Chapter 9: Environmental Evidence

ANIMAL BONES

by Bethan Charles

Introduction

A total of 1376 fragments of bone was recovered by hand in the course of the excavation. A further 1045 fragments of bone were recovered from environmental samples, sieved through meshes of >10 mm, 10-4 mm and 4-2 mm where necessary.

In addition to the bones recovered from environmental sieving, 40 fragments of burnt animal bone were recovered from sieving of human cremation burials 219, 5025 and 5135 and further material, both burnt and unburnt, came from grave 9200. These elements have not been included in the tables and are discussed below. A further 36 fragments of burnt animal bone were recovered from non-burial contexts across the site. These are included in the overall totals given above.

Condition

Animal bone did not survive in most excavated contexts, owing to the acidic nature of soils across the site. Occasional survival of bone is attributable to localised variations in soil acidity levels, with waterlogged or semi-waterlogged contexts offering the best chance of bone survival. Even so, the large majority of the bone recovered from the site was in poor condition with signs of root damage and chemical etching, characteristics which contributed to the difficulties in identifying many bones. Almost 70% of the bulk bone had fresh breaks, again indicating the fragile condition of many of the elements. It is certain that many signs of butchery, carnivore damage or pathological changes in the bone were obscured because of the attritional damage on many of the bones.

Methodology

Numbers of fragments were recorded along with an estimation of the number of individuals in each context and in total. All elements were recorded, including vertebrae, ribs and teeth. Insufficient bones were identified to species for the Minimum Number of Individuals (MNI) to be calculated.

For the Caprine sub-family an attempt was made to separate sheep and goat bones, the similarity of which often pose difficulties in identification, using the criteria of Boessneck (1969) and Prummel and Frisch (1986), in addition to the use of the reference material housed at Oxford. However, since no goat bones were positively identified in the collection all caprine bones are referred to as sheep in the text.

Ageing was based on tooth eruption and wear as well as on epiphyseal fusion. Tooth eruption and wear was measured using a combination of Payne (1973), Grant (1982) and Halstead's (1985) tables for cattle and sheep. Silver's tables (1969) were used to give the timing of epiphyseal closure for cattle and pig, again due to lack of other indicative elements from other species. However, there were insufficient elements to provide meaningful information for this report. All data can be found in the archive. No elements were complete enough to allow measurement.

Results

Tables 9.1 and 9.2 show that only a small number of bones were identified to species, principally because of the poor condition of the bone as mentioned above. The majority of elements identified to species were teeth. All of the elements identified to species from Phase 5 deposits were recovered from a waterhole (796) and represent the majority of identified fragments of bone from the site.

Cattle were the dominant species through all phases of occupation. However, it is very likely that they have been over-represented in the assemblage since their bones are larger and more robust than those of pig and sheep, which may not have survived as well as a result of the soil conditions on the site.

Two cattle mandibles from ditches assigned to Phases 3 and 4 were aged. Both were between 30 and 36 months old at death. Two further cattle mandibles from waterhole 796 were aged at 18-30 months and 30-36 months old at death. This may indicate that the majority of cattle killed were animals that had been bred for their meat, rather than animals kept for dairy products or for traction purposes. It is possible that beef made up the majority of the meat diet of the inhabitants during this phase, but the numbers are too small for certainty.

Only two sheep mandibles were complete enough for ageing. One from a Phase 6 layer (context 7279) was between 2 and 3 years of age and the other from a Phase 4 ditch (context 10373) was 4 to 6 years of age at death. Individually, these do not tell us very much about the general age of the animals at death. However, most sheep in Britain during the Roman period were primarily kept for wool (Grant 1975) and would have been older animals.

A small number of horse bones were recovered, including two mandibles from contexts 7279 and 7346 as well as a few fragments of feet bones and teeth. None of the elements had signs of butchery. One fragment of red deer antler was found within each of contexts 1381, 366 and 298 (298 is in waterhole 796).

Table 9.1 Animal bones: Total number of hand collected bone fragments by species and phase (all Period 2).

Phase	Sheep	Cattle	Pig	Horse	Red Deer	Unidentified	Total
2	3	4	1	0	0	45	53
3	1	5	0	1	0	15	22
4	9	40	7	1	0	258	315
5	3	28	1	2	3	402	439
6	3	14	0	7	0	355	379
Unphased	3	13	0	0	0	149	165
Total	22	104	9	11	3	1224	1373

Table 9.2 Animal bones: Total number of bones from sieved environmental samples by species and phase (all Period 2).

Phase	Sheep	Cattle	Pig	Bird	Fish	Unidentified	Total
2	0	0	0	0	0	1	1
3	1	0	0	0	0	8	9
4	2	5	1	1	0	94	104
5	2	7	1	1	1	878	889
6	0	0	0	0	0	31	31
Unphased	0	0	0	0	0	11	11
Total	5	12	2	2	1	1023	1045

None of the antlers had signs of working, but all were in poor condition and fragmented which may have obscured cut marks. It is not clear if deer were eaten, since at least one of the antlers had been shed. A small quantity of bird and fish bone was recovered, all from contexts in waterhole 796. Neither of the bird bones could be identified to species. A single vertebra belonging to a flatfish was recovered from context 310.

The majority of the 36 fragments of burnt bone recovered were from Phase 4 and 5 contexts. There is, however, no evidence for spatial concentrations of burnt refuse from the site.

Animal bone from burials

A total of 354 fragments of bone were recovered from contexts 219, 5025, 5134, 5135, 9200, 9202, 9204 and 9205 among the remains of human cremated bone. The majority of the material from grave 9200 (contexts 9200, 9202, 9204 and 9205) was unburnt, however.

Twelve fragments were recovered from context 219, but none could be identified to species. A further 22 fragments of bone were recovered from context 5025 and included fragments of juvenile sheep bone (one intermediate phalanx and the unfused distal articulation of tibia) and two bird bones (ulna and coracoid, both too fragmentary to be identified to species). A single unfused proximal section of a sheep proximal phalanx was recovered from context 5134. Five fragments including fragments of bird bone shaft were recovered from context 5135.

The majority of the material (314 fragments) came from burial 9200 contexts (9200, 9202, 9204 and 9205). Context 9200 contained elements from a very young/neonatal sheep, including 26 fragments of vertebrae including the atlas and axis. Also identified were five pig teeth which had been stained green, almost certainly from contamination by associated material. The only burnt bone from this context was a single fragment of a cremated radius, probably of sheep, which was completely burnt white. None of the 150 fragments of bone from context 9202 had been burnt. These again consisted of the remains of a neonatal sheep including both the right and left femur and the unfused proximal articulation of a left tibia, in addition to more vertebral fragments. Many of the fragments were broken and could not be positively identified, but they included fragments of ribs which may have been associated with the neonatal sheep skeleton.

Sixty-three fragments of bone from context 9204 included 31 unburnt fragments, many of unidentified bone stained green, along with a stained fragment of pig molar. The remaining material was all cremated. It included three fragments of undiagnositic bird. Identifiable elements included three fragments of pig molar teeth and a small part of an innominate (pelvis) acetabulum, probably of sheep, though not positively identified. The remaining pieces were too fragmented for positive identification.

Twenty-nine fragments of bone were extracted from context 9205. The only cremated fragments included most of a sheep astragalus and the remains of a pig molar in pieces. Other identified elements consisted of a pig's premolar tooth stained green and part of the lower shaft of a juvenile sheep's tibia. The remaining elements were not burnt and appeared to be from a juvenile animal consisting of fragments of the vertebral column and other broken and unidentifiable elements.

It is likely that these bones are the remains of burial gifts placed with the human remains. The majority of the material was not burnt indicating that the gifts were placed with the human remains after the cremation process

Discussion and summary

The small quantity of bone identified from the site does not provide much information regarding the diet and the animal husbandry practices of the inhabitants of Westhawk Farm. It is clear that the main domestic species, cattle, sheep and pig, were present at the site; beef may have been the main source of meat for the inhabitants, the minimal amount of age data for cattle suggesting that these animals were exploited for meat rather than other purposes. It has been shown that many of the more Romanised sites in Britain tended to have higher levels of consumption of beef than mutton or lamb (King 1978). However, as previously mentioned the small, poorly-preserved assemblage does not provide enough reliable information to allow further interpretation.

Small amounts of fish, bird and possibly deer also may have contributed to the diet. Bird, along with sheep/lamb, was also placed on cremation pyres in two cases. In the late Iron Age cremation grave 9200 bird and sheep/lamb were joined by pig, and unburnt remains of pig and sheep/lamb were also present in this burial.

PALYNOLOGICAL ANALYSIS OF SEDIMENTS FROM ROMAN WATERHOLES

by Patricia E J Wiltshire

Introduction

Assessment of sediments from three Roman waterholes at Westhawk Farm showed that only one (feature 796, samples 110 and 111) was sufficiently polleniferous to warrant full analysis. However, useful information was obtained from the assessment data from feature 9179 (sample 778) and will be used to supplement data yielded by feature 796. The sediments analysed from feature 796 accumulated mostly in the 2nd century, although the upper part of the core probably represents the early 3rd century. The sediments in feature 9179 are thought to be mostly 1st–2nd century in date so the two features are contemporaneous to some extent. Full details of the initial assessment are given in the post-excavation assessment report produced by Oxford Archaeology (OAU 2001), and the methodology for feature 9179 is given in that document. Palynological interpretation was also outlined in that report and will only be referred to here where it complements that of the fully analysed material, or where there are obvious differences which might reflect spatial or temporal differences in the palynological record.

Methods

Processing

Standard preparation procedures were used (Dimbleby 1985). Every sample was acetolysed and treated with hydrofluoric acid. Samples were lightly stained with 0.5% safranine and mounted in glycerol jelly.

Counting and expression of data

Pollen counting was carried out with a Zeiss phase contrast microscope at x400 and x1000 magnification. Counts for pollen and plant spores ranged between 350 and 495, depending on pollen concentration in each sample. These were expressed as percentages of total land pollen and spores (tlp/s). Microscopic charcoal (charred fragments >5.0 micrometres) was expressed as the number of fragments for a count of 100 palynomorphs. Fungal hyphal fragments were expressed as a percentage of total palynomorphs (including fungal hyphal fragments and fungal spores but excluding algae). Fungal spores were expressed in the same way as for hyphae. Algae were expressed as percentage of the palynomorph sum plus algae (but excluding fungi).

Nomenclature

Palynological nomenclature follows that of Bennett *et al.* (1994) and Moore *et al.* (1991). Cereal-type pollen refers to all Poaceae grains >40 μm with annulus diameters >8 μm (Anderson 1979; Edwards 1989). Botanical nomenclature follows that of Stace (1997).

Pollen diagrams

Diagrams were drawn with Tilia and Tiliagraph (Grimm 1992). Figure 9.1 is a summary diagram while Figures 9.2 and 9.3 show all taxa. For convenience of description, the diagrams were zoned subjectively and designated WHF1-3 respectively.

Results

The results for feature 796 are given in standard pollen diagrams Figures 9.1 to 9.3. The results for feature 9179 are given in the post-excavation assessment report (OAU 2001) and will not be repeated in detail here.

Waterhole 796

This feature has been interpreted as a waterhole with fills having accumulated between approximately AD 70 and AD 350 or a little earlier. If the chronology provided by artefactual evidence is correct, the sequence of sediments collected for palynological analysis might represent a period of about 100 years (just before AD 150 to just after AD 250). The sequences cut across three phases of sediment accumulation (Phases 3-5) with most of the sequence representing about 50 years from AD 150 to AD 200 (Phase 4). The upper 100 mm or so (Phase 5) represents the 50 years up to AD 250. This suggests that sediments accumulated relatively quickly in Phase 4 and rather slowly in Phase 5. It must be stressed, however, that the chronology presented here is dependent upon artefactual evidence rather than absolute dating and so must be viewed with some caution.

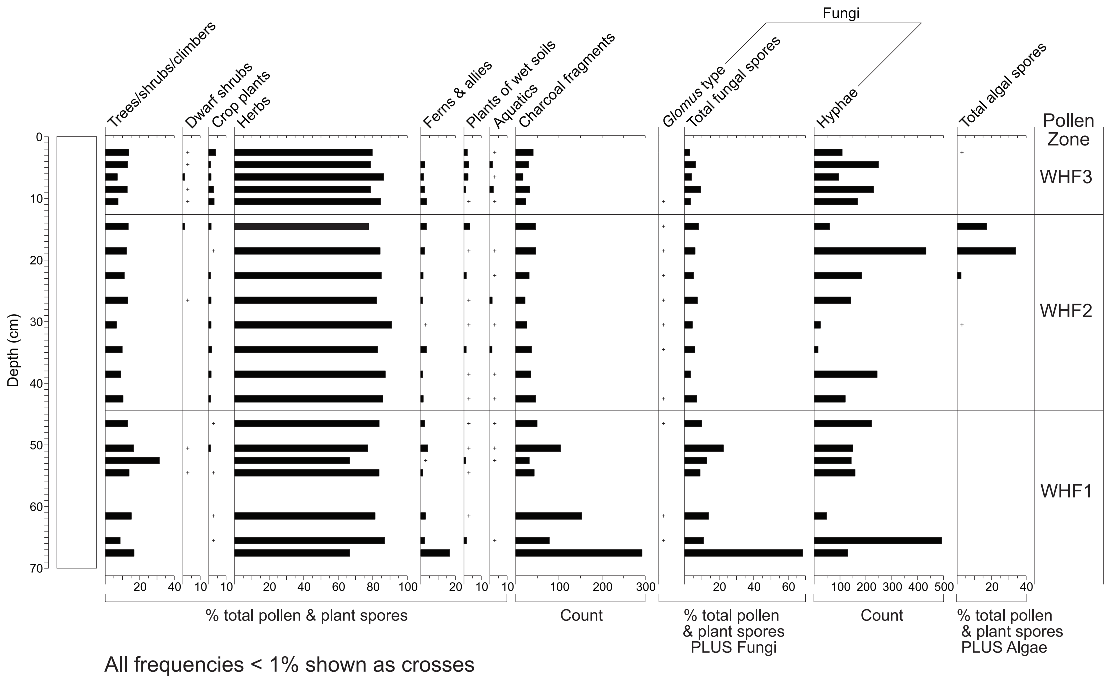

Figure 9.1 Waterhole 796: summary pollen diagram.

So few palynomorphs were found in the basal sample that the results here can only be indicative of plant taxa present rather than their relative abundance in the pollen record. The percentage values for this level must be viewed with care. However, counts adequate for reliable statistical representation were achieved for the rest of the core. The relative smoothness of the pollen curves indicate the integrity of sediment accretion and there is no evidence for any marked discontinuity or hiatus, nor anything to suggest that significant amounts of allochthonous material were dumped into the feature. Such effects would generally be reflected in erratic pollen curves.

Fungal hyphae and spores were well represented throughout the sequence. It is difficult to understand the origin of these remains although it is possible that they represent active fungal growth on organic debris falling into the feature. If this were the case, it is likely that this was during periods when water levels in the feature were relatively low, and concentrations of free oxygen were high. The relatively high percentages of unidentified palynomorphs might also reflect a fluctuating redox potential. The curve represents grains that were so badly decomposed or damaged that they could not be identified with confidence. This effect can be due to high levels of bioactivity within the sediment and this is, in turn, can be a function of availability of free oxygen.

The presence of iron pyrite framboids throughout the core shows that there were certainly periods when there was stagnant standing water in the feature. These are formed under conditions of (a) exceedingly low redox potential, (b) where there is rotting organic matter, and (c) where there is a source of detrital iron (Wiltshire *et al.* 1994). They usually develop under conditions of waterlogging where redox potential drops to the level at which fermentation and anaerobic respiratory pathways are engaged rather than aerobic ones. The byproducts of fermentation then provide substrates for the iron-reducing and sulphur-reducing bacteria. The source of sulphur might be the fermenting organic material, but the iron is usually derived from eroding soil. It is probable that soil was, indeed, eroding into the feature since *Glomus*-type fungal vesicles were present. These fungi always grow in association with living plant roots in aerated soils, so their presence in an archaeological feature might indicate that soil erosion was contributing to the accumulating deposits.

The feature seems to have been colonised and fringed by emergents, aquatics, and plants of wet soil such as Batrachium type *Ranunculus* (e.g. water crowfoot), *Sparganium* type (eg bur-reed), *Typha latifolia* (greater reedmace), *Alisma* (water plantain), *Apium* type (e.g. fool's watercress), *Mentha* (water mint), *Lythrum salicaria* (purple loosestrife), and *Filipendula* (meadowsweet). The muddy and sodden areas in the environs of the waterhole were colonised by *Lythrum portula* (water purslane), *Sphagnum* moss, *Equisetum* (horsetail), and Cyperaceae (sedges). All these attest further to the presence of standing water and wet soils in and around the feature throughout the period of sediment accumulation.

Microscopic charcoal was present throughout the sequence, but was most abundant in the earlier period of accumulation. This might mean that some activity involving wood burning was centred near the feature early in its history, but that it moved away from the immediate environs later.

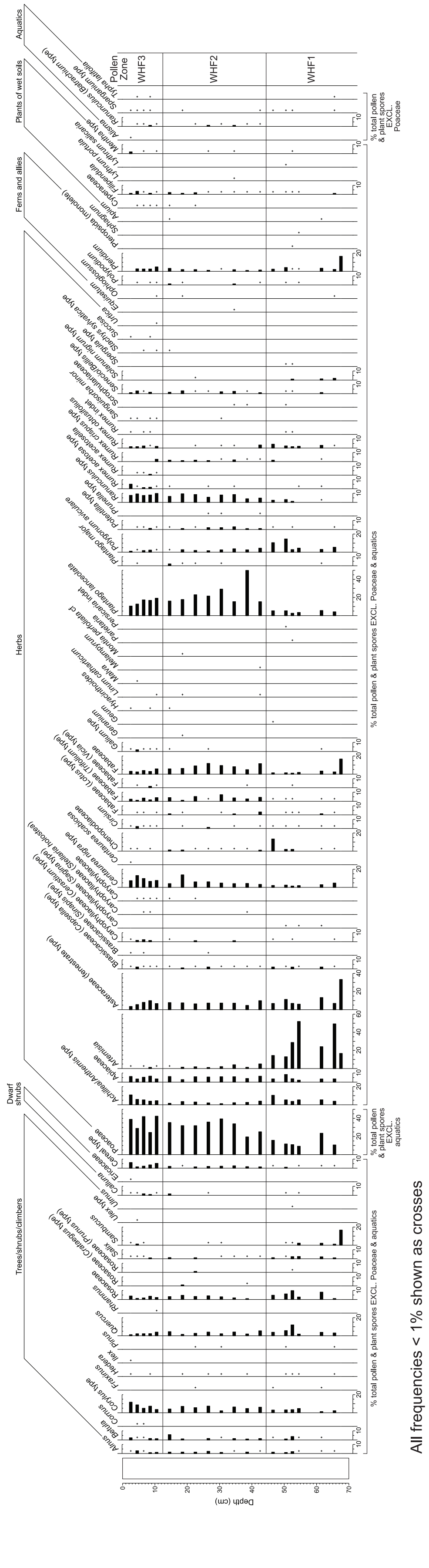

Figure 9.2 Waterhole 796: detailed pollen diagram, trees etc.

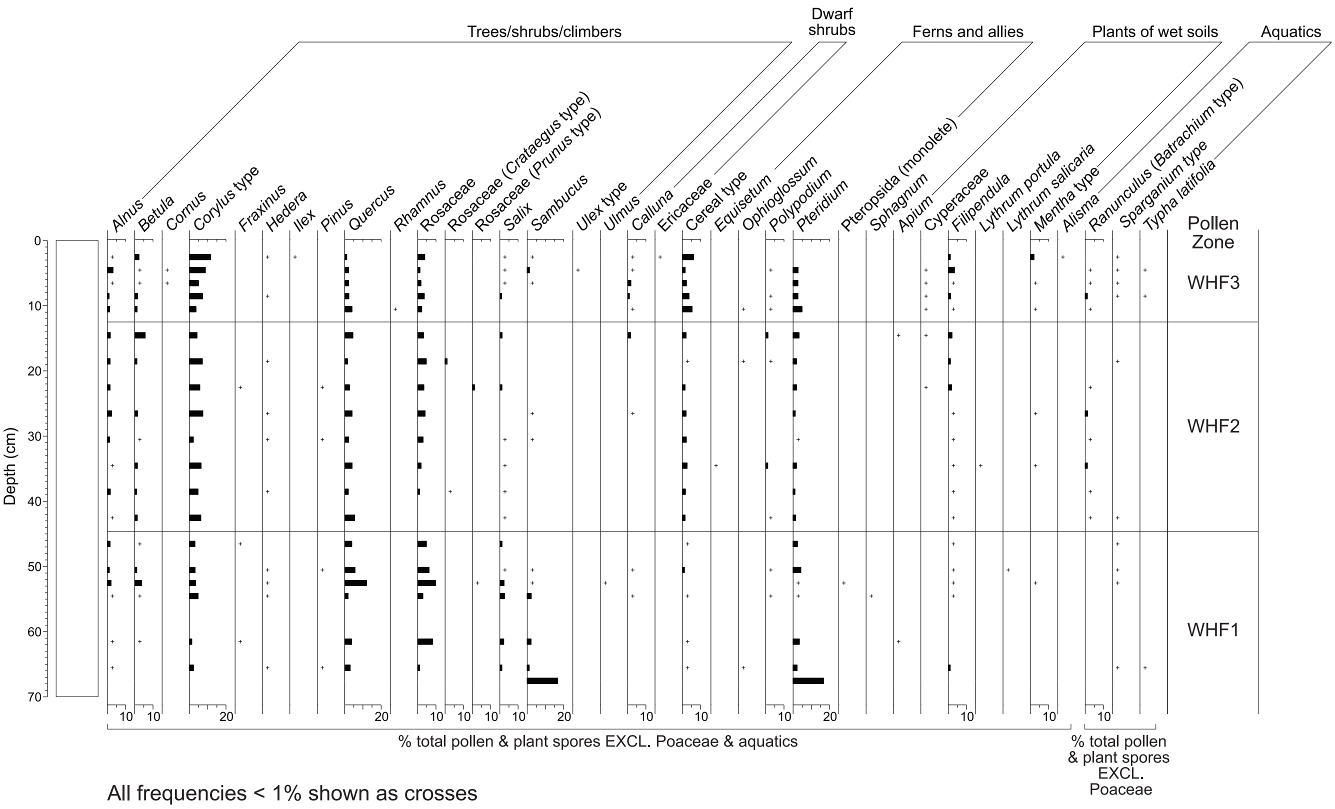

Figure 9.3 Waterhole 796: detailed pollen diagram, herbs.

Zone WHF1

Figure 9.1 suggests that this zone represents a time when the feature was set in a largely open landscape. However, a wide range of woody plants was growing in the catchment. The most abundant trees and shrubs seem to have been *Quercus* (oak), *Corylus* (hazel), and *Salix* (willow), although *Alnus* (alder), *Betula* (birch), *Pinus* (pine), Ulmus (elm), and *Fraxinus* (ash) were also growing in the area. However, the low pollen percentages of most woody plants imply that they were either growing some distance away from the feature, present in very small numbers, or heavily managed so that pollen production was much reduced.

When the low pollen production and poor dispersal of rosaceous pollen is considered, the percentages of this taxon in zone WHF1 are very high indeed. Unfortunately, preservation was such that it was not possible to identify the plants contributing this pollen with great precision; it may have been derived from *Rubus fruticosus* agg. (bramble), *Rosa* spp. (rose), or *Crataegus* type (eg hawthorn). However, it is much more likely to represent hawthorn or bramble since pollen of *Rosa* (rose) is very rare in the pollen rain (Wiltshire 1996). Other woody plants include *Prunus* type (e.g. sloe), *Sambucus* (elder), and *Hedera* (ivy). In each case, the representation was very low, but it must be remembered that all these taxa are insect-pollinated and even a single pollen grain can represent a significant biomass of the plant involved (personal observation).

There is little doubt that, although the landscape immediately around the feature was open, a diverse range of trees and shrubs was growing in its environs. Some, such as pine, birch, alder, ash, and elm were probably growing some distance away from the feature or, in the case of the deciduous trees, being managed so intensively that pollen production was low. Oak, hazel, and willow were possibly more abundant, the latter probably growing very close indeed to the waterhole. The wide range of insect-pollinated woody taxa represented in the sediments indicates that they were growing close by and, when the assemblage of shrubs is considered, it is reasonable to suggest that they formed a hedge and/or an area of scrubby vegetation close to the feature.

If the rosaceous plant(s) so well represented in the pollen spectra were *Rubus* (bramble), it is possible to imagine that the ground around the feature was either neglected or that the base of the hedge was dominated by dense growths of blackberry bushes. Not only would they add to the effectiveness of a hedge as a barrier or boundary, but could also have provided an important seasonal source of fruit.

There is little doubt that the area around the waterhole was open ground with abundant herbs and weeds. Poaceae (grasses) were relatively poorly represented and the most abundant herbs seem to have been ruderals typical of trampled waste and rough ground and ‘back yards’. These include *Artemisia* (mugwort/wormwood), *Achillea/Anthemis* type (eg yarrow/scentless mayweed), Chenopodiaceae (eg goosefoots), Lactuceae (dandelion-like plants), *Polygonum aviculare* (knotweed), *Solanum nigrum* (black bindweed), and *Rumex* (docks). In particular, the values reached by *Artemisia* are remarkably high.

This herbaceous assemblage could have resulted from various kinds of pressure, including that of human trampling and compaction of local soils. However, it might also have been the result of animals poaching the ground around the waterhole, with intense and selective grazing affecting the nature of the local herbaceous communities. Certainly, low values for grasses and high values for unpalatable plants such as mugwort, and those adapted for trampling and grazing such as knotweed and dandelion-type plants, are suggestive of high grazing pressure. Cereals were also being grown and/processed in the environs of the waterhole and many of the herbaceous plants listed above are also common weeds of arable land but their pollen might even have found their way into the feature from straw or animal dung.

Zone WHF2

The zone boundary appears to mark significant changes in local land use. Apart from hazel, which had slightly higher percentage values in this zone, trees and shrubs in the catchment seem to have suffered some impact which resulted in their lower representation in the pollen rain. The most markedly affected tree seems to have been oak, but Rosaceae, willow, elder also declined. Considering the low pollen production and poor dispersal of these latter pollen taxa, their decline might be considered to be significant.

There were also marked changed in the local herbaceous flora, including a remarkable decline in ruderals such as mugwort, yarrow/scentless mayweed, goosefoot, knotweed, and docks. Small ruderals that are rarely represented in the pollen rain, such as black bindweed, also disappeared from the record while bracken, an aggressive invader of open areas was less represented than in zone 1. The levels of microscopic charcoal also fell in this zone and this might suggest that activities associated with burning had moved some distance away from the feature.

Other herbs seem to have increased and flowered more prolifically than before. In particular, grasses gradually increased to maximum levels of about 40% of the pollen sum while there was a very marked increase in *Plantago lanceolata* (ribwort plantain). There were also significantly increased representations of other plants characteristic of grassy places and pasture, such as Fabaceae (eg clover and bird's foot trefoil), *Centaurea nigra* (knapweed), *Ranunculus* type (buttercups), and *Senecio/Bellis* type (ragwort/daisy). All these plants have low representation in the pollen rain today, even when they are relatively abundant in a sward (Wiltshire 2001). This suggests that these herbs were all growing very prolifically indeed in the environs of the waterhole and/or that their pollen was being concentrated in the dung of animals grazing the local grassy areas. Cereal type pollen also increased over the previous zone. This might suggest increased arable activity locally although, again, it could have been derived from straw or animal dung.

There does seem to have been a genuine change in the vegetation around the feature during the period represented by this zone (the latter part of the 2nd century). The decline in trees and shrubs might reflect a more intensive exploitation of local sources of wood although it could also be an indicator of a slow recovery from earlier impact. After severe coppicing and pollarding, many woody plants take much longer to recover than might be expected, often up to 20 years (Alice Holt Forestry Commission, pers. comm.). Hazel and birch are exceptions to this and can flower within a year or two of drastic cutting (personal observation based on long term garden experiment).

It is rather difficult to envisage what the vegetation changes mean in terms of land management changes in this zone, but it does appear that the surroundings of the feature become dominated by plants characteristic of rich pasture. The high values for grasses, Plantago lanceolata (ribwort plantain), and enhanced values for other pasture herbs implies that there was actually less pressure from grazing and trampling than in zone 1. Intense grazing would have the effect of removing the flowering heads of these herbs so that pastoral indicators could, actually, be reduced.

The lower values for microscopic charcoal and the increased flowering of grassland herbs might suggest that the centre of activity had moved slightly away from the site and that pasture was allowed to recover. This would also explain the demise of ruderals such as mugwort, goosefoot, and knotweed which need open ground and are poor competitors.

Zone WHF3

This zone probably represents the 50 years from AD 200 to AD 250. The local landscape seems to have changed very little indeed and land use was probably similar to that in the previous zone. However, there is some indication that the surroundings became wetter with sedges, meadowsweet, water mint, and bur-reed becoming more frequent.

Cereal pollen was also more abundant and this could mean that crop fields were located slightly closer to the waterhole, or that processing was being carried out nearby. It is even possible that cereal waste was finding its way into the feature. The better representation of elder and willow, and the appearance of *Cornus (*dogwood), *Rhamnus* (purging buckthorn), and *Ilex* (holly) might suggest that the hedgerow was less intensively managed, or that shrubs were encroaching into the area very close to the waterhole.

Plants characteristic of acidic soils such as *Calluna* (common heather), Ericaceae (other heathers), and bracken all increased in both frequency and abundance slightly in this zone. They were probably invading grassland on the more acid soils in the catchment and this could suggest less grazing and trampling pressure since none of these plants thrives under such conditions (Gimingham 1972).

Summary

In the latter half of the 2nd century, the site around the waterhole seems to have been the focus of quite intense activity. The ground appears to have had bare, trampled soils dominated by coarse ruderals plants and many other weeds. A wide range of woody plants was growing in the catchment with oak being the most important species. There seems to have been a hedge growing quite close to the waterhole but it was probably being managed quite extensively. The woodland resources were also managed by coppicing or pollarding, or else only very few trees were growing in the catchment. Later in the 2nd century, impact on the hedge and woodland resources was even greater, but human and possibly animal impact on the open ground near to the site seems to have lessened, and there was a recovery of pasture and meadow plants. Later on (possibly between AD 200 and AD 250) the site became wetter and heath plants started to encroach into the grassland. On the other hand, as heathland plants are useful domestic resources (thatching, bedding and fodder), they could have been brought from elsewhere and fortuitously found their way into the waterhole deposits. Cereal growing and/or processing also seemed to be carried out closer to the feature than in previous times although, again, the cereal pollen could have been derived from cereal waste or even dung. However, there does seem to have been some degree of recovery of the hedgerow (or scrub).

The wider picture

It is unfortunate that although, at the time of writing, a great number of studies in the environmental archaeology of sites has been completed in southern England, many have not been published. Much information is contained within unpublished assessment reports, and even comprehensive analytical reports, but the data are inaccessible and cannot be used for comparison. However, analysis of peat deposits immediately beneath Watling Street in Durovernum (Canterbury) can be quoted (Wiltshire 1989).

In spite of the accepted interpretation of the Latin name as 'a walled town by an alder marsh' (Rivet and Smith 1979, 354), palynological analysis at Canterbury showed that there was no evidence for either a marsh or abundant alder. In fact, in the late Iron Age and early Roman period in the area, the landscape was very open indeed. The area around modern Stour Street was dominated by weedy grassland with bracken being an important component of the plant community. Trees were growing in the catchment, and the most abundant were probably oak and hazel but, even here, their representation was at less than 1% of the total pollen sum at any level in the sediment sequence. It is possible that alder trees were quite abundant in the wetter areas but, if so, they must have been severely pollarded and rarely had the opportunity to flower. Indeed, no woody plant had a continuous record in the sequence and, where they were represented, they invariably achieved less than 1% of the total pollen sum.

There was a tradition of cereal production at the site and cereal-type pollen was remarkably abundant throughout the sequence. After an horizon interpreted as representing Roman influence, the major changes were a lowering of watertable (presumably through planned drainage) and the marked reduction in the abundance of the weeds of cornfield (segetals) and waste ground (ruderals). Pastoral herbs and grasses were very abundant indeed throughout the period represented by the peat deposits.

The palynological records, therefore, indicate that the area around Westhawk Farm supported a more abundant and more diverse woodland than the environs of Iron Age and Roman Canterbury. Whether this reflects more intense management of woody resources at Canterbury cannot be determined. The deposits at Canterbury and Westhawk Farm are not strictly contemporaneous, but it is interesting that the former appears to have had fewer (or more intensively exploited) woody resources than the latter.

Discussion

The data obtained from waterholes 796 and 9179 at Westhawk Farm were similar. Both features were set in, or located close to, herb-rich pasture and areas of 'waste ground'. Cereals were also being cultivated and/or processed in, or close to, the settlement. The palynological data match those of the waterlogged plant remains very well, and the higher level of taxonomic resolution provided by the seed analysis enhances the value of the palynological results. The results from charcoal and insect analyses also complement the palynological data. All the trees and shrubs identified in the charcoal report were recorded in the pollen spectra although, as expected, plants such as *Sambucus* (elder), *Betula* (birch), *Hedera* (ivy), *Ilex* (holly), *Rhamnus* (purging buckthorn), *Rubus*-type (e.g. bramble) were not found in the charcoal remains as presumably these would not be considered for fuel if other sources were plentiful. *Pinus* (pine) was not found in the charcoal record either, but it is possible that it was growing a considerable distance away from the site and at low density. Other woody taxa such as *Solanum dulcamara* (woody nightshade) and *Prunus* (cherry/sloe) were recorded in the waterlogged remains. It is gratifying, therefore, that the various analyses are mutually supportive.

The charcoal indicates that oak provided the most abundant fuel although the pollen results suggest that hazel was possibly more frequent in the immediate vicinity of the waterholes. If oak were being managed for fuel by coppicing and/or pollarding, it is not surprising that its representation in the pollen record was proportionately lower. The relative pollen frequencies could be a function of management of various species as well as proximity to the accumulating sediments. The palynological data also support both the entomological results and those of the waterlogged remains. There is little doubt that the features contained water but the pollen record indicates that the levels fluctuated considerably.

The presence of *Picea* (spruce) trees in waterhole 9179, located quite close to the shrine, was detected only by its pollen. The absence of macrofossil evidence, and the presence of spruce pollen throughout at least 100 cm of sediment of feature 9179, suggests that rather than important debris being dumped in the waterhole, one or more trees were growing in the vicinity. Furthermore, the tree must have been there for some considerable time since pollen-producing cones only occur on older trees (Mitchell 1974). The absence of spruce pollen in the other features is enigmatic since they, like feature 9179, contain sediments deemed to have accumulated in 2nd century. However, modern pollen studies have shown (Wiltshire, personal observation) that conifer pollen dispersal can be very localised indeed.

From recent, though as yet unpublished data, there is little doubt that spruce was being grown in Romano-British settlements in eastern England. Convincing evidence has been obtained for its presence in East Anglia (Cartwright 1996; Murphy 1999; Wiltshire 1998a; Wiltshire 1998b; Wiltshire 1999a) and in Hampshire (Wiltshire 1999b). Both macrofossil and palynological evidence has been obtained, and although the presence of cones and leaves does not necessarily imply that the tree was being grown, continuous record of pollen throughout sediment sequences certainly does. It is reasonable to imply a ritualistic or aesthetic reason for its cultivation since its timber is very inferior to that of most native British trees (Hyde and Harrison 1977). It was certainly being grown in the vicinity of a garden and temple at Godmanchester (Murphy 1999; Wiltshire 1999a).

Conclusions

There is little doubt that there were quite marked changes in human impact around the waterhole (feature 796) in the 100 years or so represented by the pollen sequence. After AD 150, there seems to have been a hedge near to the feature and large trees and shrubs were either growing some considerable distance away, or were being heavily exploited for fuel and other needs. The environs of the feature were dominated by open ground with ruderals (weeds characteristic of waste ground and 'back yards'). Later, the activity that encouraged these plants seems to have moved away from the area and herb-rich grassland spread into the area. Cereals were being grown or processed at the site throughout this period, but were more abundant after about AD 200. The sediments and margins of the feature were wet throughout the period represented by the pollen sequence, but the water table fluctuated. It seems to have become wetter after about AD 200 when cereals seem to have been more important at the site, and heathland plants were either starting to encroach the grassland, or were being brought into the settlement from elsewhere. There was also some recovery of the woody plants making up the hedge.

There seems to have been a greater abundance of trees and shrubs at Westhawk Farm in the 2nd and 3rd centuries than there was at Canterbury during the very early Roman period. Whether this variation in the record was due to exploitation by coppicing and pollarding, or actual abundance of trees and shrubs, cannot be determined.

WOOD CHARCOAL

by Dana Challinor

Introduction

A total of fifteen samples were chosen for charcoal analysis. The samples were selected from a range of deposits from several structures and other feature types, such as a cremation grave and a waterhole. Since one of the main uses of the site was industrial, the aims of the charcoal analysis were to determine the taxonomic composition of deposits relating to metalworking activities and investigate the evidence for woodland management practices. The wide range of features sampled also offered the potential to look at context-related variation in the use of fuelwood.

Methodology

The samples were processed by flotation in a modified Siraf-type machine, with sample sizes mostly 20-30 litres in volume. The resultant flots were air-dried and sub-sampled using a riffle box. Some of the flots were so rich in charcoal that only a small percentage of the flot was actually examined (Table 9.3). The sub-samples were then divided into fractions using a set of sieves, and fragments > 2 mm were identified. The charcoal was fractured and sorted into groups based on the anatomical features observed in transverse section at x10 and x20 magnification. Representative fragments from each group were then selected for further examination using a Meiji incident-light microscope at up to x400 magnification. Identifications were made with reference to Schweingruber (1990), Hather (2000) and modern reference material. A total of 2653 fragments were examined.

In addition to species identification, the maturity of the wood was assessed where the condition of the wood permitted it, and the number of growth rings recorded. A total of 61 roundwood fragments were examined where the complete radius or diameter of the stems were preserved. These fragments were selected from the whole flot, not just from the sub-sample. Combined methods of ubiquity or presence analysis and quantification by fragment count have been used in this report. It is acknowledged that there are differential rates of fragmentation in charcoal and that quantification by fragment count is not always reliable, but this method has been used in this report to demonstrate relationships between individual taxa. Classification and nomenclature follow Stace (1997).

Results

The results by fragment count are given in Table 9.3 and the roundwood data is given in Table 9.4. Eight taxa were positively identified. The taxonomic level of identification varied according to the biogeography and anatomy of the taxa:

> **Fagaceae**: *Quercus* sp. (oak), tree, two native species not distinguishable anatomically.
> **Betulaceae**: *Corylus avellana* (hazel), shrub or small tree, sole native species. *Corylus* and *Alnus glutinosa* (alder) have a very similar anatomical structure and can be difficult to distinguish, hence the category *Corylus*/*Alnus*. However, since no *Alnus* was positively identified, it is assumed that only *Corylus* is represented here.
> **Salicaceae**: the genera *Salix* sp. (willow) and *Populus* sp. (poplar) are not distinguishable anatomically. However, given the evidence of *Salix* in the pollen record (Wiltshire, above) it is likely to be this taxon represented in the charcoal.
> **Rosaceae**: *Prunus* spp., includes *P. spinosa* (blackthorn), *P. avium* (wild cherry) and *P. padus* (bird cherry); can be difficult to distinguish anatomically, although the charcoal from Westhawk Farm was characteristic of *P. avium*. The native status of *P. avium* is uncertain and it may be a Roman introduction to Britain (see discussion in Moffet *et al.* 1989).
> **Maloideae**: subfamily of various shrubs/small trees including *Pyrus* sp. (pear), *Malus* sp. (apple), *Crataegus* sp. (hawthorn), rarely distinguishable by anatomical characteristics.
> **Buxaceae**: *Buxus sempervirens* (box), shrub/small tree, native status discussed below.
> **Rhamnaceae**: *Rhamnus cathartica* (purging buckthorn), shrub, sole native species.
> **Oleaceae**: *Fraxinus excelsior* (ash), tree, sole native species.

Several of the samples produced small quantities of oak heartwood as well as sapwood, though in some cases preservation was not good enough to determine the maturity. The preservation of the charcoal was generally very good, with large fragments preserved. Nevertheless, there were fragments in all samples categorised as indeterminate, which were not identifiable because of poor preservation or an unusual cellular structure. In several samples the charcoal was highly vitrified, having a glassy appearance indicative of high temperatures. It is likely that these indeterminate fragments represent additional specimens of taxa positively identified at the site.

Discussion

Woodland resources

The taxa identified from the Westhawk Farm charcoal are likely to have come from local woodland, on the assumption that fuelwood is usually collected from the immediate vicinity of a settlement (eg Salisbury and Jane 1940; Western 1971; Miller 1985; Neumann 1989; Thompson 1996). Consequently, the charcoal taxa will be represented in the local environment, but will not provide an adequate reconstruction of that environment. The relatively limited range of taxa identified at Westhawk Farm indicates selection of specific wood species. Certainly, the results from the pollen analysis (Wiltshire, above) reveals that a wider range of species would have been available in the region. Nevertheless, the charcoal assemblage indicates the presence of mixed deciduous woodland, dominated by *Quercus* with *Fraxinus* and a shrubby understorey of *Corylus*, *Prunus* and Maloideae. *Salix* and *Rhamnus* favour damp soil conditions and may have grown in the valley (Fig. 9.4).

Only one species found in the charcoal assemblage was not evident in the pollen - *Buxus sempervirens* (box). The native status of *Buxus* is uncertain. While it is accepted by some as 'unquestionably native in scrub and open woodland on calcareous soils in southern England' (Mabey 1997, 254; Stace 1997, 457), the earliest identification of the species from a Neolithic context is thought to be tentative (Smith, forthcoming; Gale and Cutler 2000, 54) and others maintain that it is a Roman introduction (Farrar 1998, 143). Boxwood has been identified from Roman artefacts from excavations in London (Smith forthcoming) and occasionally as charcoal (eg Price 2000, 258) so the presence of the species in Roman Kent is acceptable. Without evidence for it in the pollen record, however, it is not possible to determine whether box was growing in the region and entered the archaeological record as fuelwood or whether the few fragments found at this site were from discarded artefacts. The use of box trees as ornamental garden features is mentioned by several classical authors (eg Pliny the Younger, *Ep*., ii, 17, 14 (Radice 1969); Pliny the Elder, *NH*, xvi, 60, 140). Since most of the boxwood fragments found at Westhawk Farm were from structure R, associated with metalworking, it is most likely that box was growing locally and was accidentally included with the main fuelwood. It is plausible that they represent trimmings from hedges; the proximity of structure R to the shrine structure may be significant.

The key issue concerning woodland resources in the Roman period is that of woodland management - were the Romans merely exploiting available resources or was there a management strategy controlling timber supply? It is very difficult to infer woodland management from charcoal, but clues to coppicing or pollarding cycles may be gained from examining patterns of similarity in ages of trees and examining patterns in growth ring widths (Morgan 1988). Figure 9.5 presents the results from all of the complete roundwood fragments from the charcoal assemblage. All species have been included in this graph as there was found to be no patterning within individual taxa groups. It is apparent from this graph that there is great variation in age and diameter be-

Table 9.3 Wood charcoal: Results of the analysis by fragment count.

Structure		-				Structure D	Structure I			Structure P	Structure R				-	
Feature type		Cremation 8956	Ditch 8240	Gully 7860	Pit 9817	Post-hole	Pit	Hearth	Pot Fill	Ditch	Pit	Pit	Pit	Hearth	Waterhole 796	
Sample number		692	671	600	749	683	53	103	213	628	66	67	89	102	15	19
Context number		8955	8366	7108	9818	8745	1082	1522	319	7347	1231	1232	1437	1529	346	429
Date		150-200	43-150	150-200	150-200	150-200	200-250	70-150	70-150	200-250	200-250	200-250	200-250	200-250	200-250	250-350
Volume of soil (litres)		15	18	20	18	20	30	25	5	20	30	30	30	30	40	10
% identified		25.0%	12.5%	1.6%	50.0%	25.0%	3.1%	25.0%	3.1%	50.0%	3.1%	3.1%	3.1%	6.3%	3.1%	12.5%
Quercus sp.	oak	130	136	201	95	162	132	129	107	115	176	126	125	180	164	149
Corylus avellana	hazel			2	10	9					6	4	9	6		
Corylus/Alnus	hazel/alder									3						7
Salicaceae	willow, poplar			6			1	1		1		3	2		3	1
Prunus sp.	blackthorn, cherry				2		2				6					
Maloideae	apple, pear, hawthorn			1	29	1			2		2	5	13	3	6	7
Buxus sempervirens	box		3								1	2	1	3		
Rhamnus cathartica	buckthorn				1							1				
Fraxinus excelsior	ash											2		1		
Indeterminate		14	19	12	16	43	24	58	28	7	27	17	20	22	19	32
Total number of fragments		144	158	222	153	215	159	188	137	126	218	160	170	215	192	196

Table 9.4 Wood charcoal: Results of the roundwood analysis. (ARW = average ring width).

Sample	Species	Ring count	Diameter (mm)	Radius (mm)	ARW
15	*Quercus* sp.	17	0	10	1.2
15	*Quercus* sp.	11	19	0	1.7
19	*Quercus* sp.	6	0	8	2.7
19	*Quercus* sp.	5	13	0	2.6
19	*Quercus* sp.	6	17	0	2.8
19	*Quercus* sp.	5	11	0	2.2
53	Salicaceae	5	0	6	2.4
66	*Quercus* sp.	14	0	15	2.1
66	*Quercus* sp.	8	12	0	1.5
66	*Quercus* sp.	7	6	0	0.9
66	*Corylus avellana*	8	0	6	1.5
66	*Quercus* sp.	14	11	0	0.8
66	*Quercus* sp.	13	0	11	1.7
66	*Quercus* sp.	13	0	7	1.1
66	*Quercus* sp.	7	13	0	1.9
66	*Quercus* sp.	10	5	0	0.5
67	Maloideae	20	22	0	1.1
67	*Quercus* sp.	15	0	13	1.7
67	Maloideae	19	0	14	1.5
67	*Quercus* sp.	14	0	6	0.9
67	*Quercus* sp.	13	11	0	0.8
67	Maloideae	23	21	0	0.9
89	*Quercus* sp.	4	0	5	2.5
89	*Quercus* sp.	5	12	0	2.4
89	*Quercus* sp.	16	0	14	1.8
89	*Quercus* sp.	12	0	10	1.7
89	*Quercus* sp.	6	0	7	2.3
89	*Corylus avellana*	11	17	0	1.5
89	*Corylus avellana*	8	16	0	2
89	*Corylus avellana*	7	8	0	1.1
89	Maloideae	10	0	8	1.6
89	*Quercus* sp.	9	0	5	1.1
89	*Corylus avellana*	11	17	0	1.5
89	*Quercus* sp.	7	0	6	1.7
89	*Quercus* sp.	8	11	0	1.4
102	*Quercus* sp.	28	20	0	0.7
102	*Quercus* sp.	29	22	0	0.8
102	*Quercus* sp.	27	20	0	0.7
102	*Quercus* sp.	28	19	0	0.7
102	*Quercus* sp.	28	0	10	0.7
102	*Quercus* sp.	27	0	10	0.7
102	*Quercus* sp.	28	18	0	0.6
102	Maloideae	12	15	0	1.3
102	*Corylus avellana*	13	0	11	1.7
102	*Quercus* sp.	31	0	12	0.8
628	*Quercus* sp.	12	0	16	2.7
628	*Quercus* sp.	13	0	18	2.8
628	*Quercus* sp.	13	0	16	2.5
628	*Quercus* sp.	12	0	15	2.5
671	*Quercus* sp.	5	5	0	1
683	*Quercus* sp.	14	0	10	1.4
683	*Quercus* sp.	9	16	0	1.8
683	*Quercus* sp.	15	0	10	1.3
683	*Quercus* sp.	23	0	10	0.9
683	*Quercus* sp.	19	0	9	0.9
683	*Quercus* sp.	18	0	9	1
683	*Quercus* sp.	17	0	7	0.8
683	*Quercus* sp.	20	0	9	0.9
683	*Quercus* sp.	23	0	11	1
683	*Quercus* sp.	10	12	0	1.2
683	*Quercus* sp.	16	0	12	1.5

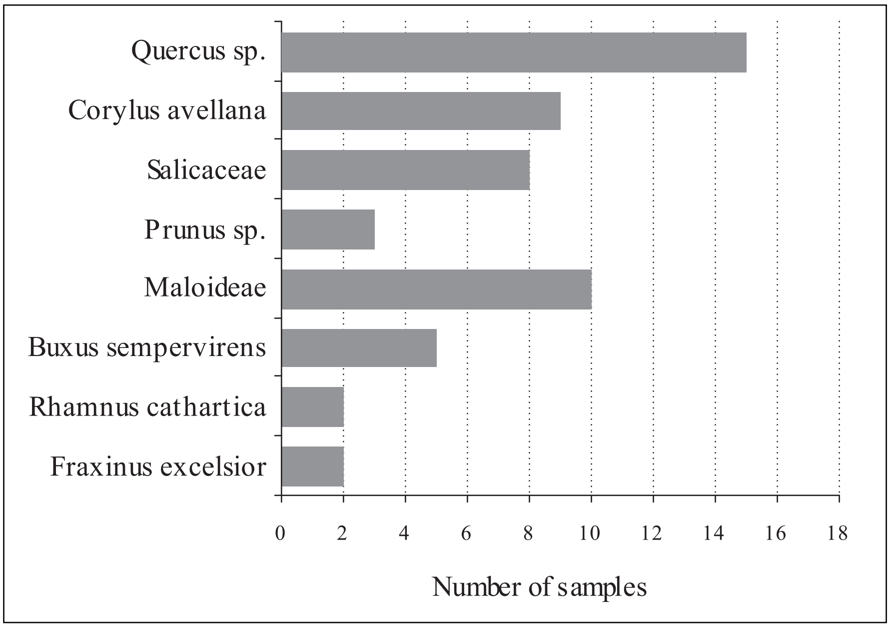

Figure 9.4 Charcoal: taxa presence by number of samples.

tween the roundwood fragments and no discernible patterns. If the wood were being regularly coppiced, a pattern of similar age/diameter would be expected (Murphy 2001, box 1) and/or wide early growth rings. At Westhawk Farm there were no indications of woodland management from the charcoal.

However, this may not be taken as conclusive evidence of lack of woodland management practices, since the roundwood fragments came from a range of deposit types which may represent several episodes of burning and deposition. It is also possible that the woodland was being managed for structural timber, not for firewood. If woodland management was not being practised at Westhawk Farm, yet fuel requirements were high to satisfy the metalworking industry, one might expect the pressure on local woodlands to have been considerable and that this would be reflected in the selection of species.

Selection of species

The collection of firewood is influenced by a number of criteria - species availability, physical properties, potential value of the wood for other uses, function of the fire and cultural values. The results from the analysis confirm the pattern noted in the assessment

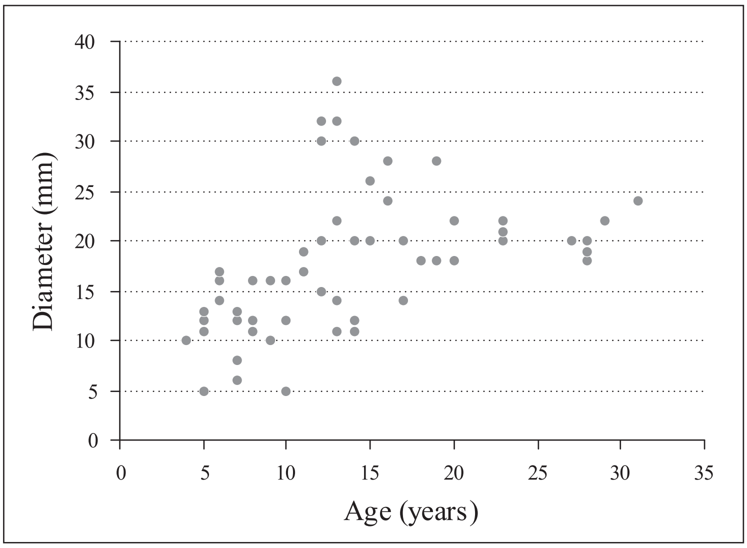

Figure 9.5 Charcoal: Age and diameter of charcoal roundwood fragments.

that oak is dominant in the samples - comprising 80% of the total assemblage (Figure 9.6) and present in all 15 samples. It is striking that the next most frequent taxa (Maloideae and *Corylus*) make up less than 3% of the total assemblage and the combined other taxa represent a mere 2%. The 'indeterminate' category is likely to be made up of some oak, but mostly non-oak/diffuse porous species which are less distinctive anatomically.

As mentioned above, all of the species in the assemblage could have grown locally. Oak is commonly found as a fuelwood in archaeological assemblages, since it makes a high energy wood fuel and its predominance in these samples suggest that the supply of this species was plentiful. Certainly, there is nothing in these results to suggest that wood supplies were limited. Given the overall dominance of oak at Westhawk Farm, the opportunity to discuss context-related variation is limited. However, there are a few interesting points worth highlighting.

Industrial activities

Several of the samples analysed came from features associated with iron-working debris, specifically structures R and I (see Chapter 7). Although there is no method for determining from archaeological material whether it was used as charcoal or as wood fuel, the processes of iron smelting and smithing would both have required charcoal as fuel (Edlin 1949, 160; Cleere and Crossley 1985, 37). At least oak would have provided good quality charcoal, capable of achieving the high temperatures necessary for iron-working. Indeed, the probable *Salix* sp. (willow) may also have entered the assemblage in this way, as it makes a better charcoal than wood fuel. It is possible that the presence of small quantities of other non-oak species (which are typical of scrub/hedgerows) may be explained by their use as an aid to ignition in charcoal burners or as an accidental inclusion. Traditional methods for making charcoal utilise shallow pits with layers of straw, grass or bracken to shut out the air (Edlin 1949, 160). There is no evidence for the process of charcoal-making at Westhawk Farm, but this is not unusual as it is rarely represented in the archaeological record for the Roman period (Cleere and Crossley 1985, 37); indeed, shallow pits or surface-level features would all have been removed by post-Roman ploughing.

The industrial samples from Westhawk Farm have produced similar charcoal assemblages to other Roman metalworking sites, although there are few examples from Kent. Nevertheless, the evidence from other sites suggests a dominance of oak, with a range of other, variable, taxa (eg Campbell 2000, 37; Cleere and Crossley 1985, 37; Figueiral 1992, 189; Gale 1999, 378). Even where there is evidence of alternative fuels being used, indicating pressure on woodland resources, oak remains a component of the assemblage (eg Murphy 2000, 220). The range of species

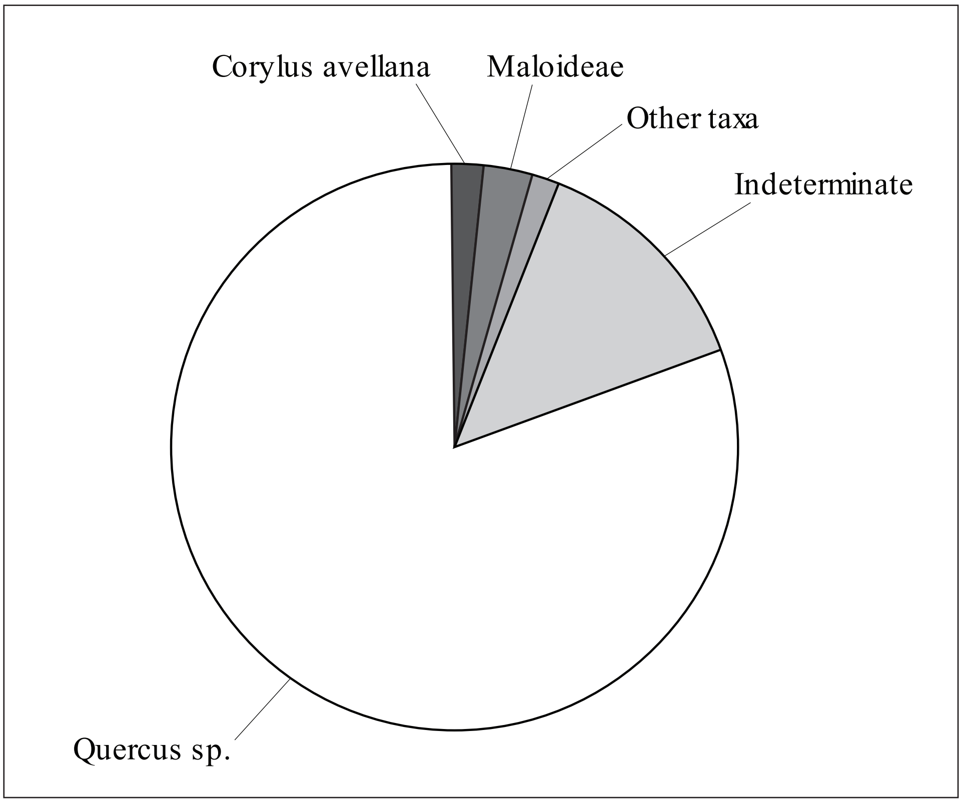

Figure 9.6 Charcoal: Composition of the assemblage.

identified at Roman metalworking sites suggests an overall picture in which there was little selection of wood for charcoal burning - oak is probably dominant because it was the most widely available wood. Certainly, there are other taxa which make better charcoal, such as *Frangula alnus* (alder buckthorn) and *Alnus glutinosa* (alder) (Edlin 1949, 165). There are also similarities between Westhawk Farm and other sites in the quantity of narrow roundwood charcoal recovered (eg Cartwright 1986, 222; Gale 1999, 382). This may relate to the intense heat produced by the use of roundwood in a fire or to collection practices; at Chesters Villa, Woolaston, the roundwood is thought to relate to coppicing (Figueiral 1992, 191), although there is no direct evidence for this here.

Domestic activities

The charcoal was interpreted as domestic refuse when it occurred as dumps in ditches and pits in association with other dumped rubbish or in association with clear settlement structures. The deposits from waterhole 796 are included in this category, although there is the slight possibility that these were ritual deposits. The significance of the assemblages from these domestic contexts lies in their similarity to those from the metalworking areas. All of the assemblages were dominated by oak, with smaller quantities of Maloideae, *Corylus, Prunus, Rhamnus* and Salicaceae. Clearly, there was no differentiation between the domestic and the industrial in terms of fuel selection. So if the fuel used for metalworking was charcoal, was this also used for domestic purposes? While it is not necessary to use charcoal for cooking and heating, it does provide a smokeless heat, which was used for some types of domestic ovens in Roman Britain (Allason-Jones 1989b, 96). However, the effort involved in charcoal-making and the resource implications of this make it unlikely to have been worthwhile for activities where standard wood fuel would suffice (Gale 1999, 383) and the size of the settlement at Westhawk Farm is unlikely to have necessitated such use of resources.

Ritual activities

Only one of the cremation burials from Westhawk Farm produced a good assemblage of charcoal (grave 8956). This is the only sample to produce a single taxon - again, oak was dominant. The predominance of a single taxon in prehistoric cremation assemblages has been noted at various sites and taken as evidence of deliberate ritual selection (eg Thompson 1999; Straker 1988). Moreover, recent assessment work on sites from the Channel Tunnel Rail Link project indicates similar predominance of a single taxon (Challinor 2000; forthcoming). However, the charcoal analysis at Westhawk Farm suggests that the predominance of oak in the cremation sample at this site is unlikely to be of ritual significance. True, the cremation sample contained only one taxon, but since oak is abundant in all of the samples, there is no convincing indication of wood selection. The abundance of oak in this cremation is more likely to relate to the abundance of oak in the locality.

Conclusions

The clear predominance of oak in all samples, regardless of feature type, suggests plentiful resources. Yet it is generally thought that the Romans must have been managing the woodland in the Weald to cope with the wood requirements of the metalworking industry (Rackham 1997, 74-5). Of course, this assumption depends upon the scale of the industry, which was quite modest at Westhawk Farm (Paynter, Chapter 7). According to Paynter's calculations, each smelt would consume roughly 64 kg of charcoal which, at a ratio of 6.5:1, would require 416 kg of wood. On this basis, and assuming a conservative 6 smelts per year, the annual wood consumption at Westhawk Farm would have been about 2.5 tonnes (*c* 2496 kg) - hardly a vast undertaking. Of course, these calculations are likely to be underestimates given the limitations of the excavations and the fact that this does not account for non-metalworking timber requirements.

Nonetheless, it must be concluded that the iron-working industry at Westhawk Farm was probably not on a large enough scale to necessitate the use of managed wood for fuel consumption. Certainly, there is nothing in the charcoal record to indicate coppicing or to suggest limited wood resources. There was no differentiation between fuelwood utilised for industrial, domestic or ritual activities - whether charcoal or wood fuel. In fact, it is apparent that the character and type of fuel used remains the same throughout all phases, from the 1st to 4th century. At least one other Wealden site (Bardown; see discussion in Cleere and Crossley 1985, 37) shows a lack of evidence for systematic woodland management or wood selection. Apparently, the iron-working industry was placed in this location because plentiful wood supplies were available.

CHARRED AND WATERLOGGED PLANT REMAINS

by Ruth Pelling

Introduction

Features at Westhawk Farm were routinely sampled for the recovery of charred plant remains. Samples of 6 to 40 litres were processed using a modified Siraf type machine. Flots were collected onto a 250 μm mesh and allowed to dry. Residues were retained on 1 mm meshes and any charred items greater than 2 mm were added to the flots. Provisional assessment of some 215 samples demonstrated that charred seeds and chaff were present in 20 samples. In addition, one of the excavated waterholes, feature 796, was found to contain waterlogged plant remains. Following assessment of 200 g sub-samples from this waterhole to establish the quantity and quality of waterlogged plant remains, five larger samples of 1 kg were processed as for charred remains, but the flots were kept wet.

Methodology

Samples selected for analysis of charred plant remains either contained sufficient charred items to warrant analysis (generally over 100 items of grain, chaff, and/or weeds), or, in the case of sample 21, contained an unusual item noted during assessment, *Pinus pinea* (stone pine). Time limitations prevented every sample selected being examined in full, although it was felt that the full range of assemblage types was examined. Samples were sorted under a binocular microscope for seeds and chaff. Identifications were made under a binocular microscope at x10 to x20 magnification and were based on morphological characteristics and by comparison with modern reference material held at the Oxford University Museum of Natural History. Taxonomic order of weeds and nomenclature follows Clapham *et al.* (1989).

Assessment of waterlogged deposits was originally conducted by scanning the flots from 200 g sub-samples under a binocular microscope at x10 to x20 magnification. The range of species identified during the assessment was quite limited, but was felt to characterise the deposits sufficiently well that detailed sorting was not necessary. However, the identification of possible Roman introductions was deemed sufficiently significant that some investigation of larger deposits was merited. The flots from 1 kg sub-samples were therefore scanned thoroughly under the binocular microscope in order to obtain a more exhaustive species list, although abundance was estimated on a relative scale (present, common or abundant) rather than absolute counts being recorded. Nomenclature and taxonomic order follows Clapham *et al.* (1989) as for charred remains.

Results

Charred plant remains

The results are shown in Tables 9.5 and 9.6. Table 9.5 includes all the samples analysed for charred remains. Six samples were taken from one large charred deposit in a Phase 2 ditch, feature 9060/8171. A seventh sample, 37, was taken from a Phase 4 pit cutting a Phase 4 ditch in the northernmost corner of the site. This sample produced iron pan encrusted remains, and hence it was not possible to produced accurate counts for seeds and chaff. Minimum counts or approximate abundance (present, common, abundant) have therefore been entered in the table. The eighth sample, 21, was taken from a Phase 3 (AD 70-150) pit within the centre of the shrine. The ratios of grain, chaff and weed seeds from the sample are shown in Figure 9.7. Table 9.6 shows the results of assessment of the samples not examined further.

Cereal remains

Cereal remains were identified as large quantities of both grain and chaff. *Triticum spelta* (spelt wheat) dominates all the cereal rich samples, as is generally true on sites of Roman date. *Triticum dicoccum* (emmer) is also recorded, but in low numbers. A hulled six-row variety of *Hordeum vulgare* (barley) is indicated by the presence of asymmetrical grain and occasional well preserved rachis. The *Avena* sp. (oats) present is likely to be wild given that the only florets with sufficient diagnostic parts were all of *A. fatua*, the wild species. However, this does not mean that the oats were not regarded as a useful grain and they may have been deliberately collected or at least tolerated within cultivated crops.

Germinated grain of *Triticum spelta* and *Hordeum vulgare* were noted in most samples with occasional germinated *T. dicoccum*. The percentage of germinated to total grain was generally low (10% or less) with a slightly higher percentage in sample 808. Sprouted embryos were also recorded in all but samples 806 and 37, although in low numbers in each sample, particularly in relation to the number of glume base.

While grain and glume bases dominated the samples all parts of the cereal ear are represented, including terminal grain and rachis fragments. Both hexaploid (*T. aestivum* type or *T. spelta*) and tetraploid (*T. turgidum* or *T. dicoccum*) wheat rachis is represented. While some rachis may be from free-threshing wheat, most is thought to be the lower tougher parts of the *T. spelta* and *T. dicoccum* ear. Basal rachis is also recorded. Rachis of *Hordeum vulgare* is present and is particularly numerous in samples 807, 808 and 809. In addition occasional large cereal sized culm nodes may be from wheat or barley straw, and awn fragments of wheat and oats are present. The combination of all these elements suggests that whole ears of wheat and barley are represented.

Weed species

A relatively mature and varied weed flora is represented which includes two species which only became widespread during the Roman period, *Agrostemma githago* (corn cockle) and *Anthemis cotula* (stinking mayweed). Most of the taxa identified are commonly regarded as arable weeds, some of which will also grow on any nitrogen-rich disturbed ground (particularly the Chenopodiaceae and Polygonaceae). The large grasses are very prominent, notably *Bromus* subsect *Eubromus*, many of which show signs of having germinated. Also significant in terms of number are two small-seeded Compositae, *Anthemis cotula* and *Tripleurospermum inodorum* (scentless mayweed), although as these species produce composite seed heads it is possible that the seeds are from only a limited number of plants. If the small Compositae are seen as representative of seed heads, then the majority of the weed seeds can be regarded as large-seeded species, which often remain with the cereal grain until the late stages of processing (see below).

Table 9.5 Charred plant remains: Data from fully-analyses samples.

	Sample	656	806	807	808	809	810	21	37
	Context	8175	10334	10334	10334	10334	10348	416	629
	Feature	8171	9060	9060	9060	9060	9060	415	630
	Fraction	1/4	100%	1/32	1/64	1/16	100%	100%	1/16
	Volume (litres)	20	6	9	9	8	10	40	30
Grain									
Triticum spelta	Spelt wheat, germinated	32	13	3	2	4	7	-	-
Triticum spelta	Spelt wheat	32	32	13	7	1	14	-	-
Triticum spelta	Spelt wheat, terminal grain	1	-	-	-	-	-	-	-
Triticum dicoccum	Emmer wheat	1	-	-	-	-	4	-	-
Triticum cf. *dicoccum*	cf. Emmer wheat, germinated	-	-	1	-	-	-	-	-
Triticum cf. *dicoccum*	cf. Emmer wheat	1	-	-	-	1	1	-	-
Triticum spelta/dicoccum	Spelt/Emmer wheat, germinated	1	9	4	1	-	7	-	3
Triticum spelta/dicoccum	Spelt/Emmer wheat	13	-	7	-	4	29	1	2
Triticum sp.	Wheat, germinated	5	-	6	14	1	-	-	-
Triticum sp.	Wheat	146	113	38	-	15	188	-	11
Hordeum vulgare	Barley, hulled asymmetric germinated	4	-		-	-	-	-	-
Hordeum vulgare	Barley, hulled asymmetric	3	2	1	-	-	-	-	-
Hordeum vulgare	Barley, hulled straight, germinated	5	-	2	-	-	-	-	-
Hordeum vulgare	Barley, hulled straight	4	-	-	-	-	-	-	-
Hordeum vulgare	Barley, hulled germinated	13	5	7	1	2	-	-	-
Hordeum vulgare	Barley, hulled	21	16	9	7	4	-	-	-
Hordeum vulgare	Barley, germinated	3	1	-	-	-	-	-	-
Hordeum vulgare	Barley	92	12	18	5	5	3	-	1
Avena sp.	Oats	1	-	21	19	7	29	-	-
Avena fatua	Wild Oats	-	1	-	-	1	2	-	6
Cerealia indet	Indeterminate	299	193	88	25	20	364	-	97
Chaff									
Triticum spelta	Spelt wheat glume base	22	3	1282	434	463	707	-	285
Triticum cf. *spelta*	cf. Spelt wheat glume base	6	-	-	11	58	22	-	-
Triticum spelta	Spelt wheat rachis	-	-	1	-	-	-	-	-
Triticum dicoccum	Emmer wheat glume base	1	2	10	18	15	46	-	-
Triticum cf. *dicoccum*	cf. Emmer wheat glume base	-		40		10	37	-	-
Triticum spelta/dicoccum	Spelt/Emmer wheat glume base	40	4	1891	840	711	1254	-	649
Triticum sp. Hexaploid	Spelt/bread type wheat rachis	-	1	-	9	-	3	-	-
Triticum sp. Hexaploid	Spelt/bread type wheat basal rachis	-	-	-	-	45	8	-	+
Triticum sp. Tetraploid	Emmer/Rivet wheat rachis	-	-	4	-	-	-	-	-
Triticum sp.	Wheat, cf. free-threshing rachis	-	-	-	3	-	-	-	-
Triticum sp.	Wheat rachis	-	-	34	-	-	8	-	-
Triticum sp.	Wheat, basal rachis	3	-	18	11	18	4	-	-
Triticum sp.	Wheat awns	+	+	++	+	+	-	-	-
Avena fatua	Wild oat floret base	1	-	5	2	1	-	-	+
Avena sp. hexaploid	Oat floret base	-	-	5	-	2	-	-	-
Avena sp.	Oat floret base	-	-	4	-	8	-	-	-
Avena sp.	Oats, awn	+	+	++	++	++	++	1	++
Hordeum vulgare	Barley rachis	1	2	98	33	35	6	-	-
Hordeum vulgare	Six-row Barley rachis	-	-	18	7	6	-	-	1
cf. *Hordeum vulgare*	cf. Barley rachis	-	-	10	-	-	-	-	-
Cerealia indet	Sprouted embryo	2	-	38	24	16	12	-	-
Cerealia indet	Detached embryo	4	17	27	15	9	-	-	+
Cerealia indet	Indeterminate rachis	2	-	-	17	10	-	-	-
Cerealia indet	Indeterminate basal rachis	-	1	12	-	9	27	-	-
Cereal size	Cereal sized culm nodes	1	-	1	3	-	1	-	-
Other Cultivated Specis									
Pinus pinea	Sone pine kernel stone	-	-	-	-	-	-	1	-
Weeds									
Ranunculus subgen *Ranunculus*	Buttercup	3	-	1	-	1	-	-	-
Brassica/Sinapis sp.	Cabbage/Turnip etc.	-	-	1	-	-	-	-	-
Raphanus raphanistrum	Wild Raddish	-	-	1	1	-	-	-	3

(*Continued on next page*)

Table 9.5 (*continued*)

	Sample	656	806	807	808	809	810	21	37
	Context	8175	10334	10334	10334	10334	10348	416	629
	Feature	8171	9060	9060	9060	9060	9060	415	630
	Fraction	1/4	100%	1/32	1/64	1/16	100%	100%	1/16
	Volume (litres)	20	6	9	9	8	10	40	30
Cruciferae		14	4	2	-	-	-	-	-
Viola sp.	Violet/Pansy etc.	-	-	1	-	-	-	-	-
Silene dioica	White Campion	-	-	-	-	-	-	-	1
Agrostemma githago	Corn Cockle	1	-	-	-	-	-	-	-
Montia fontana subsp. chondroperma	Blinks	2	-	-	-	-	2	-	-
Chenopodium album	Fat Hen	14	-	9	7	5	3	-	-
Chenopodium sp.	Goosefoot/Fat Hen	-	-	-	-	-	1	-	1
Atriplex sp.	Orache	8	2	1	1	-	-	-	-
Chenopodiaceae		4	43	6	-	2	-	-	1
Vicia/Lathyrus sp.	Vetch/Vetchling/Tare		1	7	1	2	1	-	-
Aphanus arvensis	Parsley-piert	1	-	-	-	-	-	-	-
Rosa sp.	Rose	1	-	-	-	-	-	-	-
Umbelliferae		-	-	1	-	-	-	-	-
Polygonum aviculare	Knotgrass	3	-	2	-	1	5	-	-
Polygonum lapathifolium/ persicaria	Pale Persicaria/Red Shank	20	6	5	2	-	52	-	-
Polygonum sp.	Knotgrass/Persicaria etc.	-	-	-	-	-	1	-	-
Fallopia convolvulus	Black Bindweed	7	3	1	-	-	1	-	1
Rumex sp.	Docks	54	9	19	2	12	68	-	59
Polygonaceae		6	-	3	1	1	2	-	-
Odontites verna/Euphrasia sp.	Red Barstia/Eyebright	1	-	-	-	-	-	-	-
Galeopsis sp.	Hemp Nettle	9	8	-	-	-	-	-	-
Labiatea, large		-	-	-	1	-	-	-	-
Plantago media/lanceolata	Plantain	-	-	-	-	-	1	1	-
Anthemis cotula	Stinking Mayweed	270	63	116	43	35	-	-	-
Tripleurospermum inordorum	Scentless Mayweed	531	166	407	126	159	15	-	1
Carduus/Cirsium sp.	Thistle	-	-	1	-	-	-	-	-
Centaurea nigra	Lesser Knapweed	-	1	-	-	-	-	-	-
Centaurea cf. nigra	cf. Lesser Knapweed	3	-	-	-	-	-	-	-
Centaurea sp.	Cornflower/Knapweed	-	1	-	-	-	-	-	-
Lapsana communis	Nipplewort	8	1	1	1	-	2	-	-
Leontodon sp.	Hawkbit	1	-	-	-	-	-	-	-
Compositae	Composit, large seeded	-	2	-	-	-	2	-	-
Compositae	Composit, small seeded	78	46	6	1	15	-	-	-
Juncus sp.	Rush, seed head	-	-	1	-	-	-	-	-
Bromus subsect Eubromus	Brome grass, germinated	290	46	22	17	33	-	-	-
Bromus subsect Eubromus	Brome grass	219	81	139	42	48	95	-	4
Danthonia decumbens	Heath Grass	1	-	-	-	-	-	-	-
Gramineae	Grass, large seeded	141	56	64	28	23	97	-	39
Gramineae	Grass, small seeded	45	4	31	8	10	-	-	-
Indet	seed	22	8	8	6	15	4	-	4
Indet	tree bud	-	-	2	-	-	-	-	-

Table 9.6 Charred plant remains: Data from assessed samples not subject to detailed analysis.

Sample	Context	Fill of	Feature type	Phase	Sample volume (l)	Grain	Chaff	Weeds	Species Present
34	71	68	Ditch	3	40			+	
42	808	844	Pit	3	32	+			*T.spelta T*.sp
49	942	844	Pit	3	10	+		+	Indet
56	1120	1119	Gully	4	40	+		+	T.spelta
657	8173	8171	Ditch	2	18	1000+	1000+	++++	*T.spelta T.dicoccum* *T*.sp. short grain
659	8262	8261	Ditch	?	19	+	+	+	T.spelta
660	8246	8244	Ditch	3	14	++			*T.spelta T*.sp *Avena*
738	9596	9593	Ditch	4-5	20	+++	+++	++	T.spelta *Hordeum vulgare*
746	7678	7563	Ditch	4	10	++++	++++	++++	T.spelta
780	10133	10131	Pit	Med	18	+		+	*T*.sp. short grain

\+ = 1-10.
++ = 11-50.
+++ = 51-100.
++++ = >100.

While most of the taxa present will occur on a range of cultivated soils, a few do have more specific requirements. *Raphanus raphanistrum* (wild radish) is an annual/biennial species normally associated with slightly acidic soils. *Odontites verna* (red barstia) and *Anthemis cotula* have a preference for heavy calcareous soils. The dominance of *Tripleurospermum inodorum* over *Anthemis cotula* would suggest the soil conditions are more suited to this species, however, possibly with lighter, better drained conditions. *Montia fontana* subsp. *Chondrosperma* tends to occupy seasonally flooded ground, although given the absence of other wet ground species it is possible that its requirements could be met by a seasonally flooded ditch, or localised hollow.

A few of the species identified are unlikely to be arable weeds. *Ranunculus* subgen. *Ranunculus* (buttercup) are more generally grassland or damp ground plants, but could occupy field margins or be growing within the site. *Rosa* (rose) species are scrubby climbing or scrambling plants which again may have been growing around the site or on the field margins, over walls, trees and so on, or could have entered deposits with fire wood. *Danthonia decumbens* (heath grass) is a tufted perennial of acid grassland. The *Juncus* sp. seed head is also likely to have originated in grass-

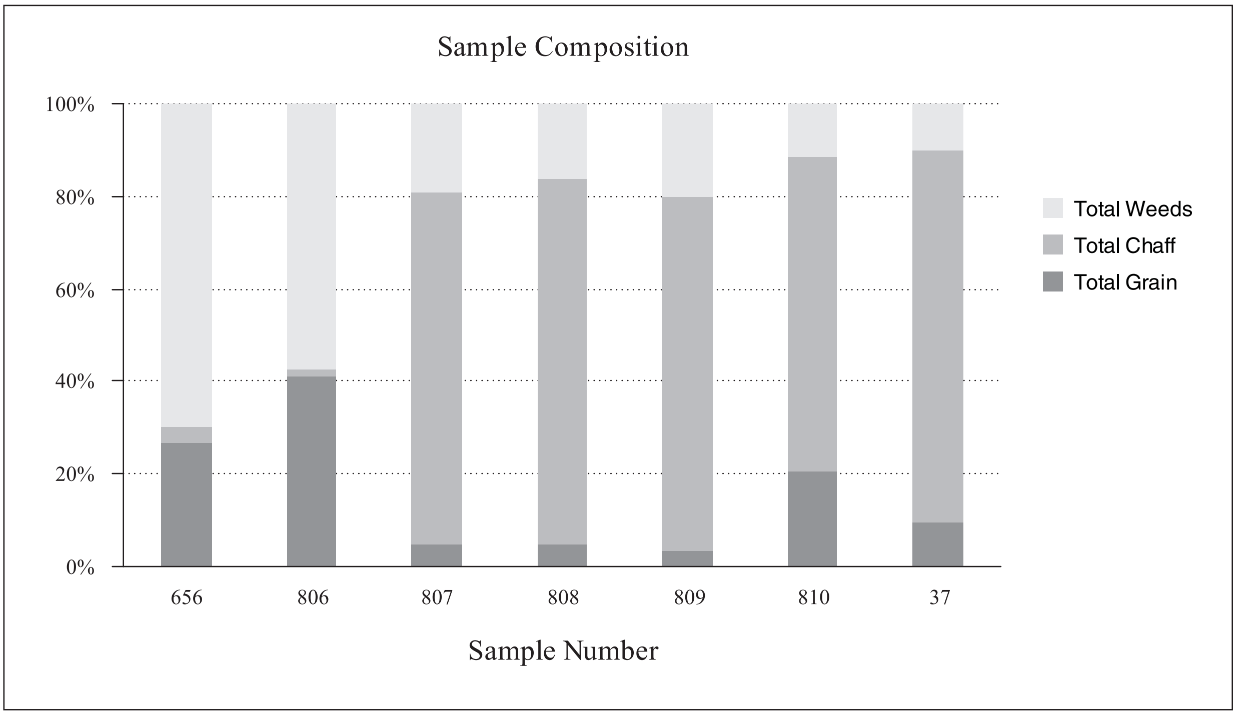

Figure 9.7 Charred plant remains: Ratio of grain, chaff and weed seeds in analysed samples (sample <21> excluded).

land or marshland. These non-arable species might have entered the site by any number of routes and given their small number this could include on clothing, in sheep's wool and so on.

The grasses form a very significant proportion of the weed assemblages, generally forming in the region of 30% of weeds and in sample 810 they form 54.5%, or 63.4% if oats are included in the weeds. Many of the *Bromus* subsect *Eubromus* seeds had germinated, particularly in sample 656. Grain of *Bromus* spp. and of wild oats are the size of cereal grains and do have some nutritional value. They are also common weeds of cereal crops and are particularly characteristic of Iron Age and Roman assemblages such that they are often regarded as potential field crops. Jones (1988, 86), however, pointed out that the question of whether *Bromus* should be regarded as a crop or a weed is meaningless as the distinction is a modern western concept. The same should be said of wild oat. If harvested with the spelt or barley crop the seeds would stay with the grain through the early stages of winnowing and sieving. They might then be separated from the cereal grain in the final stages of processing by hand picking, but could equally be left with the grain to bulk out the harvest, particularly if the harvest was poor or if it was destined for animal fodder. If the deposits represent the waste from a process involving germinating the grain, then the *Bromus* has clearly been through that process with the crop. The fact that a much higher proportion of the *Bromus* grain than the cereal grain has germinated might be due to some inherent differences in the grain (eg germinating at different temperature, moisture level etc.), or might indicate that what is represented is the waste, that is, the spelt and barley that did not germinate properly, plus the weeds and chaff.

Remains from sample 21

One sample was taken from a pit fill (context 416) of Phase 3 date (AD 70-150), located in the centre of the probable shrine. While the assemblage was very small it is significant due to the presence of a single *Pinus pinea* (stone pine) kernel shell. No seed or pine scale were recovered and no other evidence of *Pinus pinea* was found anywhere else on the site. The location of *Pinus pinea* within a shrine raises the possibility that it has derived from ritual use (possibly burning a pine cone or kernels as an altar offering) rather than as food waste. This is discussed further below.

Waterlogged plant remains

The waterlogged deposits in the waterhole (796) produced evidence for both the immediate environment around the feature and evidence for some economic species of Roman introduction. The detailed species list is shown in Table 9.7. All the deposits were dominated by large quantities of *Quercus* sp (oak) and non-*Quercus* wood fragments. The lower deposits (samples 87, 161-2, 164, 166-67) produced seeds of ruderal species including *Conium maculatum* (hemlock), *Stellaria media* (chickweed), *Urtica dioica* (stinging nettle) and *Solanum* sp. (nightshade), and wet ground or marshy species such as *Eleocharis palustris* (common spikerush), *Rorippa palustris* (common marsh yellowcress), *Lycopus europeus* (gipsywort) and *Juncus* sp. (rush). These species presumably derived from the wet muddy ground and disturbed soils around the waterhole. The upper deposits (samples 88, 158-59) similarly produced wet/marshy ground and ruderal species, with a slight increase in ruderal plants. In addition these deposits produced some drier grassland species such as *Prunella vulgaris* (selfheal) and *Stellaria gramineae* (lesser stitchwort). *Ranunculus sceleratus* (celery leaved crowfoot) suggests the presence of shallow mineral-rich water in the waterhole.

Evidence of economic species included cereal waste in the form of *Triticum spelta* and *T. spelta/dicoccum* glume bases suggesting that activities relating to food processing were taking place in this area, possibly associated with activity represented by sample 37. Such material was more common in the upper deposits, but was also noted in sample 161 lower in the sequence. Two economic species likely to be Roman introductions into Great Britain were recovered: *Prunus avium* (cherry) and *Anethum graveolens* (dill).

Discussion

Sample composition and cereal processing activities

A cereal crop must pass through certain stages of processing from harvesting to consumption (be it as food, fodder or in some other fashion such as thatch), which are defined by the type of cereal, the tools available, and by its final desired destination. The processing stages of cereals, based on ethnographic data, have been described by Hillman (1981; 1984) and, for free-threshing cereals, by G Jones (1984), with models for interpreting archaeological data. While there are limitations in the use of ethnographic models in interpreting archaeological data, particularly the absence of data due to preservation, and geographical location, it is possible by examining the composition of archaeological assemblages to speculate which crop processing stages are represented and to reconstruct harvesting techniques.

Figure 9.7 displays the ratio of grain, chaff and weed seeds in the samples analysed other than sample 21. In all cases grain forms only a minor component and either weeds or chaff dominate. Samples 656 and 806 produced high proportions of weeds with only very small quantities of chaff. The remaining samples produced approximately 70 to 80% chaff with weeds only minor elements. Grain was always limited, but was more significant in samples 656 and 806, forming up to approximately 30 to 40%.

The grain includes tail, or terminal, grain and germinated grain of both the wheat and barley. The proportion of germinated grain was always low. Sprouted embryos were also present, but in very low numbers in relation to glume bases. The chaff was dominated

Table 9.7 Waterlogged plant remains from waterhole 796.

	Sample	87	88	158	159	161	162	164	166	167
	Context	1386	1385	1554	1554	1386	1589	1456	1456	1456
	Weight	1kg	200g	200g	200g	200g	1kg	200g	1kg	200g
Seeds/Leaves										
Bryophyta	Moss	-	-	-	-	-	-	+	-	-
Pteridium sp.	Bracken fronds	-	+	-	-	+	+	-	-	-
Ranunculus acris/repens/bulbosus	Buttercup	++	+	-	+	+	+	-	+	-
R. sceleratus	Celery-leaved Crowfoot	+	-	+	+++	+	-	-	-	-
R. subgen *Batrachium*	Crowfoot	-	-	+	-	-	-	-	-	-
Rorippa palustris	Common Marsh Yellow-cress	-	-	-	-	-	+	-	++	-
Stellaria media	Chickweed	+	-	-	-	-	-	-	+	-
Stellaria graminae	Lesser Stitchwort	+	+	-	-	-	+	-	-	-
Cerastium sp.	Mouse-ear Chickweed	+	-	-	-	-	-	-	+	-
Chenopodium album	Fat Hen	-	-	-	-	-	-	-	+	+
Atriplex sp.	Orache	-	-	-	-	-	-	-	+	-
Malva sylvestris	Mallow	-	-	+	-	-	-	-	+	-
Potentilla	Cinquefoil	-	-	-	-	-	+	-	-	-
cf. *Prunus avium*	cf. Cherry	+	-	-	-	-	+	-	-	-
Rubus fruticosus	Blackberry/Bramble	-	-	-	-	-	+	-	-	-
Anethum graveolens	Dill	-	-	-	-	-	-	-	+	-
Conium maculatum	Hemlock	+	-	-	-	-	+	-	+	-
Polygonum persicaria/lapathifolium	Willow Shank/Pale Persicaria	+	-	-	-	-	-	-	-	-
Polygonum aviculare	Knotgrass	+	-	-	+	+	+	-	+	+
Rumex cf. *conglomeratus*	Sharp Dock	+	-	-	-	-	-	+	-	-
Rumex sp.	Dock	+	-	+	+	+	-	-	+	-
Urtica dioica	Stinging/Common Nettle	++	-	-	-	-	+	-	+	+
Corylus avellana	Hazel nut shell	+	-	-	-	-	-	+	-	-
Solanum sp.	Nightshade	-	-	-	-	-	+	-	+	-
Lycopus europaeus	Gipsywort	-	-	++	-	+	+	-	-	+
Prunella vulgaris	Selfheal	-	+	+	+	-	-	-	-	-
Ballota nigra	Black Horehound	-	-	-	-	-	+	-	+	-
Plantago media/lanceolata	Plantain	+	-	-	-	-	+	-	-	-
Plantago major	Plantain	+	-	-	-	-	+	-	-	-
Galium aparine	Goosegrass	-	-	-	-	-	+	-	-	-
Sonchus asper	Spiny Milk-Thistle	-	-	-	-	-	-	-	+	-
Centaurea sp.	Knapweed	-	-	-	-	-	+	-	-	-
Compositae		+	-	-	-	-	-	-	-	-
Juncus sp.	Rushes	+	-	-	-	-	-	-	+	-
Eleocharis palustris	Common Spike Rush	+	+	+	+	-	+	-	-	+
Carex sp.	Sedge	-	+	+	-	-	+	-	-	+
Triticum spelta	Spelt wheat glume	-	-	-	+	-	-	-	-	-
Triticum spelta/dicoccum	Spelt/Emmer glume	++	+	+	+	-	+	-	-	-
Indet	Tree bud scale	-	-	-	-	+	-	-	-	-
Indet	Leaf	-	-	-	-	-	-	+	-	-
Indet	Bud scale	-	-	-	-	-	+	-	-	-
Wood/Charcoal										
Quercus sp.	Oak, wood	-	+	++	+	+	-	-	+	-
Quercus sp.	Oak, charcoal	+	+	+	+	-	-	-	-	-
Non-*Quercus* sp.	Non-Oak wood	++	++	-	-	++	-	++	-	+++

by glume bases, but included basal rachis, awns, and occasional cereal sized culm nodes. Rachis of barley was also present. As discussed above the weeds were generally large seeded, including large numbers of grasses, or were from composite seed heads. Sample 656 in particular produced very large numbers of grasses and Compositae.

The composition of all samples would suggest the cereal processing waste is represented (the chaff and weeds) rather than the product (the clean grain). Samples 807, 808, 810 and 37 are characteristic of the by-products of Hillman's stages 11 and 12 for glumed wheats (Hillman 1981); the chaff, tail grain and weed seeds separated from the grain by sieving with medium coarse and fine sieves. Some grain and cereal sized weed seeds may also be derived from hand sorting (stage 14). The fact that the material is charred would suggest that it has been burnt as waste or as fuel.

Samples 656 and 806 are not so characteristic of the 'sievings', but could represent hand-sorted weed seeds and spoilt grain. It must also be considered that these samples contain deliberately collected grasses, perhaps as hay or fodder, although traditional hay meadow species are not present. It must also be considered that preservation may have affected the composition of these samples, as chaff will be more readily destroyed than grain or weed seeds at higher temperatures (Boardman and Jones 1990). It is likely, however, that at least two separate stages or even events of cereal processing are represented in ditch group 9060, with another separate episode represented by sample 37.

The presence of germinated grain raises the possibility that germination was deliberate, which would tend to imply malting activities. Malting involves forcing the grain to germinate by steeping in water and then turning out on to a floor in a heap or 'couch' to 'chit'. Once the modification of the endosperm is sufficient the germination process is stopped by roasting the grain in hot air, which produces the malt, which in turn is used for brewing beer (Brown 1983; Corran 1975). Evidence for large scale malt production has been recovered from 'corndriers' from the 2nd century AD onwards (van der Veen 1991). The percentage of germinated grain in the deposits is low, however, as might be expected in an ordinary crop which has been allowed to spoil slightly. The very large number of germinated *Bromus* seeds is unusual. Charred remains, particularly when derived from secondary deposits such as the backfill of ditches or pits generally represent the waste or by-product rather than the product itself. It is therefore reasonable to assume that if malting were taking place it would be the waste assemblages that would be represented archaeologically, that is, the grain which had not germinated along with the chaff, weeds and coleoptiles (sprouted embryos). The deposits in ditch group 9060 might then represent malting waste, where the grains which failed to germinate are disposed of with weeds, including weedy grasses that had germinated. In the absence of the actual sprouts, however, this remains speculative.

Sample distribution

Across the site as a whole the bulk sampling tended to produce charcoal but few samples with seeds and chaff. Samples which did produce grain and cereal processing waste were concentrated in three substantial deposits and one more moderate deposit. Ditch group 9060, which includes ditch section 8171, produced the largest deposit from which multiple samples were taken (samples 656, 657, 806, 807, 808, 809 and 810). Large deposits were also recovered from ditch 7563 (sample 746), pit fill 629 (sample 37) and a slightly smaller deposit from ditch 9596 (sample 738). It is possible that much of the other charred seeds and chaff derive from these large deposits, scatted about the site by later activity including plough action. Such limited numbers of substantial deposits might suggest that cereal processing was operated on a large community scale in restricted areas rather than that individual family groups processed their own cereals as and when they needed.

In terms of area it seems that cereal processing shifted location between Period 2 Phase 2 and Phase 4. In Phase 2 the activity is located within the eastern or south-eastern area of the site, an area suggested to be concerned with agriculture. Trackways seem to lead from this area away from the settlement, possibly to adjacent fields. The later cereal processing deposits are from the area to the north or north-west of the main road, possibly representing processing activity within the separate building plots, which might indicate greater fragmentation of processing activity in the later period. No cereal processing waste was recorded from the area around the shrine in any phase.

The internal distribution of material from group 9060 provides evidence for multiple phases of deposition. One long deposit was identified, given feature number 9060, into which cut 8171 was made. Sample 810 was taken from the extreme south-west of the linear deposits, while samples 806-809 were from the north-eastern part of the deposit, sample 806 the closest to cut 8171. Samples 657 (not analysed) and 656 were taken from cut 8171. The composition of the samples suggests all those from cut 9060 might be from the same deposit with the exception of sample 806, which is more similar to sample 656, with a large proportion of weeds, little chaff and more barley than the other samples. This would suggest that 806 actually represented spill from 656 and that at least two episodes of dumping are represented. It is possible therefore that this feature received successive dumps of material over some time.

Sample 37 was taken from a feature in the northernmost corner of the site, and again is characteristic of cereal processing debris. The deposit was also characterised by iron pan encrustation of the material, suggesting a fluctuating water table in this area. Two waterholes are situated fairly close to the feature, thus it is possible that the watertable was higher here than elsewhere on the site.

Species cultivated

Spelt wheat is the principal wheat recovered across Roman Britain. In Kent it has been recorded from the middle Bronze Age (Pelling 2003, 71). In other parts of southern Britain spelt tended to replace emmer during the Late Bronze Age or Iron Age (Grieg 1991). Recent evidence from the Channel Tunnel Rail Link scheme (eg Pelling 2001) suggests, however, that both hulled wheats were cultivated alongside each other or even together in the south-east region throughout the Iron Age and into the Roman period. The paucity of emmer in the Westhawk Farm samples is therefore of some interest. Van der Veen and O'Connor (1998) suggest that in north-east England the Iron Age cultivation of emmer is linked to extensive farming systems, while the cultivation of spelt is linked to a more intensive mode of production. While insufficient detailed work has been conducted in Kent it is important to note that there do appear to be spelt producing sites and spelt/emmer producing sites, although as yet no purely emmer producing sites.

While the cereal remains generally appear to represent a continuation of Iron Age agricultural traditions, there is evidence for Roman introductions into

Westhawk Farm. *Prunus avium* appears to have been introduced into Britain by the Romans along with other cultivated *Prunus* species including *P. domestica* (plum). Pre-Roman records have been suspect, being old identifications based on charcoal. Roman examples have been recorded from several sites including Upper Thames Street in London (Willcox 1977) and Silchester, Hampshire (M Robinson, pers. comm.). *Anethum graveolens* is an aromatic umbellifer, wild forms of which are known in the Mediterranean, the probable origin of its domestication. As with other spices, such as coriander and cumin, it formed part of the diet of the Roman world and was possibly spread originally by the army. It is recorded from military sites on the frontiers of Roman Britain, such as the 2nd century AD fort at Bearsden in southern Scotland (Dickson and Dickson 2000) where it presumably formed part of the military diet. It has also been recovered from later Roman settlements, in 4th century AD deposits at Barton Court Farm (Robinson 1986) and Farmoor (Robinson 1979), both in Oxfordshire. It is interesting that it was present in rural sites in Kent as early as the 1st or 2nd century.

The other significant introduction is *Pinus pinea*, now recorded at several sites in Britain during the Roman period. Locally, seed coats have been recorded from Monkton-Mount Pleasant on the Isle of Thanet (Pelling unpublished) and a mid 2nd century site at Springhead, Northfleet (Campbell 1998) and pine cone scales from a well at Lullingstone Roman villa (Doherty 1987). Similar finds have been recorded from several sites in London in the City and Southwark (Willcox 1977; Kislev 1988; Giorgi 2000) and from York (Hall and Kenward 1990). All of these finds have been interpreted as the residue of food consumption, as they included the waste products but not the seed and were recovered from refuse contexts. As food waste the remains presumably indicate high-status food and relatively affluent residents. The Westhawk Farm example was recovered from a ritual context and must therefore raise the possibility that it was a religious offering. A growing number of sites have produced evidence for the use of stone pine in religious contexts such as temples of Mithras at Carrawburgh on the Antonine Wall (Richmond *et al.* 1951) and in London (Grimes 1968), the triangular temple at Verulamium (Wheeler and Wheeler 1936, 118-119), from Chew Park, Somerset (Rahtz and Greenfield 1977), from a shrine in Rocester, Staffordshire (Monckton 2000) and most recently the grave of the 'female gladiator' at Great Dover Street, Southwark (Giorgi 2000). Most of the ritual finds therefore are from military or urban sites. The Westhawk Farm deposit indicates that other Romano-British sites were also witnessing Roman style or influenced rituals, although the location of the site on a major road suggests that it could be visited by travelling Roman soldiers or high status visitors.

Stone pine therefore appears to be a Mediterranean food of some significance in terms of 'ritual' and value as a food. Other Mediterranean fruits or foods found on British sites are also likely to have been of some value and this is possibly reflected in their use within ritual contexts, such as grapes burnt on the funeral pyre, then placed within a grave at Pepper Hill in Kent (Davis forthcoming), and charred lentils (*Len culinaris*) from the same grave at Pepper Hill, and from cremation graves in Hopper Street, East London (de Moulins, pers. comm.). Other fruits found associated with the 'female gladiator' were dates, figs, and almonds. These finds may reflect the requirements of Mediterranean gods to receive Mediterranean fruits or may simply reflect the value of these imported goods.

While cherry and dill could have been easily cultivated locally, producing fruit/seed quickly (particularly in the case of dill). Stone pine, if cultivated locally would not have produced cones for several years. The number of finds from rural sites in Kent may be associated with its successful cultivation on suitably calcium-rich soils, although evidence of the overseas trade in Italian cones is known from a Roman ship wreck near Toulon, France (Kislev 1988). It is equally possible therefore that in Kent Roman traditions were particularly readily adopted, or that proximity to trading ports and roads was influential.

Conclusions

The plant remains recovered from the Roman roadside settlement of Westhawk Farm are in some respects typical of the pattern emerging for Roman sites in Kent. Spelt wheat is the major cereal cultivated, while emmer wheat is also recorded. At present detailed investigation of sites in Kent is too limited to speculate on the significant of spelt versus emmer cultivation. Cereal processing appears to have been taking place within the site possibly within restricted areas or zones. Germinated grain and a large number of germinated *Bromus* seeds may have derived from malting activities.

Associated weed seeds provide little evidence for soils types or cultivating conditions, but do suggest that waste from several stages of cereal processing was dumped together.

The location of the site on a major road may explain why at least three imported or newly introduced food plants were deposited. Cherry and dill may represent food debris while a find of stone pine within a shrine may represent a religious offering, perhaps by travellers or by wealthy inhabitants of the settlement.

INSECT REMAINS FROM ROMAN WATERHOLES

by Mark Robinson

Introduction

Samples from three substantial waterholes were assessed to determine their potential for insect analysis. Two of these features were considered to have good potential to provide useful palaeoenvironmental information about the site (Table 9.8).

Table 9.8 Insect remains from waterholes: Samples examined.

Sample	Context	Feature	Date	Sample weight
722	9414	Waterhole 9179	?2nd century AD (Phase 3)	4.0kg
166	1456	Waterhole 796	mid-late 2nd century AD (Phase 4)	1.0kg
165	1456	Waterhole 796	mid-late 2nd century AD (Phase 4)	1.0kg
164	1456	Waterhole 796	mid-late 2nd century AD (Phase 4)	1.0kg

Methods and results

Each sample was washed over onto a 0.25 mm mesh to separate the organic material from the inorganic fraction. The organic material was then subjected to paraffin flotation to extract insect remains from plant debris. The flot was washed in detergent then sorted in water under a binocular microscope for insect fragments. The insects were identified and the results listed in Tables 9.9 and 9.10. Nomenclature for Coleoptera follows Kloet and Hincks (1977).

Interpretation (Fig. 9.8)

Waterhole 9179

The majority of the insects from waterhole 9179 were aquatic individuals. The small water beetle *Helophorus* cf. *brevipalpis* outnumbered all the other beetles in the sample. It flourishes in small bodies of stagnant water. Other beetles of this habitat from the waterhole included *Hydrobius fuscipes*, *Ochthebius minimus* and *Hydraena testacea*. The occurrence of several individuals of *Tanysphyrus lemnae* suggested that its host plant, *Lemna* sp. (duckweed) carpeted the surface of the water. The splashed sides of the waterhole or the muddy margins around the top perhaps provided a habitat for *Platystethus cornutus* gp.

The remainder of the insects probably fell in from the surrounding landscape. There was no evidence that any had been amongst refuse dumped in the waterhole. The environment of the site in the 2nd century AD was relatively open. There were only two members of Species Group 4, beetles of wood and trees. One of them, *Scolytus rugulosus*, is a bark beetle of the family Rosaceae, particularly *Prunus* spp. (sloe, plum, cherry etc.) in hedges and orchards. The other, *Phymatodes alni*, is a cerambycid beetle that bores into more substantial dead hardwood with the bark on, such as *Quercus* sp. (oak). While it is possible that there were some oak trees on the site it is also very plausible that this beetle emerged from wood brought as fuel for the iron working that was occurring on the site.

Insects of open habitats including grassland were relatively well represented. Species of Scarabaeidae and Elateridae which have larvae that feed on the roots of grassland plants, such as *Phyllopertha horticola* and *Agriotes* sp. (Species Group 11) comprised 3.4% of the terrestrial Coleoptera. Scarabaeoid dung beetles (Species Group 2), mostly members of the genus *Aphodius*, comprised 11.9% of the terrestrial Coleoptera. This is sufficiently high a percentage to suggest that domestic animals were grazing in the vicinity of the waterhole, although an even higher value would have been expected if the waterhole had been used to water large numbers of stock corralled around it.

There was also evidence for areas of weedy disturbed ground or bare ground with clumps of vegetation, as might be expected in a settlement. Some of the Carabidae (ground beetles) from the sample, for example *Amara apricaria* and *Harpalus rufipes*, favour such habitats. They also occur in arable fields. The phytophagous Coleoptera included *Brachypterus* sp., which feeds on *Urtica dioica* (stinging nettle) and *Gastrophysa polygoni*, which feeds on *Rumex* spp. (docks) and *Polygonum* spp. (knotgrass etc.).

The insects, however, gave no evidence for structures or human habitation in the settlement. The beetles of Species Group 7, which occur in general foul organic material habitats, were not, at 5.1% of the terrestrial Coleoptera, particularly abundant. The various synanthropic beetles and woodworm beetles of Species Group 9a, 9b and 10 were absent.

Waterhole 796

The samples from waterhole 796, which were all from the same context, are considered together. The same beetles of stagnant water were again abundant and *Helophorus* cf. *brevipalpis* was likewise by far the most numerous. There was, however, less evidence for *Lemna* sp. (duckweed) growing on the surface of the water, with only a single individual of *Tanysphyrus lemnae*.

As for the previous waterhole, there were many insects which probably fell in from the surrounding landscape. However, there were also some which had perhaps been amongst refuse. The landscape of the later 2nd century AD seems to have remained relatively open. The only wood and tree-feeding beetles of Species Group 2 were *Scolytus rugulosus* again and *Chalcoides* sp. The latter feeds on the leaves of *Salix* and *Populus* spp. (willow and poplar).

Various insects gave evidence of grassland. Members of Species Group 11, such as *Agriotes lineatus*, which feeds on the roots of grassland herbs, were, at 1.9% of the terrestrial Coleoptera, not very abundant, but other grassland species were present. They included the weevil *Gymnetron pascuorum* which feeds on *Plantago lanceolata* (ribwort plantain) and the members of Species Group 3 such as *Sitona* sp. which feed on *Trifolium* spp. (clovers) and *Vicia* and *Lathyrus* spp. (vetches). Workers of a grassland ant, *Lasius flavus* gp. were also present. It is the ant which builds anthills. The scarabaeoid dung beetles of Species Group

Table 9.9 Insect remains from waterholes: Coleoptera.

	Minimum No. of Individuals				Species Group
Water hole	9179	796/256			
Sample	722	166	165	164	
Sample weight (kg)	4.0	1.0	1.0	1.0	
Trechus micros (Hbst.)	2	-	-	-	
Bembidion lampros (Hbst.) or *properans* Step.	1	1	-	-	
B. doris (Pz.)	1	-	-	-	
B. biguttatum (F.)	1	-	-	-	
B. guttula (F.)	1	-	-	-	
Bembidion sp.	-	-	-	1	
Pterostichus strenuus (Pz.)	-	-	-	1	
P. vernalis (Pz.)	1	-	-	-	
Tachys sp.	1	1	-	-	
Agonum viduum (Pz.)	-	-	-	1	
Amara apricaria (Pk.)	1	1	1	-	6b
Amara sp. (not *apricaria*)	2	1	-	-	
Harpalus rufipes (Deg.)	2	-	1	-	6a
H. S. *Ophonus* sp.	1	-	-	1	
H. affinis (Schr.)	1	1	-	-	
Acupalpus cf. *meridianus* (L.)	1	-	-	1	
Dromius linearis (Ol.)	1	-	-	-	
Haliplus sp.	1	-	1	-	1
Hygrotus inaequalis (F.)	1	-	-	-	1
Hydroporus sp.	2	1	-	-	1
Agabus bipustulatus (L.)	1	-	1	-	1
Colymbetes fuscus (L.)	1	-	-	1	1
Helophorus aquaticus (L.)	1	-	-	-	1
H. grandis Ill.	1	-	-	1	1
H. aquaticus (L.) or *grandis* (Ill.)	2	1	1	-	1
Helophorus spp. (*brevipalpis* size)	103	32	8	11	1
Cercyon haemorrhoidalis (F.)	-	-	-	1	7
Cercyon sp.	1	-	1	-	7
Megasternum obscurum (Marsh.)	2	1	1	-	7
Hydrobius fuscipes (L.)	2	1	1	1	1
Anacaena globulus (Pk.)	1	-	-	-	1
Helochares or *Enochrus* sp.	1	-	1	1	1
Histerinae indet.	-	-	1	-	
Ochthebius bicolon Germ.	-	-	-	1	1
O. cf. *bicolon* Germ.	2	-	2	-	1
O. minimus (F.)	4	-	2	-	1
O. cf. *minimus* (F.)	6	2	-	-	1
Hydraena testacea Curt.	4	-	-	-	1
Limnebius papposus Muls.	2	-	-	-	1
Carpelimus bilineatus Step.	-	-	-	1	
Platystethus cornutus gp.	4	2	2	1	
P. nitens (Sahl.)	1	-	1	2	
Anotylus rugosus (F.)	-	2	-	1	7
Stenus sp.	-	-	-	1	
Rugilus sp.	-	1	-	-	
Gyrohypnus angustatus Step.	-	-	1	-	
G. fracticornis (Müll.) or *punctulatus* (Pk.)	1	-	-	-	
Xantholinus longiventris Heer	1	-	-	-	
X. linearis (Ol.) or *longiventris* Heer	-	-	1	-	
Philonthus sp.	1	1	-	-	
Aleocharinae indet.	3	2	1	1	
Geotrupes sp.	1	1	1	1	2
Aphodius depressus (Kug.)	1	-	-	-	2
A. foetidus (Hbst.)	1	-	-	-	2
A. granarius (L.)	1	5	3	2	2
A. pusillus (Hbst.)	2	-	1	-	2

(*Continued on next page*)

Table 9.9 (*continued*)

	Minimum No. of Individuals				Species Group
Water hole	9179	796/256			
Sample	722	166	165	164	
Sample weight (kg)	4.0	1.0	1.0	1.0	
A. rufipes (L.)	-	1	-	-	2
A. cf. *sphacelatus* (Pz.)	1	-	1	-	2
Onthophagus ovatus (L.)	-	1	-	1	2
O. taurus (Schreb.)	-	-	1	-	2
Onthophagus sp. (not *ovatus*)	-	1	-	-	2
Phyllopertha horticola (L.)	1	-	-	-	11
Agriotes lineatus (L.)	-	1	-	-	11
Agriotes sp.	1	-	-	1	11
Cantharis sp.	-	-	2	-	
Cantharis or *Rhagonycha* sp.	1	1	-	-	
Anobium punctatum (Deg.)	-	1	2	2	10
Tenebrioides mauritanicus (L.)	-	-	-	1	9b
Brachypterus sp.	2	-	-	-	
Atomaria sp.	1	2	2	-	8
Lathridius minutus gp.	-	-	2	3	8
Enicmus transversus (Ol.)	-	-	1	1	8
Corticaria punctulata Marsh.	-	-	-	1	8
Corticariinae indet.	1	1	2	2	8
Phymatodes alni (L.)	1	-	-	-	4
Oulema lichenis Voet	1	-	-	-	
Gastrophysa polygoni (L.)	1	1	-	-	
Phyllotreta nigripes (F.)	-	-	-	1	
Longitarsus sp.	2	-	1	2	
Chalcoides sp.	-	-	-	1	4
Epitrix pubescens (Koch)	-	1	-	-	
Podagrica fuscicornis (L.)	-	1	-	-	
Chaetocnema concinna (Marsh.)	1	-	1	2	
Apion radiolus (Marsh.)	-	1	-	-	
Apion sp. (not *radiolus*)	1	-	1	-	3
Sitona sp.	-	2	-	-	3
Tanysphyrus lemnae (Pk.)	3	1	-	-	5
Bagous sp.	1	-	-	-	5
Ceutorhynchus erysimi (F.)	1	-	-	-	
Ceuthorhynchinae indet.	1	-	1	-	
Gymnetron pascuorum (Gyl.)	-	-	1	-	
Scolytus rugulosus (Müll.)	1	1	-	1	4
Total	194	74	51	51	

Key to species group:
1. Aquatic
2. Pasture/Dung
3. ?Meadowland
4. Wood and Trees
5. Marsh/Aquatic Plants
6a. General Distbd Grnd/Arable
6b. Sandy/Dry Distbd Grnd/Arable
7. Dung / Foul Organic Material
8. Lathridiidae
9a. General Synanthropic
9b. Serious Stored Grain Pests
10. Esp. Structural Timbers
11. On Roots in Grassland
12. Heathland and Moorland

Table 9.10 Insect remains from waterholes: Other insects (+ = present).

		Minimum No. of Individuals			
	Water hole	9179	796/256		
	Sample	722	166	165	164
	Sample weight (kg.)	4.0	1.0	1.0	1.0
Philaenus or *Neophilaenus* sp.		-	-	1	-
Aphidoidea indet.		-	2	-	1
Saldula S. *Saldula* sp.		1	-	-	-
Lasius flavus gp.	- worker	-	-	2	-
Lasius flavus or *niger* gp.	- female	1	-	1	-
Hymenoptera indet. (not (Formicidae)		-	1	2	1
Chironomidae indet.	- larva	-	-	-	+
Bibionidae indet.	- adult	-	-	-	2
Diptera indet.	- puparium	-	261	-	-

2 were particularly abundant, comprising 18.9% of the terrestrial Coleoptera. The most numerous members of this group were again species of *Aphodius*, in this instance *Aphodius granarius*. However, there was also an example of *Onthophagus taurus*, represented by a left elytron from Sample 165. This beetle is now extinct in Britain although it still occurs in Northern France and Belgium (Allen 1976, 205-6; Paulian 1959, 88-9). The high value for Species Group 2 strongly suggested that domestic animals were concentrated in the vicinity of the waterhole.

The same species of Carabidae that favour weedy, cultivated or sparsely vegetated ground (Species Groups 6a and 6b) that occurred in waterhole 9179 were also identified from waterhole 796. One weed which commonly occurs around settlements, *Malva sylvatica* (common mallow) was the likely host of two mallow-feeding beetles, *Podagrica fuscicornis* and *Apion radiolus*. Mallows are very susceptible to grazing, so they presumably grew in an area separate from where the domestic animals were enclosed. *Epitrix pubescens*, which feeds on *Solanum* spp. (nightshades), was also present.

Unlike waterhole 9179, there was good evidence for settlement activity and structures in the vicinity of waterhole 796. *Anobium punctatum* (woodworm beetle), a member of Species Group 10, comprised 4.7% of the terrestrial Coleoptera from waterhole 796. It usually attacks structural timbers. Members of the Lathridiidae (Species Group 8), which are fungal feeders on plant material such as hay, thatch and straw, comprised 12.3% of the terrestrial Coleoptera. Most numerous was *Lathridius minutus* gp. but *Enicmus transversus* and *Corticaria punctulata* were also present. It is possible that these beetles had been among plant debris dumped in the well.

The general synanthropic beetles of Species Group 9a were absent. However, there was a single beetle from Species Group 9b, the serious pest of stored grain, *Tenebroides mauritanicus*. It is almost certainly a Roman introduction to Britain and is restricted to indoor habitats. The adults of *T. mauritanicus* are predominantly carnivorous, feeding on other pests in stored grain such as *Oryzaephilus surinamensis* (Kenward and Williams 1979, 94). However, the larvae chiefly feed on grain and are very destructive. A single individual does not demonstrate large scale grain storage near the waterhole, but does at least show the use of grain from a major store.

The beetles of Species Group 7 such as *Megasternum obscurum* and *Anotylus rugosus*, which occur in a wide range of foul organic debris, were, at 6.6% of the terrestrial Coleoptera, no more abundant than might be expected given the presence of scarabaeoid dung beetles. No other habitats were suggested by the insects. However, the numerous Diptera (fly) puparia in Sample 166 were likely to have been from larvae that developed and pupated in an item incorporated into the deposit. Unfortunately, it was not possible to identify the puparia.

Discussion

The insect evidence from the two waterholes at Westhawk Farm suggested that the settlement was not of fully urban character. There were open grazed areas and there was by no means a full synanthropic fauna of beetles that occur in various indoor habitats as have been found in towns such as York (eg Hall and Kenward 1990). Indeed, insects indicative of a settlement were entirely absent from one of the waterholes. However, rather similar results have been obtained from some other Roman small unwalled towns such as Scole, Norfolk and Elms Farm, Heybridge, Essex (Robinson forthcoming b). These towns probably had large open areas between buildings.

The discovery of *Tenebroides mauritanicus* in the absence of any other pests of stored grain was surprising. Its partly carnivorous habit makes it dependent on other grain beetles and there have been few finds of it from Roman Britain. The other records are from major Roman towns where there was large scale grain storage, for example York (Kenward and Williams 1979) and Lincoln (Kenward, pers. comm.). Perhaps it had been imported to Westhawk Farm amongst grain rather than living in stored grain on the site.

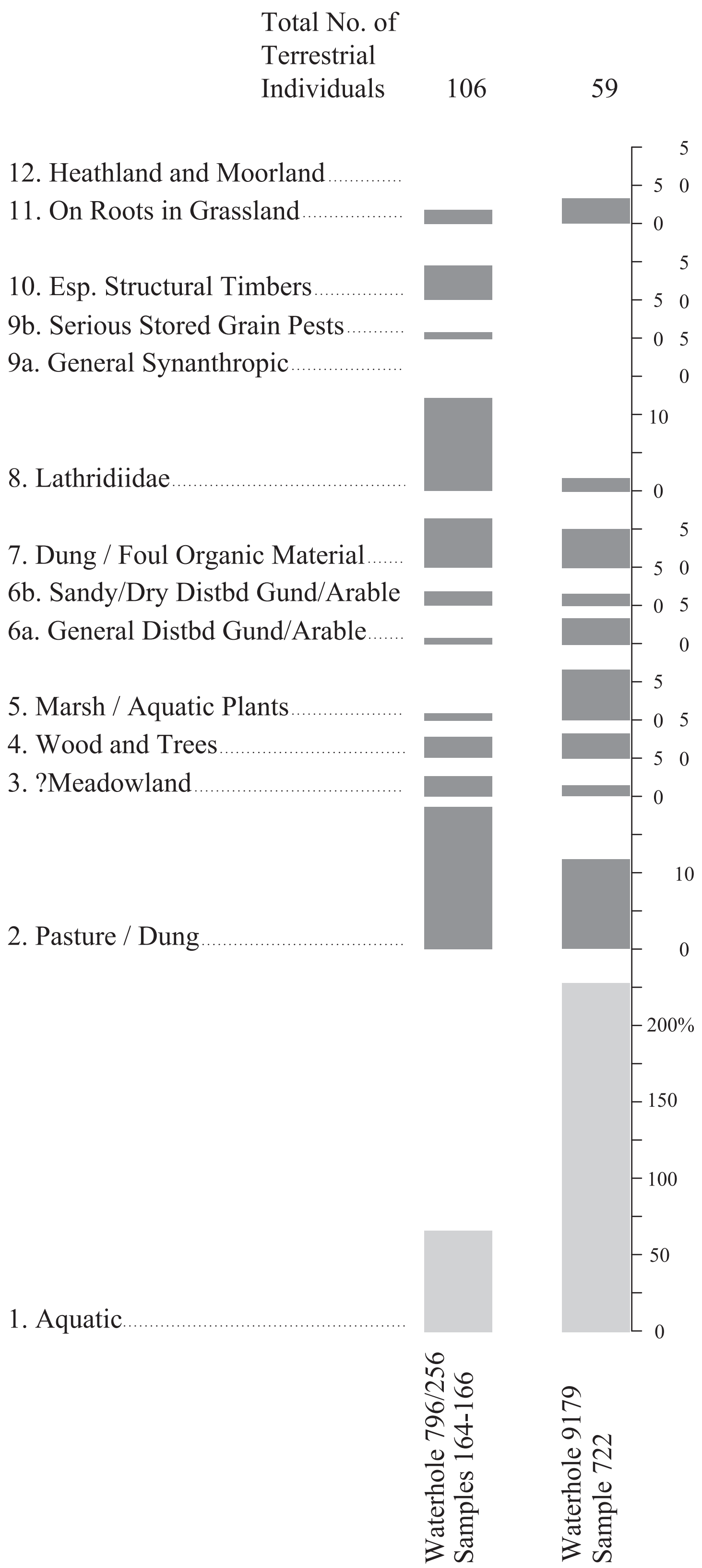

Figure 9.8 Coleoptera: Habitat/species groups expressed as a percentage of the total terrestrial Coleoptera. (Not all the terrestrial Coleoptera have been classified into groups).

The record of *Onthophagus taurus* is also of interest. This dung beetle has been recorded from several Neolithic and Bronze Age sites, but is now extinct in Britain (Robinson 1991, 320). It probably survived as a very rare member of the British fauna until the early 19th century AD (Allen 1976, 205-6, 220-21). It is possible that this beetle, which still occurs across the Channel, declined later in Kent than elsewhere in England because climatic conditions are more similar to those of north-east France.