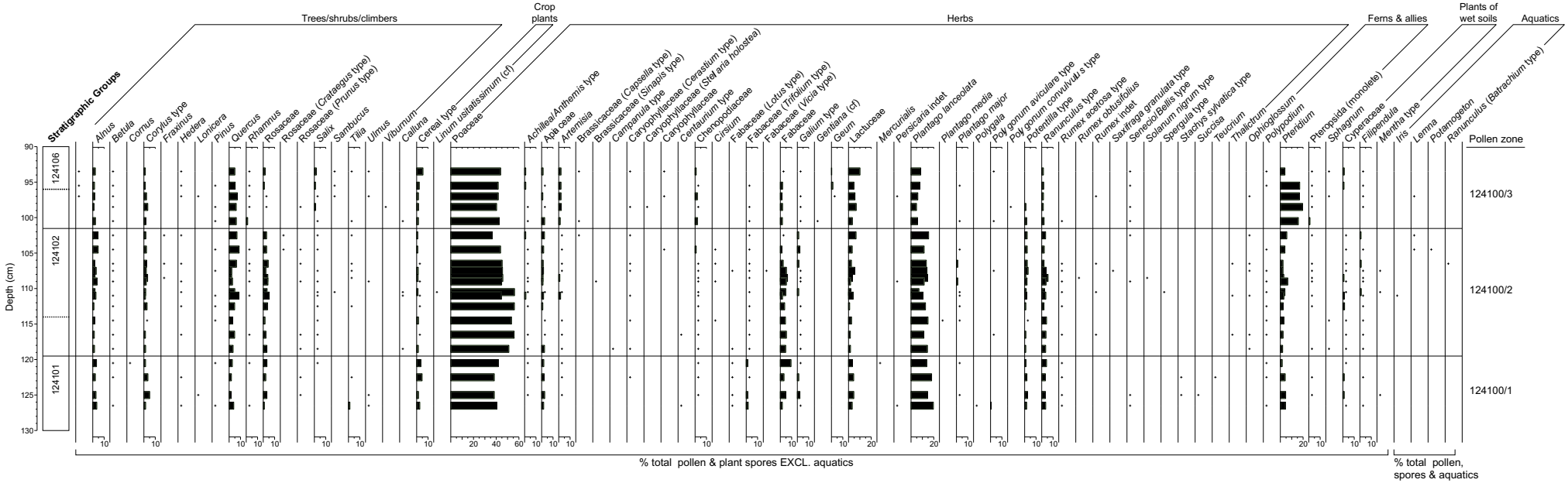


Feature 150011



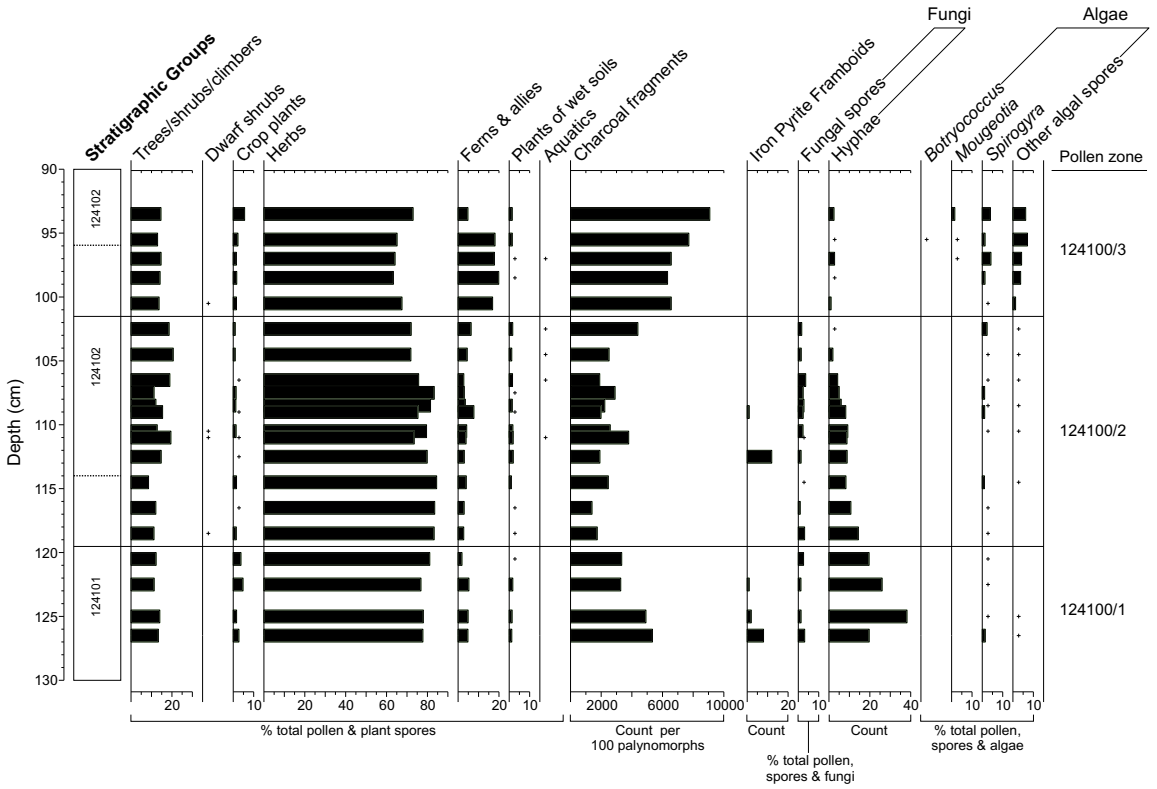
All frequencies < 1% shown as crosses

Feature 150011



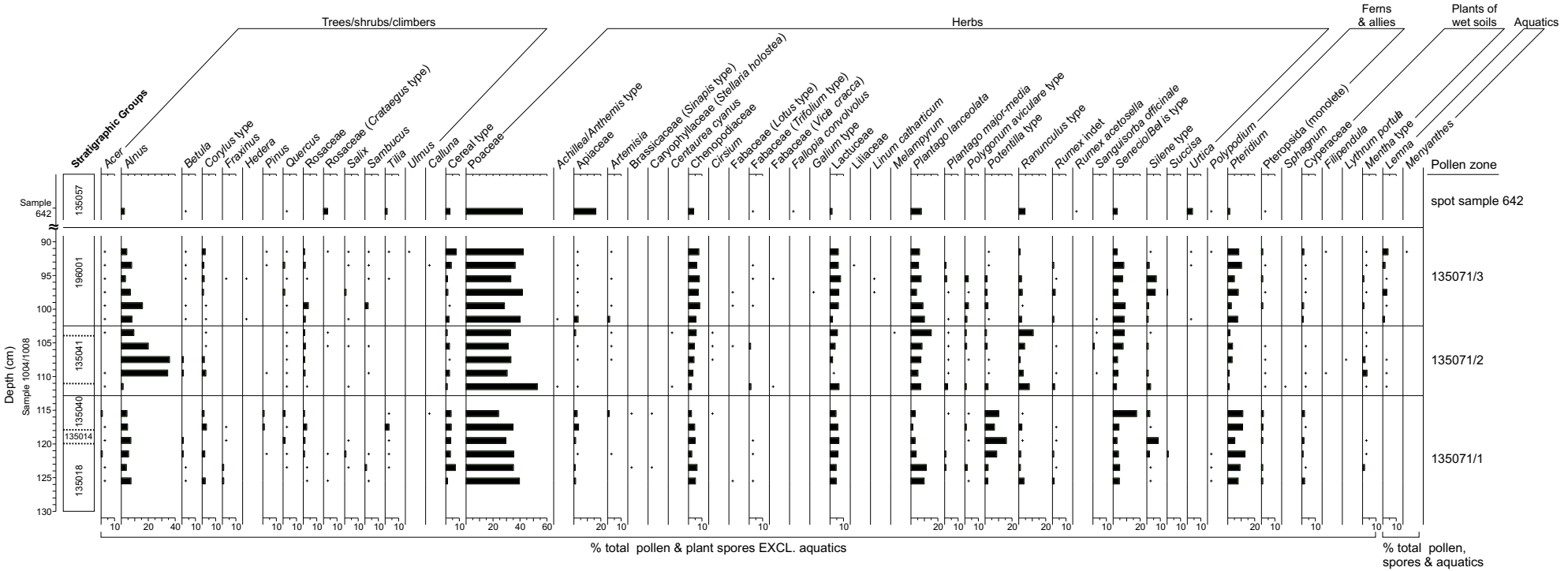
All frequencies < 1% shown as crosses

Feature 124100



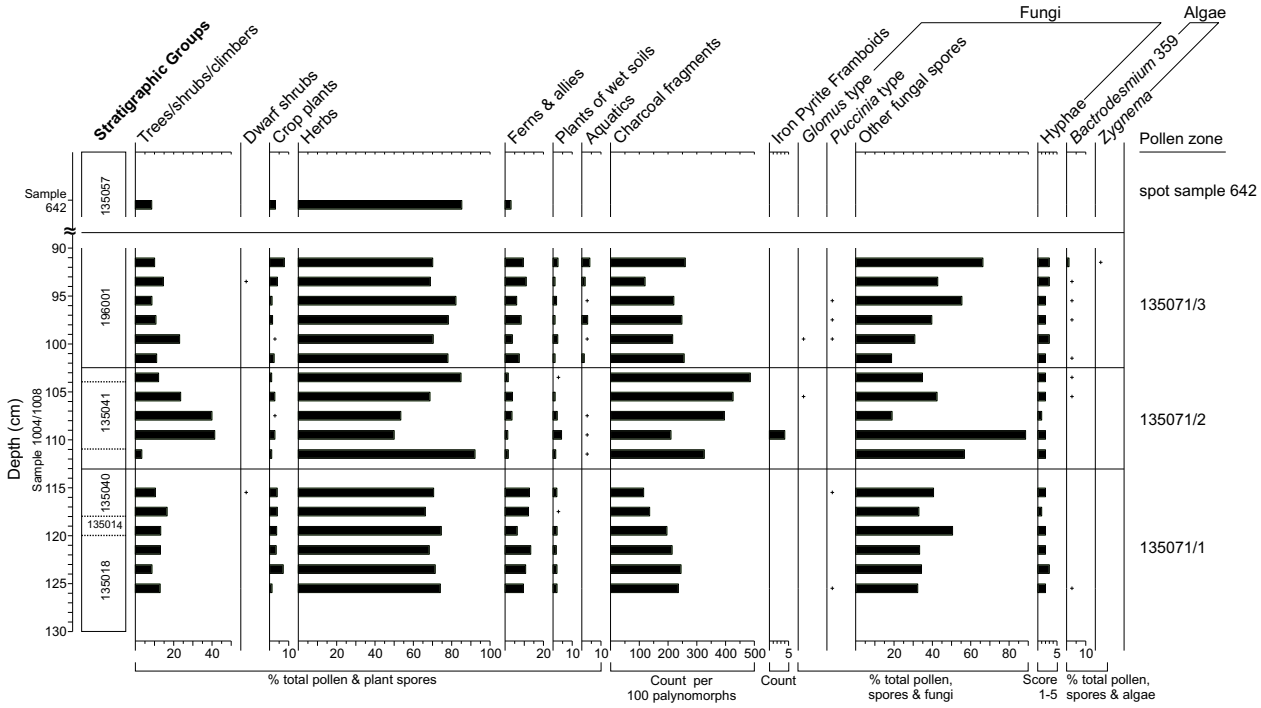
All frequencies < 1% shown as crosses

Feature 124100



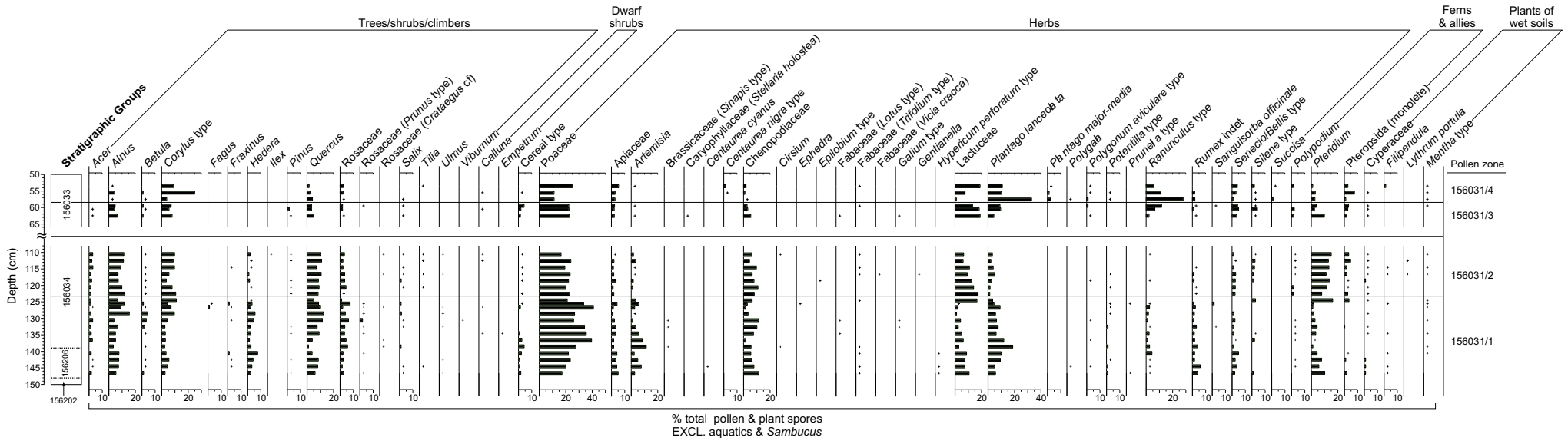
All frequencies < 1% shown as crosses

Feature 135071



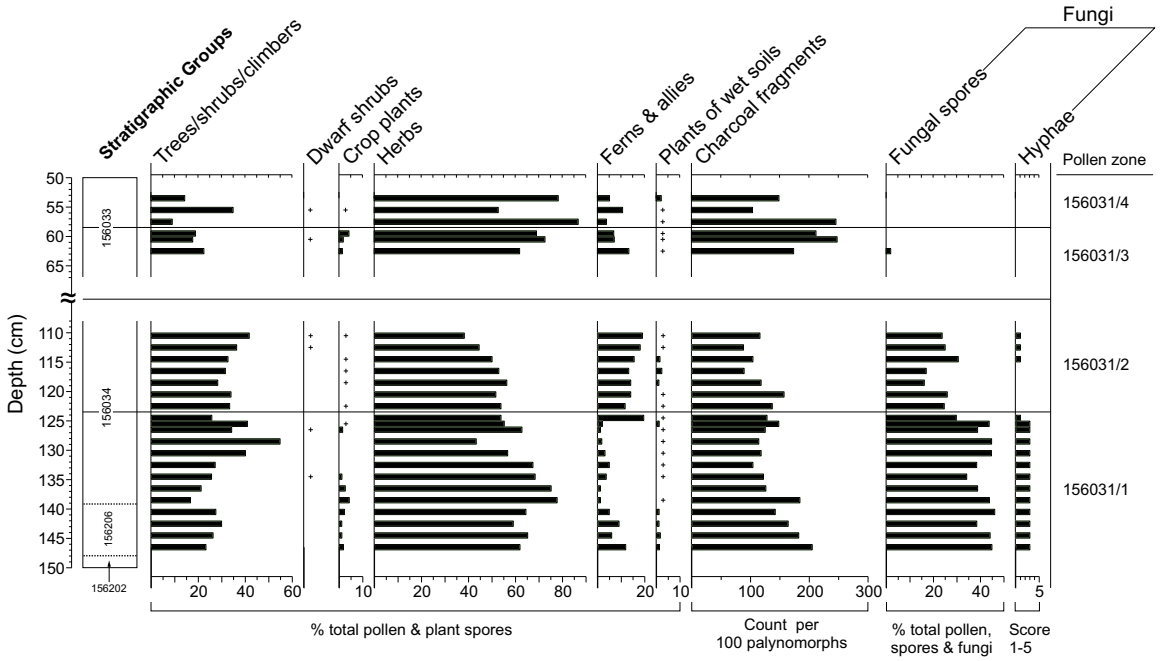
All frequencies < 1% shown as crosses

Feature 135071

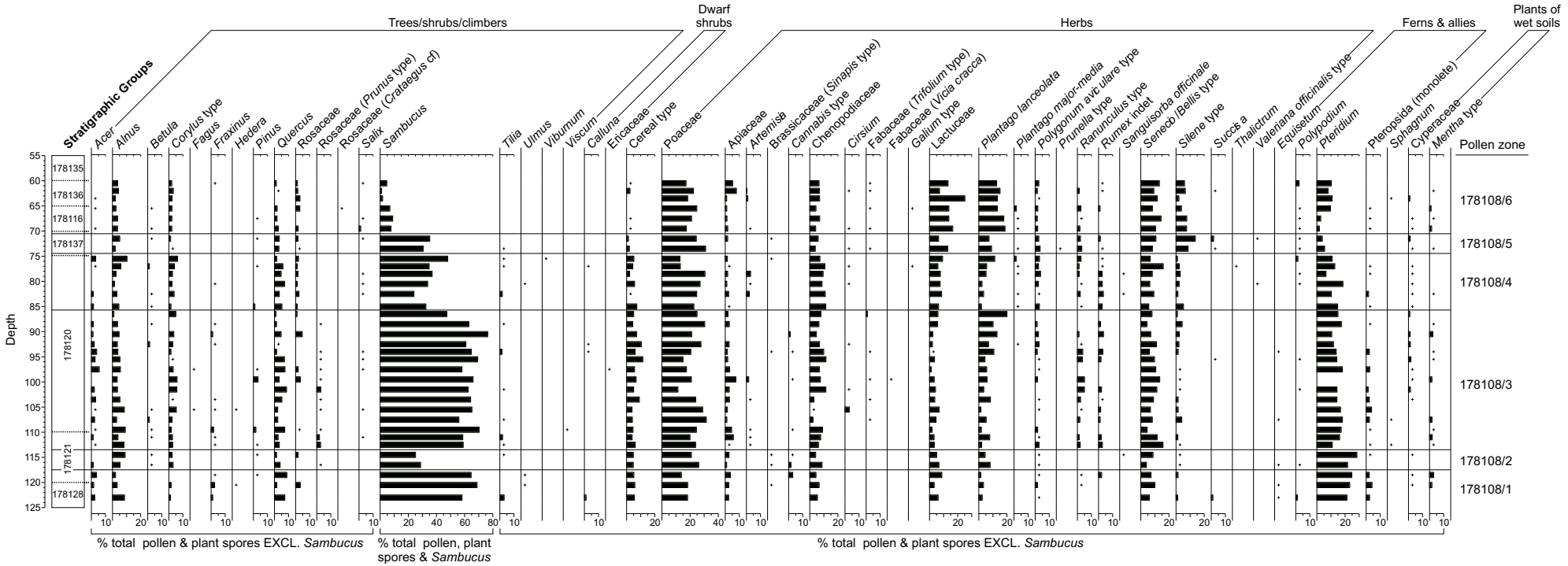


All frequencies < 1% shown as crosses

Feature 156031

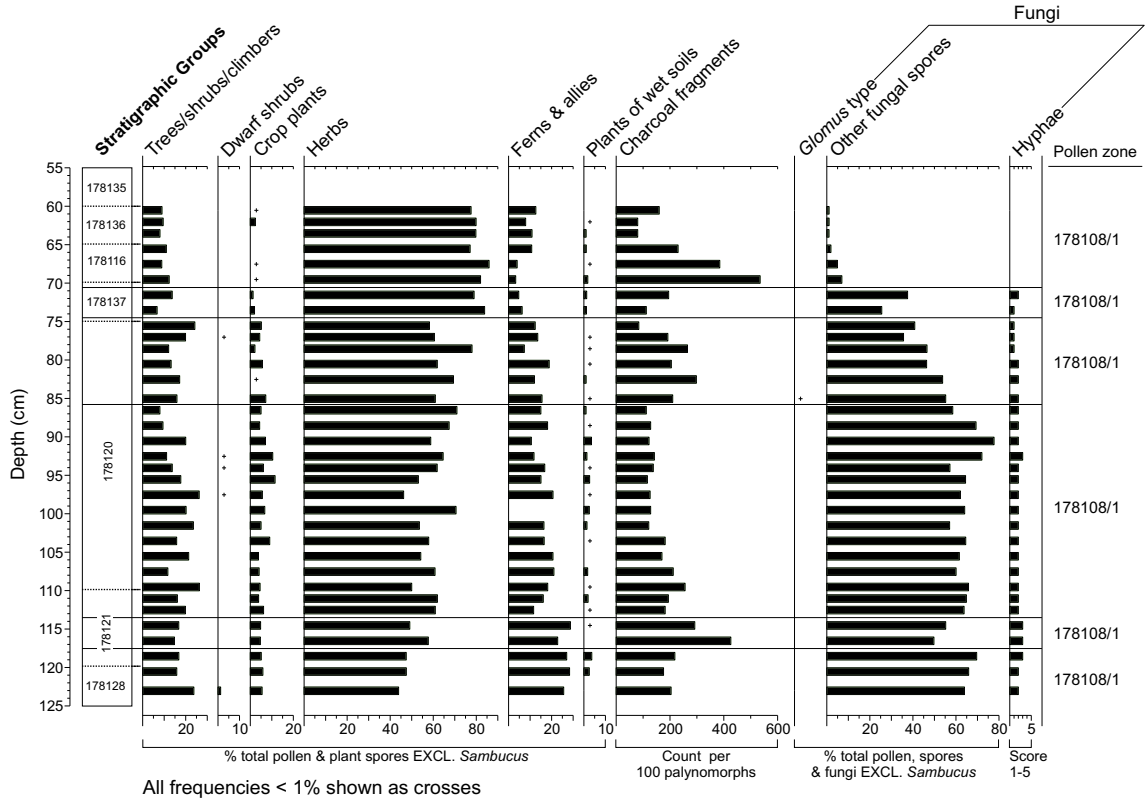


Feature 156031

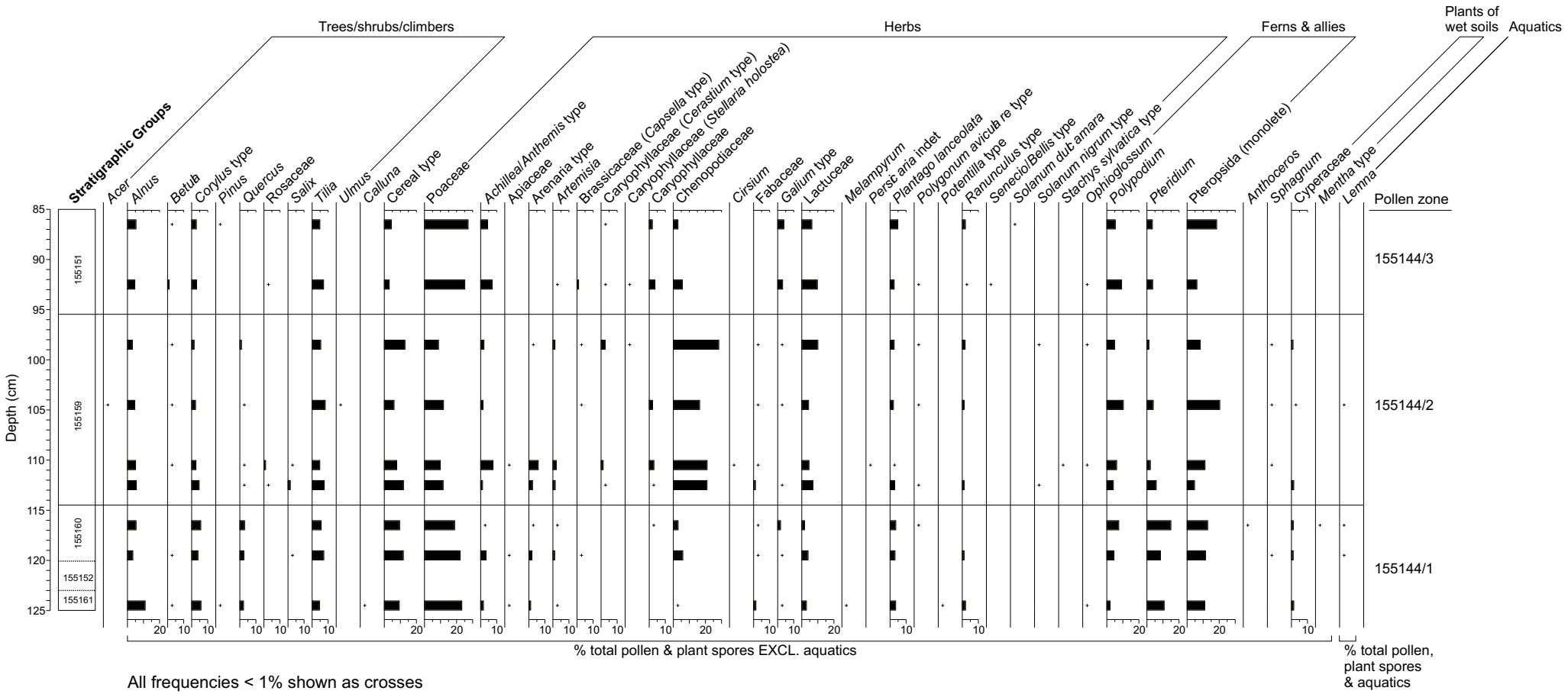


All frequencies < 1% shown as crosses

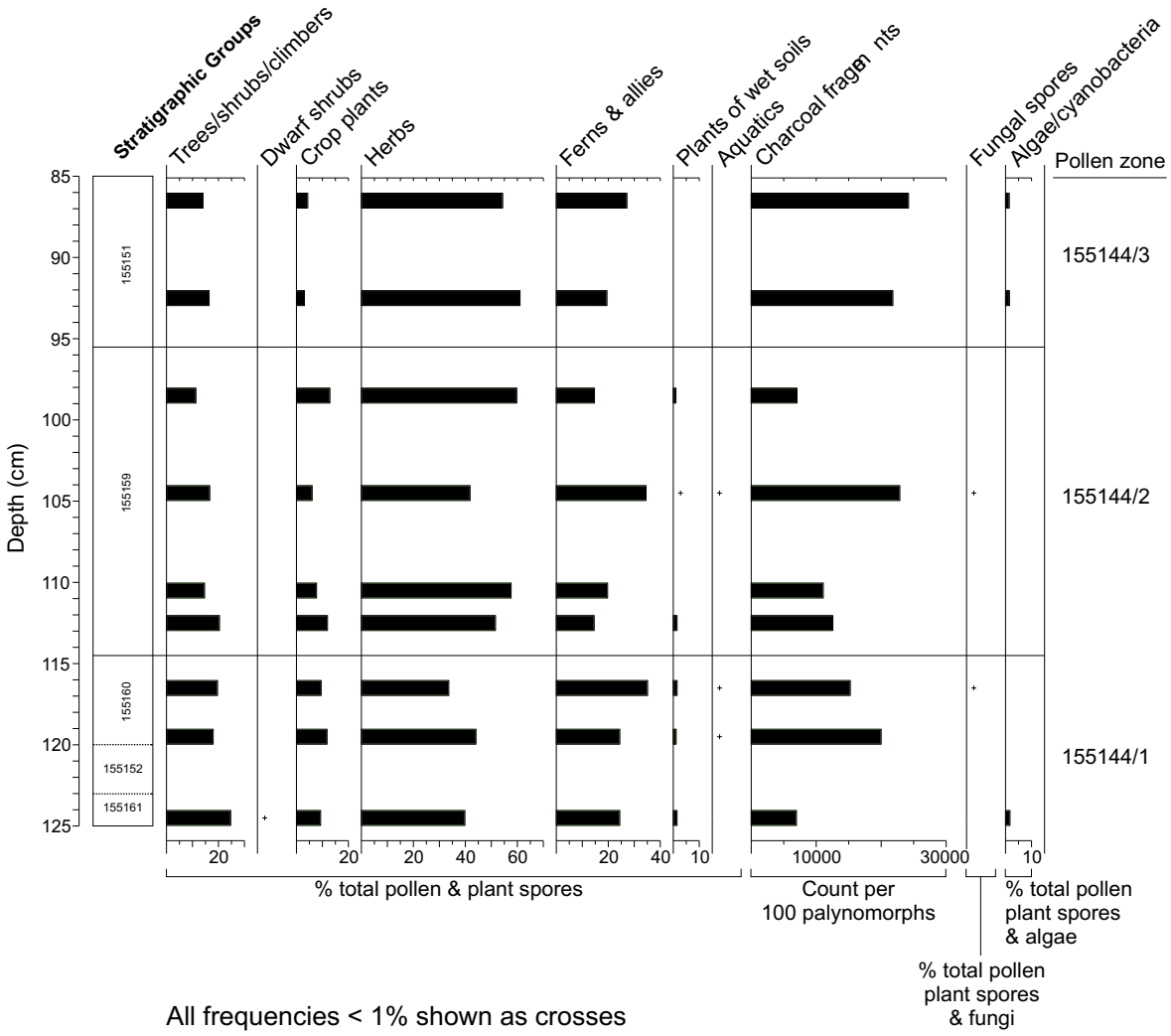
Feature 178108



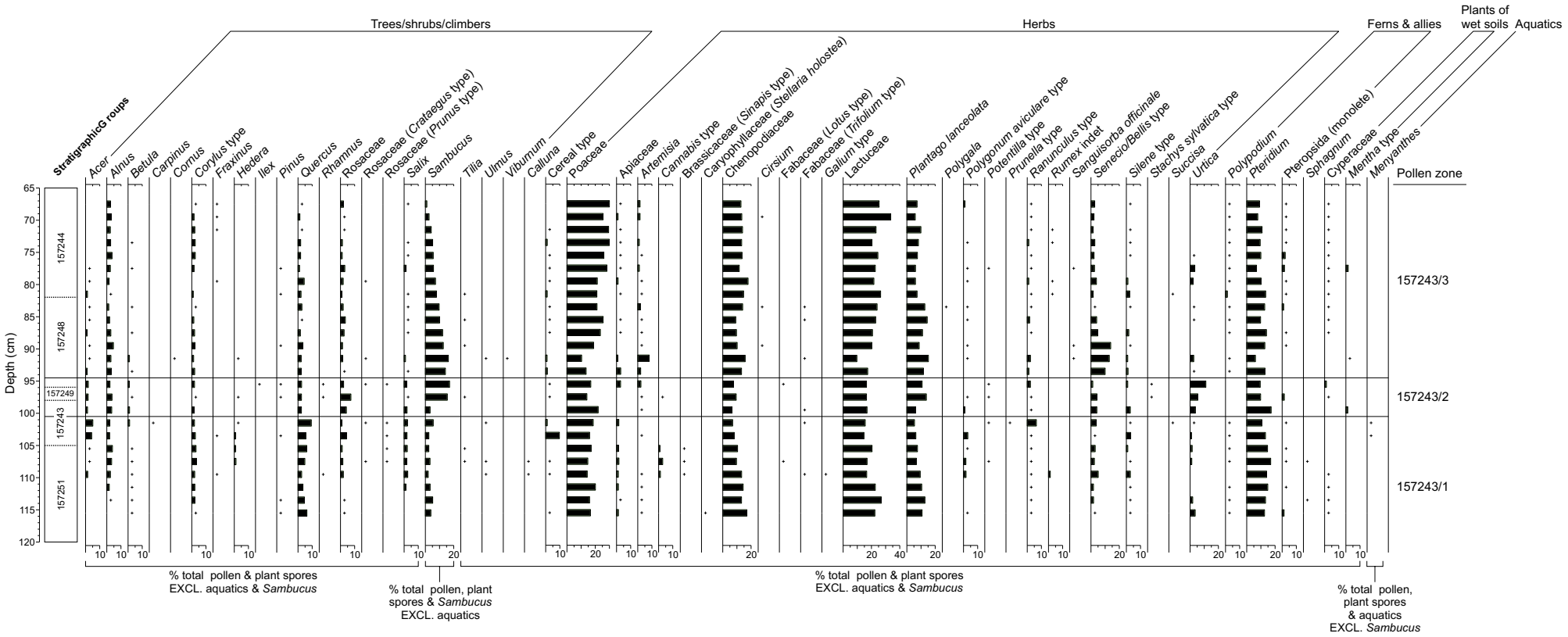
Feature 178108



Feature 155144

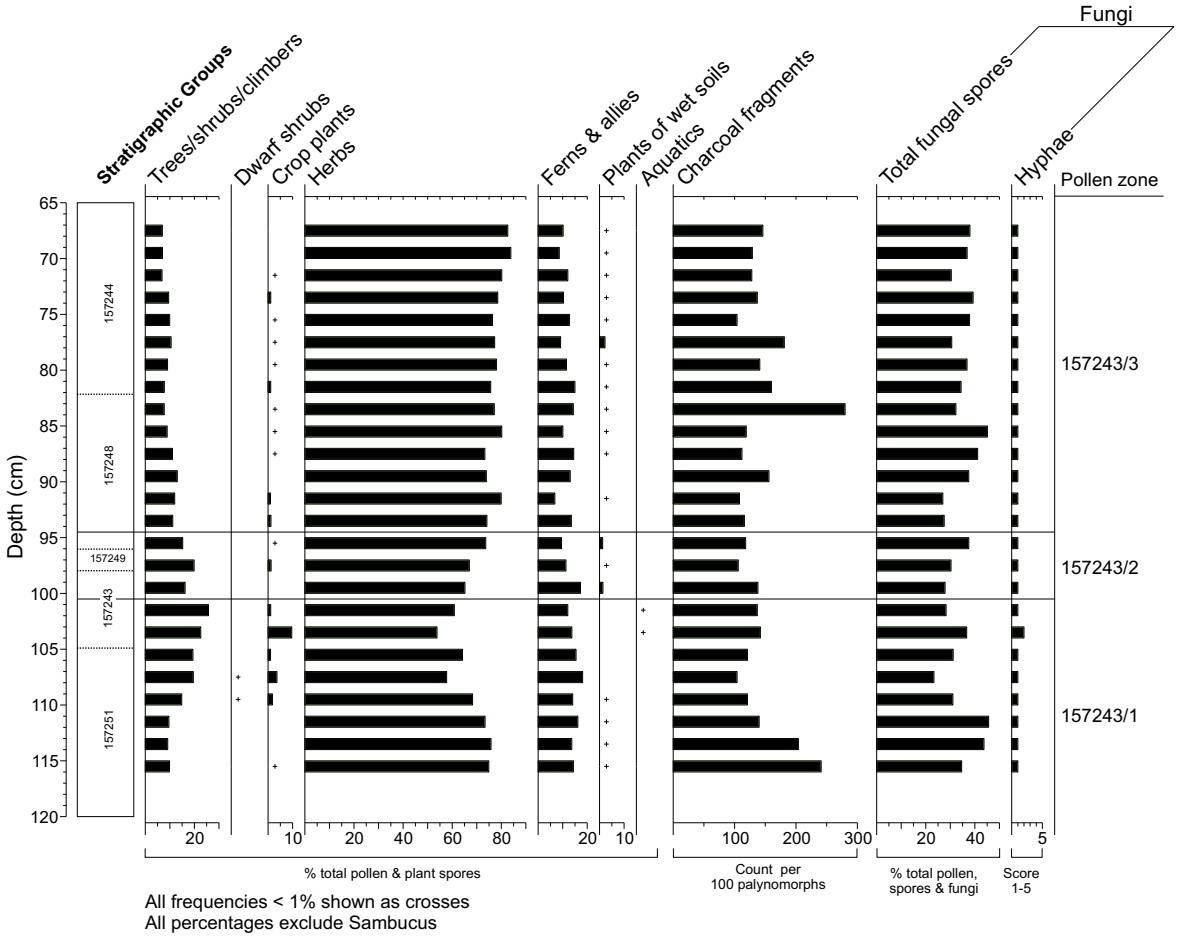


Feature 155144

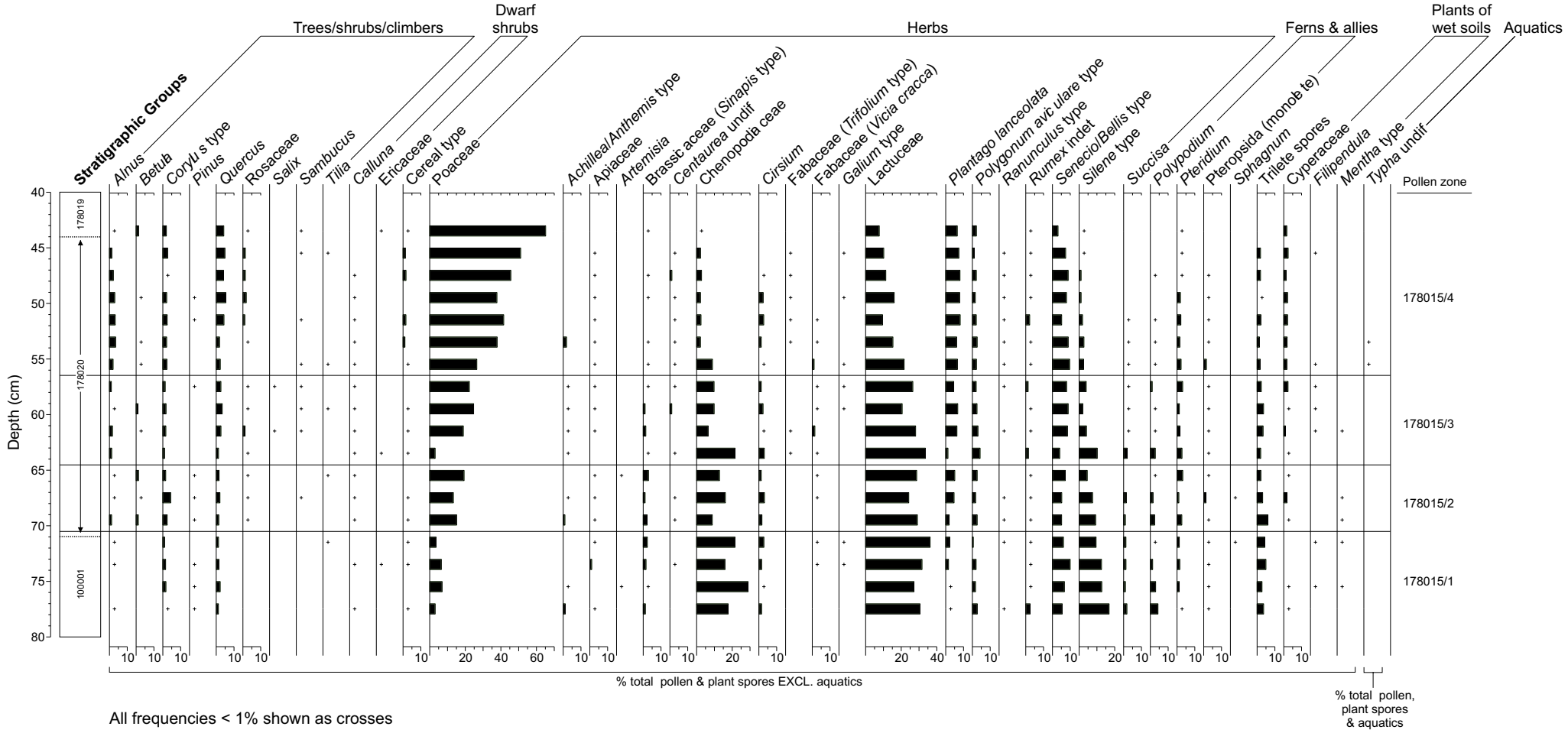


All frequencies < 1% shown as crosses

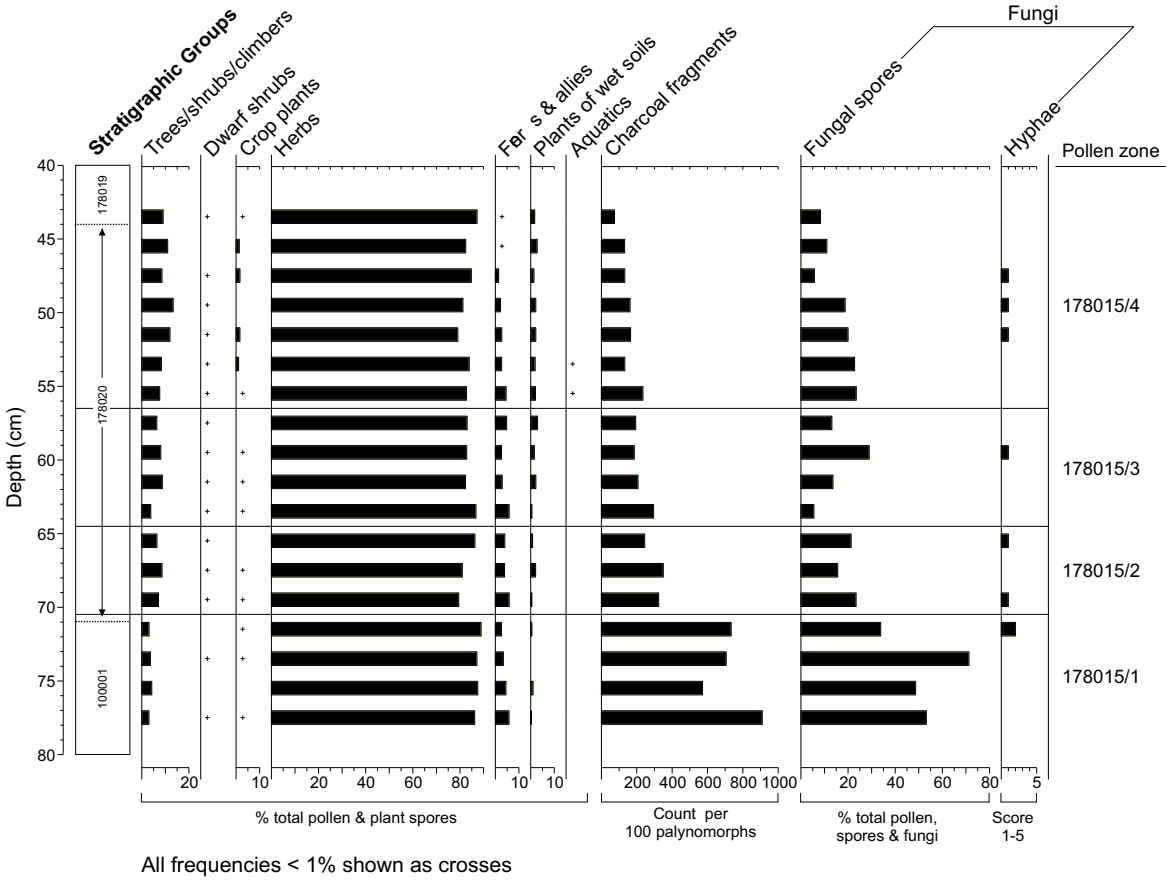
Feature 157243



Feature 157243

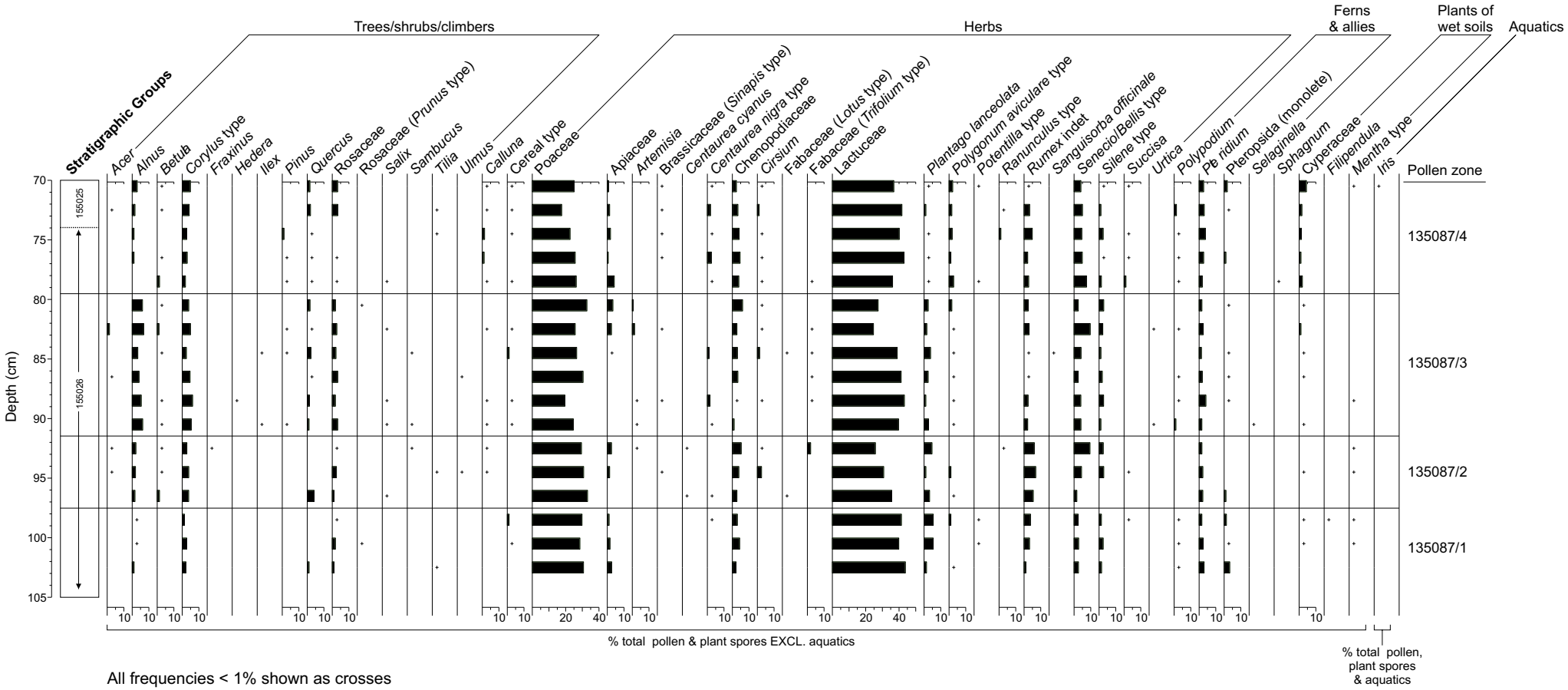


Feature 178015

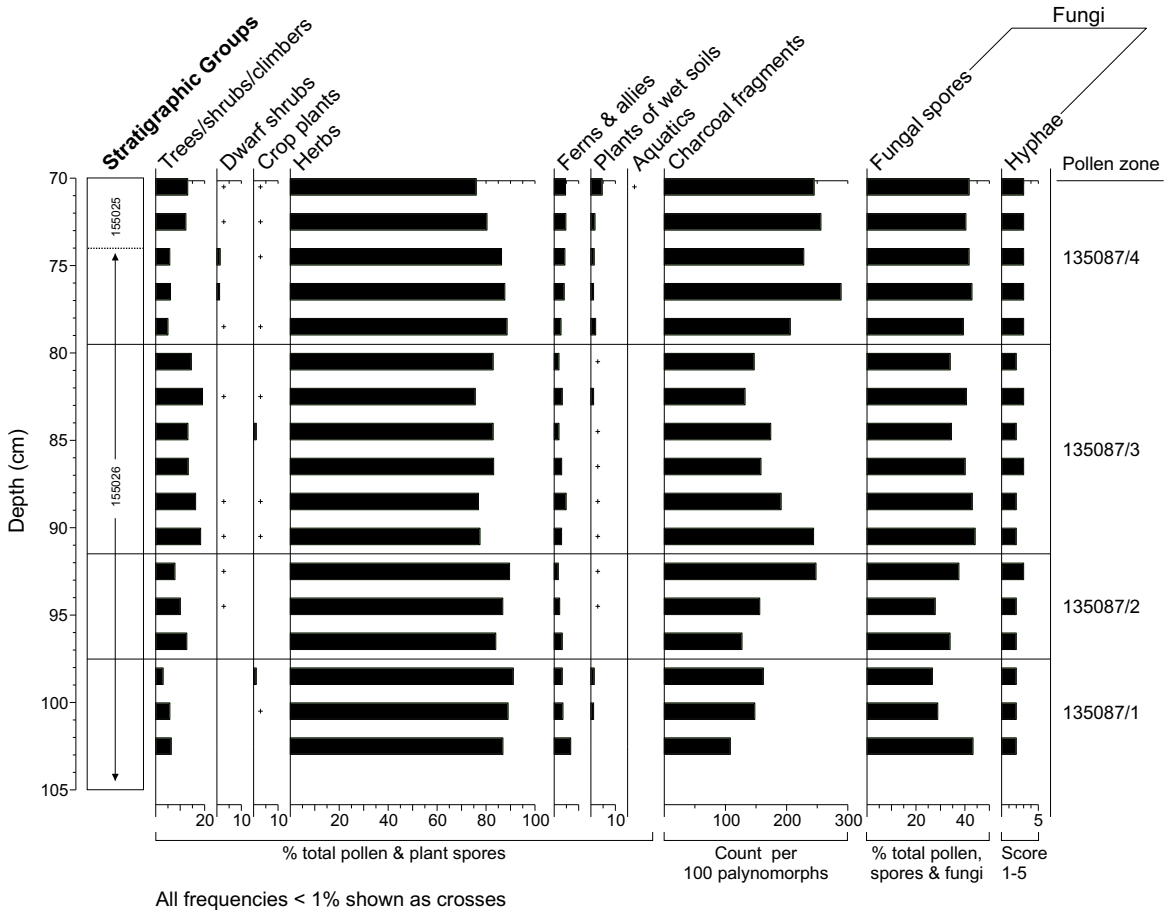


All frequencies < 1% shown as crosses

Feature 178015



Feature 135087



Feature 135087