WATERLOGGED PLANT REMAINS FROM PERRY OAKS

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Introduction and Methods

In the autumn of 1998, following the decommissioning of the Perry Oaks Sludge Works at Heathrow, West London, excavations were carried out by Framework Archaeology. Earlier evaluations had revealed evidence of activity dating from prehistoric to Roman times, including Neolithic ritual features and agricultural and settlement features dating from the middle Bronze Age through to the Roman period. Of particular interest were a series of middle Bronze Age to Roman wells, pits and waterholes that contained exceptionally well preserved environmental remains.

This report discusses the waterlogged plant macrofossil evidence from eleven of these features. The following list shows whether insect or pollen samples were also examined;

- Two MBA waterholes, F135071 (insects and pollen) and F141024 (insects)
- A M/LBA waterhole, F124100 (pollen)
- A M/LBA pit, F178108 (insects and pollen)
- A M/LBA waterhole, evaluation site POK96, either F960514 or F960529 (insects)
- A LBA well, F156031 (insects and pollen)
- A LBA pit, F136194
- A LBA well, F180080
- An ERB waterhole, F133198 (pollen)
- A RB waterhole, F174009 (insects and pollen)
- A LRB pit, F135087 (insects and pollen)

The selection of 35 samples for full analysis was made following an assessment of c.175 environmental samples taken from the site. For the assessment, 1kg subsamples were hand-floated onto a 250 micron mesh by Framework Archaeology staff. The residues were washed through a mesh of the same size. Flots and residues were kept wet and stored in a cold store.

The assessment, carried out by Gill Campbell (unpublished assessment report Gill Campbell and Dana Challinor (n.d.)), recommended that six of the above features were fully analysed. The remaining features were selected either because rapid scanning by the author showed the plant remains to be particularly interesting, or so as to make comparisons with the pollen and insect results.

For the full analysis, the flots were sorted under a binocular microscope. Full counts and identifications of the fruits and seeds were made as far as was possible. Seven of the flots were subsampled as indicated in Table 1, because the flots were too large to sort in their entirety. In these cases, total macrofossil counts in Table 1 have been estimated by multiplying up the subsample counts (marked as * in the table). In a few cases the seeds were too numerous or, in the case of rush seeds (*Juncus* sp.) too small to quantify. Estimations have been given in the table. Plant macrofossils other than fruits and seeds have only been quantified where they are easy to identify and count, as in the case of willow catkin buds, and where they provide useful environmental information, e.g. Rosaceae thorns.

Results and Taphonomy of the Waterlogged Plant Remains

The full list of species for each sample is given in Table 1. The nomenclature follows Stace (1991).

In Figures 1 to 11 the species have been grouped according to their main habitat preferences, in order to make comparisons and show changes through time and space. Ellenberg's (1988) ecological indicator values and ecological information from Stace (1991) were the two main sources of information to help to group the taxa. Total counts of remains per litre have been used for these figures rather than percentages, because where there are large variations in the sizes of the assemblages, percentages can give misleading results. When plotted according to their stratigraphic positions, macrofossil counts can also clearly show where organic decay has occurred due to drying out of the deposit (e.g. F178108, Figure 4). Table 2 gives the results of the grouping by habitat as percentages, to facilitate comparisons in the feature descriptions below.

It should be noted that grouping plant taxa by habitat preferences is a somewhat subjective exercise, since many plant species will grow in a range of habitats. Only plants with a fairly restricted habitat range have been selected for these figures, but this still includes many that, whilst typically found in one habitat, can grow in others. In these cases, the character of the whole assemblage is usually used to suggest the most likely habitat. Appendix 1 below lists the taxa for each group.

In archaeobotanical plant assemblages, interpretation is further complicated due to the fact that they are usually the product of several sources of material, so that a mixture of habitats is represented. Some of the features at Perry Oaks clearly contained dumped plant material, since waterlogged and charred cereals and chaff were recovered. This raises the possibility that some of the grassland taxa may also have been dumped, in waste hay, bedding or animal dung, rather than growing in the immediate locality. The presence of dung beetles in all of the features sampled for insects suggests that this is a distinct possibility (Robinson, this volume). This is discussed in more detail below.

The waterlogged plant remains discussed in this report have all been preserved due to the existence of anaerobic conditions in the lower levels of the deep features. Differences in the 'fragments per litre' figures given in Table 1 show that some of the upper deposits have not remained totally anaerobic since burial. Fluctuations in the water table have led to the differential decay of some of the more delicate fruits and seeds in samples such as 1533 (context 178136 SG 178136, F178108). In this case, only the tough coated seeds such as fumitory (*Fumaria* sp.) and elderberry (*Sambucus nigra*) have survived.

The open, water-filled features at Perry Oaks would have served as a pitfall trap for fruits and seeds being dispersed naturally in the area. The dispersal distance for fruits and seeds is clearly much smaller than for pollen, and in many cases the vast majority of seeds fall immediately below the parent plant. However, this does vary a great deal according to the species, particularly when dispersal agents such as wind, birds and animals are taken into account. Plant species are also very variable in the quantities of seeds produced. All of these factors need to be taken into account when interpreting the data.

Waterlogged plant assemblages are affected by differential preservation to a much smaller extent than charred assemblages, but even under optimal conditions some taxa are less likely to survive than others. The main group of species that rarely survives waterlogging is the family Fabaceae (legumes - vetches, peas, beans etc.), although pod fragments are sometimes recognisable. Many of the Fabaceae were important crops, fodder plants and weeds of cultivation, so this preservation bias needs to be taken into account. At Perry Oaks, the examination of insects and pollen from many of the same contexts as the plant macrofossils has helped to redress the balance. Poaceae are also likely to be under-represented, as the thin caryopses do survive well, and are easily torn and crumpled beyond recognition. The excellent conditions of preservation in some of the features at Perry Oaks ensured the survival of cereal chaff, complete with grains still enclosed in the husks in some cases.

Because of these biases it is very important to examine in conjunction as many categories of environmental information from each deposit as possible. Thus, interpretations from the deposits where pollen, insects and plant macrofossils have all been examined are much more reliable, because the other forms of evidence can offset limitations due to conditions of preservation and restricted levels of identification.

Some Notes on Identification and Significant Taxa

Cereals **–** The excellent conditions of preservation in some of the samples at Perry Oaks meant that cereal chaff and cereal-sized caryopses (the outer coat of the grain) were preserved. In some cases the caryopses had the shape and cell structure to indicate that they were from the arable weed, chess (*Bromus* sect. *Bromus*). In most cases grains were too collapsed and torn to determine which species they had come from, but they were large enough to be certain that they were from cereal grains rather than grasses.

Cereal chaff **–** Well-preserved emmer (*Triticum dicoccum* Schübl.) and spelt (*T. spelta* L.) glume bases and spikelet forks were present in some samples from the MBA to LRB periods. In most cases the remains were too compressed or fragmentary to identify them beyond emmer/spelt. However, in a few cases identifications were made to species level.

i) The most reliable criterion was the presence (spelt) or absence (emmer) of veins on the outer face of the rachis internode. Unfortunately the rachis internodes were not often well enough preserved to observe this character.

ii) The other, less reliable but more often visible criteria used were a combination of several of Hillman’s characters, so as to make identification more certain; the appearance of a clear secondary keel in emmer, the prominence of intermediate nerves between the keels (strong in spelt, less so in emmer), and the width of the glume bases viewed edgeways on to the spikelet (wider in spelt). Only when all of these characters were visible, were definite identifications to species made. When some of the characters were observed, tentative identifications were sometimes made.

Waterlogging makes it impossible to use characters where angles between parts of the spikelet are measured, because the remains are usually flattened and flaccid. However, where conditions permitted, glume bases were measured, and these figures are available in the archive.

The fragments of barley rachis (*Hordeum* sp.) were very small, so no identification to species level was possible. The most likely species to have been cultivated from the LBA onwards is six-row hulled barley (*Hordeum vulgare* L. emend.), although naked barley (*H. vulgare* var. *nudum*) was quite commonly grown during the MBA.

Cultivated Flax (*Linum usitatissimum* L.) – No flax seeds were recovered, but small fragments of capsule were found in three fully analysed samples and one assessment sample from Bronze Age features. Although it is not possible to know whether archaeobotanical remains have been fragmented before or after deposition, the small size of all of the capsule fragments may indicate that the remains represent capsules broken up to release seeds when dry, rather than whole capsule segments that have become preserved during the retting process (being rotted down in water). This could also explain why no seeds were recovered. This type of waste, made by crushing the dried capsules or pulling the stalks through a comb ('rippling') could then have been fed to livestock, once the valuable seeds had been removed for sowing, extraction of oil or human consumption. The capsule fragments could have blown into the feature or been introduced in animal dung or fodder. There is, therefore, no definite evidence that these waterholes, wells and pits had been used for flax retting, but flax was obviously being grown locally during the Bronze Age. Because flax has a small root run, it needs to be grown on damp soils to avoid drying out. It is likely, therefore, that flax was growing in the vicinity of the water-filled features.

Damson-type Prunus stones (*Prunus* cf. *domestica* ssp. *insititia*) – Two stones which had oval profiles much more like bullaces than sloes (11.8x8.4mm; 10.2x6.2mm) were recovered from two LBA features (F156031 and F136194). Bullace stones have been identified from the prehistoric Swiss lake sites (Heer 1865), as well as from Roman and later sites in Britain (Roach, 1985). However, it is possible that these were simply genetic variants from sloe (*P. spinosa*) bushes.

Cotton Thistle (*Onopordon acanthium* L.) – This tall (up to 2.5m), downy, biennial thistle is thought to have been introduced into the British Isles, since it is rarely found in deposits earlier than the Roman period. A relatively large number of seeds were recovered from Iron Age deposits at Farmoor, Oxfordshire, suggesting that it may have been deliberately cultivated or collected (Robinson 1979). Robinson suggested that its down or seeds were put to some purpose. There are also classical Roman and medieval references to medicinal uses for this plant (e.g. Pliny, C1st AD) which include curing a range of ailments, from a crick in the neck to convulsions and rickets. The large seeds have also been used on the Continent to provide oil for cooking and fuel for lamps, and the downy fibres were used in England in the 16th century as stuffing for mattresses and pillows. The stems can also be peeled, boiled and eaten with butter (Readers Digest 1981). At Perry Oaks, two Romano-British waterholes produced a few seeds, F133198 and F174009, so it is possible that the plant had been grown for one reason or another. Today, cotton thistle (or Scotch Thistle) has become naturalised on disturbed and waste ground.

Small-flowered buttercup (*Ranunculus parviflorus*) - This plant of open ground appears to have been more common in the past than it is today. It may have been growing in open grassland swards, but it can also grow as an arable weed (Clapham et al, 1987). It is notable that the three Bronze Age and ?Iron Age features in which it occurred at Perry Oaks (F135071, F178108, F180080) also produced most of the cereal remains. It did not occur in the Roman features. Godwin (1975) notes that it has a southern distribution in Britain and south-western in Europe generally. It was recorded from the nearby late Bronze Age waterfront site at Runnymede Bridge (Greig, 1991), and from Iron Age deposits at Farmoor, Oxfordshire (Robinson, 1979). Small-flowered buttercup may be a further indicator, in addition to the insects (see Robinson, this report), of the warmer conditions that occurred at this time.

***Other late arrivals to Britain* –** In addition to cotton thistle and small-flowered buttercup, other late arrivals to Britain with their earliest records in Godwin (1975) being Roman are hemlock (*Conium maculatum*), mallow (*Malva sylvestris*) and swine-cress (*Coronopus squamatus*). Since the publication of Godwin's 'History of the British Flora', however, archaeobotanical records have grown at an ever increasing rate. Hemlock was recovered from LBA deposits at Runnymede (Greig, 1991). At Perry Oaks it was only recovered from Roman samples. Records for cotton thistle are given above. Mallow was recorded from IA samples at Farmoor (Robinson, 1979), but at Perry Oaks it occurred in MBA and Roman samples. Swine-cress was only present in Roman samples at Perry Oaks, and no early records are known to the author.

Stinking mayweed (*Anthemis cotula*) is thought to be a native plant but is rarely found earlier than the Roman period. Jones (1981) cites the recovery of single seeds from three Iron Age sites in southern England, but at Perry Oaks it was not found prior to the Early Romano-British period.

Feature descriptions

MBA waterhole F135071 (Figure 1)

Six samples were examined for waterlogged plant macrofossils, four of which produced a wide range of well preserved remains. Sample 1141 (context 135040 SG 135067), taken from below the log ladder, was the lowest of the samples stratigraphically, but sample 1140 (context 135034 SG 135062), a thin layer higher up the profile, produced by far the greatest concentration of plant remains. 1140 also produced the largest amounts of emmer (*Triticum dicoccum*) and spelt (*T. spelta*) glume bases and spikelets, including some that were radiocarbon dated to 1260-910 cal BC (sample 9374). The presence of compacted layers of straw and chaff, interleaved with numerous wild parsnip (*Pastinaca sativa*) and common mallow (*Malva sylvestris*) fruits and stems in both samples from this thin layer (samples 1140 and 1135) suggested that crop processing waste mixed with ruderal weeds had been deposited in the waterhole. Crop processing waste was recovered from all four of the lower, better preserved samples, accounting for 2 to 10% of the identifiable remains. A few barley (*Hordeum vulgare*) rachis fragments provided evidence for the cultivation of barley, in addition to emmer and spelt. The absence of synanthropic insects from the deposit of crop processing waste, context 155028 SG 135062 (Robinson, this report), demonstrated that the straw had not been used for thatching, flooring or bedding before being deposited in the waterhole.

A few flax (*Linum usitatissimum*) capsule fragments were recovered from two of the samples. Waterlogged features often produce evidence of flax processing waste, since leaving the plants to rot in water (retting) is one of the stages in processing flax for its fibre. Because only a few capsule fragments and no seeds were present in otherwise very well-preserved samples there is no clear evidence for retting having taken place in this particular waterhole. Retting is a smelly process that would have fouled the water if it was being used for human or livestock consumption, and caused eutrophication. It is likely that flax processing waste had been fed to livestock and small amounts had been introduced into the feature in animal dung.

Mallow and parsnip are tall perennials (parsnip is a biennial) that grow primarily on drier soils. Mallow shows a preference for calcareous soils, whilst parsnip is often found on nutrient-enriched soils. Being perennials, they would not have been growing as arable weeds, but may have survived around field margins. Alternatively, they may have become mixed with the straw in the early stages of threshing. Both plants are readily grazed by animals, but a threshing area is likely to have been situated on drier ground which was fenced off from livestock. The plants would have been fruiting some time between July to September, which would correspond with harvesting arable crops. A beetle which feeds on mallow, *Podagrica fuscicornis*, was recovered from the same context as the seeds (Robinson, this volume).

Many of the weeds represented in these deposits could have been growing amongst arable crops, and were probably deposited with the processing waste. This suggestion is borne out by the close relationship of the occurrences of the two groups when figures such as Fig. 1 (F135071), Fig. 4 (F178108) and Fig. 10 (F174009) are examined. The species that were most likely to be crop weeds rather than general wasteground weeds were poppy (*Papaver dubium* and *P. rhoeas/argemone*), annual knawel (*Scleranthus annuus),* corn spurrey (*Spergula arvensis*), field pennycress (*Thlaspi arvense*), parsley piert *(Aphanes arvensis*), scentless mayweed *(Tripleurospermum inodorum*) and red bartsia/eyebright (*Odontites vernus/Euphrasia* sp.). Annual knawel is often found on dry, sandy soils, whilst corn spurrey shows a preference for acidic soils. The presence of cereal pollen in context 135031 SG 135057 (Pat Wiltshire, assessment report) could indicate that cereals were being grown in the vicinity of the waterhole. However, cereal pollen could have been introduced on the chaff and straw being dumped in the waterhole (Robinson and Hubbard, 1977).

Other habitats represented by the plant macrofossils were nutrient-rich waste areas, grasslands and waysides, woodland/scrub/hedgerow, and aquatic or bankside plants. Of the wasteground weeds, common nettle (*Urtica dioica*), fat hen (*Chenopodium album*), chickweed (*Stellaria media*) and knotgrass (*Polygonum aviculare*) seeds were particularly frequent. Grassland plants included buttercups (*Ranunculus acris/repens/bulbosus*), with a few taxa indicative of wetter (e.g. blinks, *Montia fontana*) or acidic (e.g. sheep’s sorrel, *Rumex acetosella*) soils. The high grassland counts in samples 1140 context 135034 SG 135062 and 1135 context 155028 SG

135062 were mainly due to the large numbers of mallow and parsnip fruits present, as noted above. The waterlogged remains from these first two groups could have come from plants growing around the waterhole, although in the case of samples 1140 and 1135 they were obviously introduced amongst dumped material. The insect sample was taken from the same context as these two samples (context 155028 SG 135062), and it was found to give strong evidence for grassland that was grazed, but not heavily (Robinson, this vol). A pollen sample from context 135031 produced large amounts of Apiaceae pollen (Wiltshire, this vol), no doubt derived from the wild parsnip (Pat Wiltshire, pers. comm.). Grass pollen was the predominant component of the assemblage, with some evidence of woodland/scrub/hedgerows and some cereal-type pollen.

Woodland, scrub or hedgerow taxa accounted for an average of 17% of the remains in the feature as a whole. The main taxa were bramble, (*Rubus* sect. *Glandulosus*; both seeds and bramble/rose thorns, indicating that the plants grew nearby) hawthorn (*Crataegus monogyna*; again, seed and hawthorn *Prunus* sp. thorns) alder (*Alnus glutinosa*), elder (*Sambucus nigra*) and three-nerved sandwort (*Moehringia trinervia*). Alder and hawthorn-type Rosaceae pollen were recorded in the assessment sample from this feature (Wiltshire, assessment report), but few insects indicative of this habitat were found (Robinson, this vol). It is suggested (see general discussion) that scrub or a hedgerow occurred close to the feature, rather than woodland.

The only evidence of an aquatic plant actually growing in the waterhole was from duckweed (*Lemna* sp.), a free-floating aquatic which grows in a wide range of still to slow-flowing bodies of water. Five of the six samples produced these seeds, and the *Lemna*-eating beetle *Tanysphyrus lemnae* was recorded from context 155028 SG 135062. Gypsy-wort (*Lycopus europaeus*), spike-rush (*Eleocharis* subg. *Palutres*), sedges (*Carex* sp.) and rushes (*Juncus* sp.) may have been growing around the margins of the feature.

Apart from differences attributable to the poorer conditions of preservation towards the top of the feature, all of the six samples produced very similar assemblages. There was no clear change in frequency of particular species through the profile, i.e. none of the groups gradually increased or decreased, but erratic variations did occur. This suggests that the deposits that built up in the waterhole had very similar origins, which in turn suggests that they accumulated over a fairly short period of time. Whilst it is possible that the remains originating from the surrounding vegetation could have built up over a long period of time if the habitat did not change to any great extent, the deposition of cereal processing waste in all of the lower levels suggests more rapid backfilling of the feature.

MBA Waterhole F141024 (Figure 2)

Three samples were examined from the base of this feature, one of which, sample 1144 context 121044 SG 121033, was from the same context as insect sample 277. The stratigraphically lowest layer, sample 1146 context 121045 SG 141023, produced the lowest concentration of plant remains, only 42 fragments per kg. soil. This sample was a primary fill consisting mainly of natural sediment that had eroded from the sides of the feature (Dana Challinor, pers. com.), which explains the sparse nature of the assemblage.

As in F135071, disturbed or wasteground weeds were well represented (average = 49% of total remains), particularly common nettles and docks (*Rumex* sp.). Chenopodiaceae and chickweed were much less numerous than in the above feature. This could be due to differences in time, space (the features are c. 70m apart) or the fact that cereal processing waste was not deposited in F141024.

Woodland, scrub or hedgerow taxa were again frequent, amounting to an average of 21% of the remains. Willow (*Salix* sp.), sloe (*Prunus spinosa*), hawthorn (*Crataegus monogyna*), alder buckthorn (*Frangula alnus*), buckthorn (*Rhamnus catharticus*), field maple (*Acer campestre*), elder and bramble were all represented. These are primarily small trees or shrubs that are frequently found in hedgerows today. The herbaceous plants, three-nerved sandwort and hedge woundwort (*Stachys sylvatica*) are characteristic of woodlands or shady hedgerows. The insect assemblage from this feature produced a fairly high percentage of tree and wood dependent coleoptera (Robinson, this vol), including beetles that feed on willows, sloes and hawthorns. An oak bark beetle was also present, and this fits in with the recording of oak leaf fragments in two of the samples. Acorns do not always preserve well under anaerobic conditions, but their absence could also be due to management of this large tree species, perhaps by coppicing, pollarding or layering. Alternatively, the leaves could have blown into the feature from a tree growing some distance from the waterhole. No old woodland insect species were present, and Robinson suggests that this feature was either situated near to a hedge, or that scrub regeneration occurred following abandonment.

Duckweed was growing in the waterhole, and rushes, mint (*Mentha* sp.) and gypsywort were growing around the edge. The presence of tripartite bur-marigold (*Bidens tripartita*), a plant of nutrient-rich muddy places, could indicate use of the waterhole as a drinking hole for livestock (Ellenberg 1988, 612).

The remaining taxa were either general weeds of disturbed ground or grassland species, such as buttercups, thistles and plantains.

M/LBA Waterhole F124100 (Figure 3)

This was a teardrop shaped waterhole with a gradual ramp down to a low, straight-fronted wattle revetment. The waterhole was situated c.500 metres east of the main group of Bronze Age features sampled for plant macrofossils, so it is interesting to see how similar the assemblage was to the other four features. Only one sample (804, context 124102) from this feature was worthy of full analysis. The sample came from a layer towards the bottom of the feature.

The plant macrofossils were not especially numerous, but a reasonable range of taxa (29 taxa) was recorded. The presence of frequent fragments of wood, leaves, fruits and seeds from woodland/scrub/hedgerow plants suggests that this type of habitat occurred nearby. Hawthorn (*Crataegus monogyna*), sloe (*Prunus spinosa*), buckthorn (*Rhanmus cathartica*), alder buckthorn (*Frangula alnus*), willow (*Salix* sp.) and bramble (*Rubus* sect. *Glandulosa*) were all well represented (50% of total macrofossils), and the presence of bramble/rose type thorns confirmed that these were not the result of seed dispersal by birds. The proximity of species-rich hedges or scrub near the waterhole was also indicated by the pollen analysis (Wiltshire, this vol). It was suggested that some of the larger tree species also represented, such as oak, ash, lime, birch and pine may have grown further away. None of these taxa were represented in the plant macrofossil assemblages from the waterlogged features, which supports this suggestion. Birch seeds, in particular, are produced in large numbers and travel a great distance on the wind.

Weeds of nutrient-enriched soils such as common nettle (*Urtica dioica*) and chickweed (*Stellaria media)* were fairly frequent in this sample (23% of total). Mint (*Mentha* sp.) and water-pepper (*Persicaria hydropiper*) were growing around the edge of the waterhole. Water pepper is often found growing in nutrient-enriched soils on the edge of standing water, such as occurs where livestock drink (Ellenberg 1988, 612).

The remaining taxa were either grassland herbs or more general weeds of disturbed ground. Purging flax (*Linum catharticum*) is characteristic of drier soils that are poor in available nitrogen, so it is possible that these seeds originated in waste hay or dung from animal that had been grazing on drier pastures. The single cf. emmer glume base might also have originated in dung, if crop processing waste had been used as fodder. Alternately, it may have come from crops growing or being processed in the local vicinity, since there was some pollen evidence for arable cultivation (Wiltshire, this vol).

M/LBA pit F178108 (Figure 4)
Four samples from this large pit were examined for waterlogged plant remains. Insects and pollen were also studied, the samples having been taken from context 178120 SG 178120, which is the same context as plant macrofossil sample 582.

The two lowest samples, sample 1537 Context and SG 178131 and sample 582 context and SG 178120, were very similar in the number and range of plant taxa that were present (see Figure 4). The two upper samples, sample 1534 context and SG 178137 and sample 1533 context and SG 178136, showed typical signs of drying out, with much fewer taxa being present. The remains in these upper samples were primarily tough coated seeds, in particular elder and bramble. Thus, woodland taxa dominated the assemblages due to differential preservation. Because rush (*Juncus* sp.) seeds were not counted they do not appear in the figure, but this taxon was especially frequent in the upper samples. Spike-rush (*Eleocharis* subg. *Palustres*) nutlets and sedge nutlets were also present, suggesting the presence of marshy ground around the feature.

The lower, well-preserved samples produced a wide range of taxa that fell into all of the habitat groups except for ‘heath’. Small amounts of cereal remains and several different arable weed taxa were present, indicating the deposition of waste. These remains may have originated in dung or spilt fodder, since livestock appear to have been kept in the area (see below). Alternatively cereals could have been grown in the vicinity, since the insects indicated that dry conditions existed locally. Cereal pollen was found throughout the profile.

A single fragment of cultivated flax (*Linum usitatissimum*) capsule was found, providing further evidence for the cultivation of this crop during the Bronze Age. As in F135071, the fragment could have been introduced amongst fodder or dung.

Both pollen and insect results suggest that this feature was close to human settlement, as synanthropic beetles were present (Robinson, this vol) and microscopic charcoal was abundant (Wiltshire, this vol). Elder pollen was also dominant (Wiltshire, this vol) and this nitrogen-loving shrub is almost always associated with human occupation.

The presence of woodworm beetles indicated that a wooden building had stood nearby (Robinson, this vol). Robinson found a particularly high percentage of dung beetles in this sample, indicating that domestic animals were concentrated near this pit. It is not so easy to find indications of the proximity of settlement from the plant macrofossils, since weeds of disturbed/cultivated ground were the dominant group in most of the well preserved samples from all of the features. The presence of domestic waste such as cereal remains is one indication that habitation, animal enclosures or a processing area must be close by. In addition, common nettle, chickweed and elder seeds were all particularly numerous, and these taxa are indicative of high levels of nutrients. Nettle feeding beetles and bugs were also frequent (Robinson, this vol). Henbane, a weed of dung heaps and farmyards, was not found in Bronze Age samples, although it has been recovered in samples of this date on other sites (e.g. LBA Potterne, Wilts, Carruthers, 2000) and was present in later features at Perry Oaks. Being a poisonous weed that can cause spasms leading to death in livestock, it may have been deliberately weeded from this area if animals were being kept close to the feature.

Woods/scrub/hedgerow taxa were the second most dominant group. Alder, willow, bramble (seeds and cf. thorns), *Prunus* sp. (seeds and cf. thorns), alder buckthorn, field maple and elder were all present. Pollen from this group was also recorded, in particular elder and *Prunus* sp. There were numerous examples of a bug that feeds on sloe (*Prunus spinosa*) in this sample (Robinson, this vol). This occurrence, and the recovery of *Prunus* sp. and bramble/rose thorns suggests that these taxa, at least, were growing nearby. Sloes (also called blackthorn) and brambles make an effective stock-proof hedge when growing in a dense thicket.

A range of dry and wet grassland taxa were recorded. Beetles characteristic of well-drained soils (*Agrypnus murinus*, Robinson, this volume) were frequent in this sample. Some of the wetland/marsh group, such as gypsywort, spike-rush, mint and blinks, may have been growing around the margins of the pit. Celery-leaved crowfoot and sweet-grass would have been growing in the stagnant water in the feature, perhaps after it fell out of use.

MBA well POK 96 F (either 960514 or 960529) (Figure 5)

This single sample was taken during evaluation excavations by the Museum of London during 1996. The well was located c. 120 metres to the south of the main group of WPR 98 Bronze Age features.

The plant remains in this sample were not particularly numerous and had probably suffered from some decay in the past. A reasonable range of taxa was recorded, however, providing some information about the local environment. Weeds of disturbed or cultivated places were dominant, as usual, with common nettles and fat hen being the most frequent taxa.

As with the other Bronze Age features, woods/scrub/hedgerow plants were the second most important group. Bramble seeds were especially numerous, with many small fragments of seed indicating that the number had been much higher than was counted. Elder, *Prunus* sp. (probably sloe) and alder buckthorn were the other shrubs represented. Bramble/rose-type thorns were present, in addition to willow catkin buds, tree bark, wood and leaf fragments. The evidence suggest that the place of origin of these remains, probably a hedge or area of scrub, had been situated close to the well. The alternative explanation is that the remains derived from scrub that grew up around the well after it had fallen out of use.

Although none of the waterlogged plant remains appeared to consist of deliberately dumped waste material, small amounts of charred cereal remains were present. These included spelt spikelet forks, grain and barley rachis fragments. Pot was also present in some of the well deposits (Angela Batt, pers. comm.), demonstrating that waste materials were being deposited in the well.

LBA well F156031 (Figure 6)
The three samples taken from this feature all came from the base of context 156020 SG 156034. Insects and pollen were also studied from this deposit.

All of the flots were extremely large and consisted primarily of fragments of leaf and wood. By far the most dominant habitat group represented by the fruits and seeds was woodland/scrub/hedgerows (average = 77% of total remains), suggesting that this feature was very close to scrub or hedgerows. Two species found only in this feature at Perry Oaks were dogwood (*Cornus sanguinea*) and yew (*Taxus baccata*). These are both species that prefer basic soils. The other taxa represented were three-nerved sandwort, bramble (seeds and cf. thorns), sloe (seeds and cf. thorns), hawthorn, buckthorn, alder buckthorn and elder. Although all of the other taxa would have been suited to growing as a hedgerow or bordering woodland, yew is a large, slow-growing woodland species. Wiltshire (assessment report) noted the high occurrence of oak pollen and said that trees and shrubs were relatively important in the pollen assemblage. Ivy, hazel and willow were also recorded. She also noted higher cereal pollen counts, but the absence of this type of macrofossil waste suggests that the arable field must not have been in close proximity to the pit.

Robinson (this vol) notes that there was much evidence of scrub from the insect remains, amounting to 11.5% of the terrestrial Coleoptera. Dead wood and oak trees were suggested by the insect assemblage, although most of the species were primarily associated with scrub. As noted by Robinson, it is not possible to tell from these remains whether scrub had regenerated around the well, or if the well had been dug in a scrubby area. What is clear from all three sources of evidence is that small trees and shrubs were growing very close to the well at the time that context 156020 SG 156034 was forming, close enough for leaves, twigs, wood fragments, fruits and seeds and insects to fill the bottom of the well. In addition, some larger trees may have been growing in the vicinity.

The only other two habitats represented were grasslands and disturbed ground. There were not many seeds from these taxa, suggesting that the surrounding area was relatively undisturbed during the LBA/EIA period. However, Robinson did find some synanthropic insect remains in this context, indicating that human settlement may not have been very far away.

LBA pit F136194 (Figure 7)
Three samples were examined from context 136193 near the base of this pit. The lowest, sample 1349 context and SG 136193, was taken from beneath a bowl SF460. Samples 1348 context and SG 136193 and 1317 context and SG 136193 were taken as part of a series from above the bowl. No insect or pollen samples have been studied from this feature.

The assemblages stand out as being quite different from all of the other features examined in detail. As in most of the samples, weeds of disturbed, cultivated or waste ground were dominant (average = 44% of the total remains). However, aquatic plants came a close second (average = 38%). Wet grassland/marsh/bankside plants were also more frequent than in most of the other features (average = 7%, maximum of 17%), except for the LBA well F180080 (see feature description below).

Seeds from the floating/submerged water-weed, water-starwort (*Callitriche* sp.), were so numerous that the number had to be estimated. Other emergent and floating plants growing in and around the margins of the feature were water-pepper (*Polygonum hydropiper*), sweet-grass (*Glyceria* sp.), lesser spearwort (*Ranunculus flammula*), water-crowfoots (*Ranunculus* subg. *Batrachium*) and mint (*Mentha* sp.). All of these are commonly found in slow flowing to still ponds and ditches. Rushes (*Juncus* sp.), spike-rush (*Eleocharis* subg. *Palustres*), blinks (*Montia fontana* ssp. *minor*) and sedges (*Carex* sp.) were probably growing on marshy land around the pit.

No cereal remains were present in these samples although a few of the weeds represented could have been growing as arable weeds, e.g. parsley-piert *(Aphanes arvensis*), fool's parsley (*Aethusa cynapium*). Of the more general weeds of disturbed or cultivated ground, many-seeded goosefoot (*Chenopodium polyspermum*) and members of the Polygonaceae family (docks) were particularly numerous. These taxa grow in a wide range of disturbed habitats, but are particularly frequent in nutrient enriched soils.

Compared with the other Bronze Age samples, very few woodland/scrub/hedgerow remains were recovered from this feature. A few bramble, hawthorn, sloe, buckthorn and elder seeds were present, but these amounted to less than 1% of the total remains on average.

The three samples were very similar in their species composition, the only differences being the concentrations of remains found. The upper sample produced roughly ten times fewer remains than the lowest one in the series. This is clearly the result of poorer conditions of preservation towards the top of the deposit.

LBA well F180080 (Figure 8)
Five samples were taken from the lower levels of this feature in a column (series no. 1213). The samples came from three different contexts at the base of the well (context and SG180087, 180086, 180085). No insect or pollen samples were examined.

Fruit and seed numbers were not especially high in these samples, but all of the habitat groups were represented. The dominant group was weeds of disturbed / cultivated land, as usual (average = 49% of total remains). Nutrient-loving weeds such as fat hen, small nettle and common chickweed were fairly frequent, as were more specific arable weeds, such as parsley piert and scentless mayweed.

Cereal grains and a few emmer/spelt, spelt and barley chaff fragments were recovered from these samples, suggesting that domestic waste, fodder or dung had found its way into the well. No doubt many of the arable weed seeds had been introduced with these remains.

The second most important group was plants of wet grassland/marsh/banksides. This was mainly due to relatively high counts of blinks (*Montia fontana* ssp. *minor*) seeds. Meadowsweet (*Filipendula ulmaria*), wood-rush (*Luzula* sp.) and sweet-grass (*Glyceria* sp.) were also present in low frequencies, and drier grassland taxa were fairly well represented. This suggests that the surrounding vegetation consisted of grassland that was probably seasonally waterlogged and permanently damp in places.

This was the earliest sample to produce macroscopic evidence of heathland, with several heather (*Calluna vulgaris*) shoot tips and some cross-leaved heath (*Erica tetralix*) leaves. Pollen evidence for heathland vegetation was recorded in the earliest pollen zone in M/LBA pit F178108. Heather grows on sandy and peaty soils, but cross-leaved heath is typically found on wetter, boggy areas of heath. These remains could represent locally growing vegetation, in which case they indicate that the local soils had deteriorated following the clearance of scrub and/or woodlands. However, the presence of cereal waste also suggests that it could have been deposited in domestic waste, fodder or dung. The only woodland/scrub/hedgerow seed found in this feature was a single bramble seed, so some changes in the landscape appear to be taking place between the middle and late Bronze Ages.

ERB waterhole F133198 (Figure 9)

This single sample 843 context and SG 133085 was taken from a waterhole c. 300m east of the main group of Bronze Age waterholes discussed in this report. Disturbed ground weeds were by far the most dominant group (78%), primarily due to the large number of common nettle (*Urtica dioica*) seeds in this sample. Docks (*Rumex* sp.) and knotgrass (*Polygonum aviculare*) were also frequent, and the presence of henbane (*Hyoscyamus niger*) indicated that areas of nutrient-enriched soil were present.

This was the earliest sample to produce cotton thistle (*Onopordum acanthium*) seeds (see Notable Taxa section above), an introduced plant that may have been deliberately cultivated for oil from its seeds, its down, as a vegetable or for medicinal use. It is also the earliest record for hemlock (*Conium maculatum*) from this site, another medicinal herb, though deadly poisonous if taken internally. Culpepper (1826) suggests that bruised leaves and roasted roots can be applied externally to inflammations, tumours, ulcers etc. and to relieve gout. This umbellifer also grows in damp wasteground and grassland, so may have become naturalised in the locality of the waterhole. A third toxic but medicinally useful plant that could have been growing naturally or deliberately collected was henbane (*Hyoscyamus niger*). This species was recorded from the EIA well 180080 and has been recovered from Bronze Age sites elsewhere in Britain, the earliest record being from MBA Wilsford Shaft (Robinson, 1989). However, it was primarily found in Romano-British samples at Perry Oaks.

A few waterlogged glume bases of emmer/spelt wheat were recovered, together with several species of arable weeds. The first occurrences of stinking mayweed (*Anthemis cotula*) on the site were recorded from this sample, perhaps indicating the cultivation of heavier, damper clay soils in the area.

RB waterhole F174009 (Figure 10)
Five samples were examined from a waterhole near the ERB waterhole F133198. Insect and pollen samples have been taken from the same context as macrofossil samples 913 and 1116, context 174039 SG 174066,. It should be noted that in figure 10, the samples were taken from two different cuts within the feature, so that they form two separate stratigraphic sequences; samples 915, 916 1116 and 913 in cut 174063, and sample 912 in cut 174062.

Samples 915 and 916 produced fewer plant macrofossils than the three samples from the adjacent cut. The assemblages from all five samples were dominated by common nettle seeds *(Urtica dioica*). Other nitrophilous taxa were also numerous, particularly fat hen, chickweed and docks. Weeds of disturbed/cultivated ground made up 77% of the assemblages for 915 and 916, which were very similar to each other in composition. The other three, more productive samples produced a wider range of plant remains, with an average of 62% being from disturbed/cultivated habitats. Robinson (this vol) noted that his sample from this feature produced very strong evidence for the proximity of settlement-related habitats, including timber buildings. He also found large numbers of beetle remains associated with nettle-covered disturbed ground. These two lines of evidence, therefore, provide clear evidence for nettles growing around the feature and local nutrient enrichment of the soil.

Mallow (*Malva sylvestris*) feeding beetles were also recovered from the insect sample. Seeds and capsule fragments from this species were relatively frequent in sample 912.

A few chaff fragments from emmer/spelt wheat and barley were present, together with several arable weed seeds. These remains were present in much higher concentrations in the samples from the other cut within this feature, fill 174039 SG 174066. Emmer (*Triticum dicoccum*) and spelt (*T. spelta*) glume bases and spikelet forks, indeterminate cereal caryopses, a few fragments of barley rachis and a few cereal-sized culm nodes were recovered from these three samples, amounting to a maximum of 16% of the total remains in sample 913 at the base of the sequence. Arable weeds were also frequent, particularly stinking mayweed. Some of the general weeds of disturbed/cultivated ground may also have been growing with the cereals. Robinson found no evidence for grain pests, so it is unlikely that these crops were being stored nearby. He did find frequent remains of beetles that feed on fungi growing on old hay, animal bedding and thatch. It is possible that the cereal remains may have been deposited as old bedding material, although it was fairly well preserved and did not appear to have started to rot. It was also not found as compressed, matted layers, as were the cereal remains in F135071. In addition, dung beetles were not found to be particularly frequent in this feature. The most likely explanation is that this material was deposited as crop processing waste.

All of the habitat groups were represented in these assemblages. Both cross-leaved heath and heather remains were present as evidence of heathland growing in the vicinity. Grassland taxa were fairly frequent, including wet grass or marsh taxa such as blinks. Rush seeds, sedge and spike-rush nutlets were particularly frequent, and meadowsweet was found in four of the five samples. These taxa are indicative of damp meadows or ungrazed marshy ground, since they are readily grazed by livestock. However, Robinson found no evidence of marsh from the insects and very little evidence for grasslands. He suggested that either overgrazed pasture or only small areas of grassland existed around the feature It is possible, then, that the plant remains were deposited as hay taken from damp meadows, perhaps even old, mouldy hay, as indicated by the insects (see paragraph above).

Woodland/scrub/hedgerows were only represented by a sloe stone, and a few bramble and elder seeds. These could have been introduced in domestic waste, since all are edible. Robinson found very little evidence of woodland insects, and suggested the landscape was very open, possibly with isolated trees.

Plants growing in and around the feature included water-crowfoot, mint, water-dropwort and gypsywort. Seeds from this group, however, were fairly rare and Robinson recorded no aquatic insects.

LRB pit F135087 (Figure 11)

This feature was located in the same area as the bulk of the Bronze Age features examined, so it presents a useful comparison. The pit cuts MBA waterhole F135071. An insect sample was studied from the same context as macrofossil sample 1167, context and SG 135077.

Figure 11 shows that there was a loss of organic material from the upper two samples, particularly sample 1164 context 135073 SG 135081, a top fill of the pit. The few plant remains recovered showed signs of decay, but because so few woody-seeded taxa were present, a bias towards woodland taxa was not seen in this case. This contrasts with the effects of differential preservation on the Bronze Age samples, e.g. Figure 4, F178108, where tree/shrub fruits and seeds were more likely to survive drying out due to their woody seed coats.

All of the habitat groups were represented in the lowest, best preserved sample, sample 1168 context 135078 SG 135086. However, only traces of aquatic (a water-dropwort mericarp), heath (a heather shoot tip) and woodland/scrub/hedgerow taxa were present. All of the woodland remains were from edible fruits and nuts (hazel nutshell, bramble and elder seeds), suggesting that they had probably been deposited as domestic waste, rather than been growing nearby. This suggestion is supported by the lack of evidence for woodland amongst the insect remains (Robinson, this vol).

As usual, disturbed/cultivated ground taxa were by far the most dominant group, accounting for 83% of the remains on average. Although several nitrophilous taxa were very numerous, including orache (*Atriplex patula/prostrata*), chickweed and docks, common nettle was, for once, rare. Robinson noted the presence of some nettle and mallow eating beetles, but not nearly as many as in F174009. Two capsule fragments of mallow were recovered from this feature.

A few cereal remains, including spelt wheat chaff, a barley rachis fragment and two cereal-sized culm nodes were recovered from the lower two samples. The arable weed, stinking mayweed, was fairly frequent. Only a single synanthropic beetle fragment was found, and no woodworm beetles were present. Robinson suggested that this pit was not located close to habitation. In this case, the cereal remains probably represent fodder and/or dung, since crop processing waste would have been a useful supplement to the diet of domestic livestock.

Both damp and drier grasslands were relatively well represented. Swine cress (*Coronopus squamatus*) was particularly abundant, and this is often found in muddy areas around gateways and by paths. Hemlock was also frequent. The insect assemblage included numerous scarabaeoid dung beetles, and Robinson noted that the evidence for grasslands was greater in this feature than in the other Roman feature, F174009. He suggested that domestic animals were being kept in the field in which pit F135087 was located, because the dung beetle occurrence was so great.

General discussion

The waterlogged plant macrofossils have provided evidence for changes in the vegetation at Perry Oaks from the middle Bronze Age to the late Romano-British period, although no Iron Age samples were examined. Additional evidence for these changes has been obtained from the insect and pollen analyses. Wherever possible, pollen, insects and waterlogged plant macrofossils were studied from the same deposits. This multidisciplinary approach has meant that many of interpretations could be confirmed by using several lines of evidence, and that where one class of biological remains could not provide answers, another could be used.

All of the middle Bronze Age features produced substantial evidence for the presence of woodlands, scrub or hedgerows in the vicinity of the waterholes, pits and wells. The pollen evidence (Wiltshire, this vol) suggests that old hedgerows existed close to many of the features, and the high occurrence of leaf fragments, Rosaceae thorns and fruits and seeds supports this suggestion. The fact that this was not just a local phenomenon, restricted to the main area of Bronze Age features in the western half of the site was demonstrated by the examination of M/LBA waterhole F124100, at the far eastern edge of the site. Woodland taxa were also dominant in this single sample. Similarly, changes towards a much more open countryside seen in the two Romano-British samples to the north of the excavated area were also seen in the single LRB sample in the midst of the main group of BA samples. The changes observed through time, therefore, hold true across the whole area of the site from which samples were examined.

If the plant macrofossil results had been studied in isolation, the large number and wide range of shrubby and woodland herb taxa found in the Bronze Age samples would have suggested that the local vegetation had been dominated by scrub. This is because grass caryopses do not preserve well, and tend to be overwhelmed by the large fruits from trees and shrubs, which are more easily identified and counted. In addition, grazing reduces the range and number of grassland seeds produced. The insect and pollen results showed that there was strong evidence for grassland throughout the Bronze Age, and that the majority of tree and wood dependent insects were associated with scrub and hedgerow species rather than mature woodlands. The range of small tree/shrub species recorded amongst the plant macrofossils would certainly have been very suitable for use in hedgerows. Sloe, hawthorn, buckthorn, alder buckthorn, dogwood, willow, elder and bramble are all small woodland edge or scrub trees and shrubs, several of which are armed with thorns. The presence of bramble-type and hawthorn/sloe-type thorns in many of the features demonstrated that the hedgerows were growing very close to the water-filled features. Only a trace of hazelnut shell was recovered, possibly because this valuable food resource had been gathered from the hedgerows. The shells are more likely to have been disposed of in domestic fires, and areas of domestic waste close to habitation. Hazel pollen has been recorded in many of the samples examined to date.

The percentage composition table shows that there was a marked reduction in woodland/scrub/hedgerow remains from around the LBA, as seen in F136194 (Fig. 7). There could be spatial differences at this stage, because both F136194 and 180080 in the middle of the site produced very little evidence for woodland species, whilst LBA F156031 had a similar profile to the MBA features in the same western area.

This particular feature (F136194) stands out as being different from the other ten that were fully analysed. It was the only feature to produce substantial numbers of seeds from aquatic plants. Unfortunately neither insects or pollen were examined from this feature, so it is not clear whether or not this was a very local phenomenon, perhaps due to abandonment of the pit, enabling a diverse aquatic and waterside flora to become established in the undisturbed stagnant water. It is interesting to note that very few aquatic plant remains were recovered from any of the other water-filled features, suggesting that they were either deliberately kept clear of vegetation, or that human disturbance and/or grazing and trampling by livestock prevented an aquatic flora from becoming established. Some of the plant species, such as golden dock, swine-cress (both LRB pit F135087) and trifid bur-marigold (MBA waterhole F141024), are indicative of damp, muddy areas that have been trampled by livestock.

Although the establishment of a diverse aquatic flora may have only taken place in F136194, another change seen in this feature appears to also apply to later features. This is the increase in wet grassland/marsh/bankside plants, such as rushes, spike-rush, sedges, pale persicaria and ragged robin. In the case of this feature, many of the remains may have been growing on damp soils around the abandoned feature. However, the LBA well F180080 had even greater numbers of remains in this group, though very few remains from truly aquatic plants. The three Romano-British features studied produced fewer wet grassland remains, but generally larger numbers than the Bronze Age features. Presumably, these taxa were growing on marshy land that had previously been occupied by trees and shrubs. Clearance of the scrub or hedgerows no doubt would have contributed to increased wetness of the low-lying soils. It is also possible that there was some deterioration in the climate in the LBA/EIA, following on from the warmer period in the MBA (Robinson, this report), resulting in the abandonment of the site for some time. However, the LBA well F180080 produced evidence that cereal cultivation may still have been taking place in the area, and there was very little evidence for scrub regeneration from the plant macrofossils Unfortunately neither insect or pollen samples were taken from this feature.

The deterioration of soils in the area following late Bronze Age clearances was demonstrated by the appearance of heathland remains. These were first found in the LBA well F180080, although *Calluna* pollen was present in a few MBA and MBA/LBA features. Heathland macrofossils also occurred in low numbers in all three RB features examined. The presence of leaves from cross-leaved heath (*Erica tetralix*) in addition to heather (*Calluna vulgaris*) indicated that both wet and dry soils had been colonised by heathland vegetation.

Plant macrofossils providing evidence for disturbance and, in some cases, nutrient enrichment through the activities of humans and the management of livestock were abundant in all of the features examined. In some cases, for example in the case of the nettles in RB waterhole 174009 (see feature description), it was possible to show from a combination of plant macrofossil and insect evidence that the weeds were growing around the feature. Nettles can be processed in a similar way to flax in order to recover fibres from the tough stems. Unless bundles of nettles were recovered, it would be difficult to prove that this had been taking place. Nettles also produce large numbers of seeds that fall close to the plant, but since the beetle numbers were also frequent, it is fairly certain that nettles dominated the vegetation around the feature.

Weed seeds may also have been introduced into the feature amongst domestic waste, bedding, cereal processing debris or animal dung. The presence of large numbers of dung beetles in the insect assemblages from two pits, F178108 (M/LBA) and F135087 (LRB) demonstrated that dung was finding its way into the features. The recovery of pot, bone and charred crop processing waste from the features provided evidence for the dumping of domestic waste, although much of this may have occurred after they had been abandoned. Waterlogged cereal processing waste was recovered from seven of the eleven features examined in detail, together with arable weed seeds that had probably been deposited amongst the chaff and grain. This can be confirmed by observing the close relationship between the occurrence of cereals and that of arable weed seeds in Figures 1 to 11.

In several of the features it was likely that the cereal remains had been introduced amongst fodder and/or animal dung, rather than being deposited as crop processing waste. The quantities of chaff and grains were not great, although much may have been lost in the less well-preserved samples. Emmer wheat (*Triticum dicoccum*), spelt wheat (*T. spelta*) and barley (*Hordeum* sp.) appear to have been cultivated throughout the Bronze Age to Late Romano-British periods (although the identification of emmer in the EIA samples was not confirmed). Spikelet forks from the MBA waterhole, F135071, were positively identified as being from spelt wheat, and these remains were submitted for radiocarbon dating, confirming their MBA date. This is an early confirmed record for the cultivation of spelt, although a few charred spelt glume bases have been recovered from M-LBA samples from the settlement at Trethellan, Cornwall, (Straker, 1991), and from MBA occupation levels at Brean Down, Avon (Straker, 1990). Spelt is hardier than emmer, although both can be winter sown. It is also better suited to heavier soils than emmer. Barley is a very versatile crop that has the widest geographic range of all of the cereals. It is considered to be well suited to growing on light, calcareous soils, but it can thrive on a wide range of soils. Evidence from the charred plant remains (Dana Challinor, this volume) was fairly sparse, but it did confirm the main findings in the waterlogged cereal assemblages. However, an additional cereal, rye, was recorded in significant numbers in some of the Roman charred samples. Since rye is usually only found in small quantities until the Saxon period, this could indicate that soil degradation had made the cultivation of this minor crop worthwhile at Perryoaks.

Because mixed waste appears to have been deposited in the features, including crop processing waste, animal dung and other domestic waste, it is difficult to be specific about where the cereals were being cultivated. Many weeds of cultivation will grow in too wide a range of soils to be useful. Two of the weeds that are more specific in their requirements are annual knawel (*Scleranthis annuus*) and corn spurrey (*Spergula arvensis*). Both of these arable weeds are said by Ellenberg (1988) to be indicators of acidic soils. An achene and a seed from each of these taxa were recovered from MBA F135071, and a corn spurrey seed was found in ?LBA F180080. Neither of these taxa were present in the RB feature F174009, even though it produced the largest quantity of cereal and arable weed remains. This could indicate a change from cultivation of acidic soils to more neutral ones, or changes in crop husbandry practices that may have reduced the acidity of the soil.

It has been suggested that the sudden appearance of stinking mayweed (*Anthemis cotula*) in the Late Iron Age to Romano-British period was due to increased cultivation of heavy, damp soils (Jones, 1981) from this period onwards. Spike-rush (*Eleocharis* subg. *Palustres*) is also said to be more commonly recovered in charred assemblages at this time, and this could have grown as an arable weed in damp soils. In the Perry Oaks samples these two taxa behave as predicted by Jones; stinking mayweed was found only in the Romano-British features, and spike-rush was at its most frequent in the RB waterhole F174009, the feature that produced large quantities of cereal remains.

A fourth crop plant was only recovered from Bronze Age features. A few cultivated flax (*Linum usitatissimum*) capsule fragments were present in features F135071, F178108 and F156031 (assessment sample, Gill Campbell and Dana Challinor (n.d.))). In addition, a single record for a beetle that feeds on flax (as well as spurges), *Aphthona* cf. *euphorbiae*, was made for F141024. This provides continuous, though rather slight, evidence for flax cultivation from four out of the six Bronze Age features studied for plant and insect remains. As noted in the ‘Significant Taxa’ section, these small fragments of capsule are more likely to be waste material from ‘rippling’ the dry plants, than retting waste. The remains may have entered the features in animal dung. There is no definite evidence, therefore, for the use of these water-filled features for retting flax, and where possible, flowing water was used for this smelly process. However, the crop would have been well suited to growing on the damp soils at Perry Oaks and may have been cultivated nearby.

It was interesting to note that, where several samples were taken from a feature, the assemblages were always very similar to each other. This was the case even when a sequence of contexts were sampled from the base to the middle of the feature. The only obvious differences were in the state of preservation of the remains. By examining the figures, some signs of fruit and seed loss can be seen in the uppermost samples from most of the features, even though the samples were originally selected because they contained frequent waterlogged plant remains. Where woodland species were present, this always resulted in differential preservation favouring the woody coated seeds of this habitat group. In the later features, where very few woody seeds were present, all of the habitat groups appear to have been equally affected. This similarity between the plant assemblages in different samples from a feature suggests that the features silted up and were backfilled with waste fairly quickly, since the surrounding vegetation and types of waste being deposited did not have time to change to any great extent.

The only exception to the loss of remains from the upper levels was F141024, which showed the opposite trend. In this case, the earliest deposit sampled was a primary fill which was derived from erosion of the gravelly edges of the cut (Angela Batt, pers. comm.), so it is not surprising that the sample produced very few plant remains. The other two samples produced fairly similar quantities of remains.

Comparisons with other sites

The nearest comparable site producing large quantities of Bronze Age waterlogged plant macrofossils was the LBA riverside settlement at Runnymede Bridge (Greig 1991). Emmer, spelt and a small amount of barley remains were recovered, in addition to flax seeds and capsule fragments. Oats and rye were possibly only growing as contaminants of the crops. Although alder and willow were growing along the river, much of the surrounding woodland had been cleared by the LBA at Runnymede. Grazed grassland, wasteland, cultivated land, aquatic and waterside plants were all well-represented. Most of the taxa recovered from the Perry Oaks samples were also recorded from Runnymede Bridge.

Few other reports on waterlogged plant macrofossils from Bronze Age sites have been published, and deposits dating back to the MBA are particularly rare. The LBA waterfront site at Anslow’s Cottages, Berkshire on one of the Thames’ tributaries, the River Kennet, produced only a small amount of evidence of human activity from the plant remains. Alder carr was still dominant on the floodplain, although locally grassland was important with some areas of disturbed ground (Carruthers 1992).

Emmer, hulled barley, opium poppy and flax remains were recovered from the MBA site at Wilsford Shaft (Robinson 1989). A wide range of wild plant taxa was also recovered from the shaft, including early records for mallow and henbane. Weeds of disturbed ground and plants of dry, calcareous grassland were the dominant habitat groups represented, and woodland/scrub/hedgerow taxa were scarce.

Work is continuing on samples from adjacent areas included in the Heathrow Terminal 5 project. Both waterlogged and some productive charred assemblages are being recovered, so it is hoped that gaps in the environmental sequence of the area can be filled in in the near future.

Bibliography

Campbell Gill and Challinor Dana Perryoaks (WPR98) and Northern Taxiway (GAI 99) Assessmnet of the Plant Remains (unpublished) Assessment Report

Carruthers W.J. (1992) Plant Remains. *In* C.A. Butterworth and S.J. Lobb, *Excavations in the Burghfield Area, Berkshire.* Wessex Arch. Rep. **1**, 149-158

Carruthers, Wendy J. (2000) Mineralised plant remains. *In* Andrew J. Lawson, *Potterne 1982-5: Animal Husbandry in Later Prehistoric Wiltshire*. Wessex Arch. Rep. **17**, 72-84

ClaphamA.R., Tutin, T.G. and Moore, D.M. (1987) *Flora of the British Isles*. 3rd Edition. CUP

Culpepper, Nicholas (1826) *Culpepper's Complete Herbal*. Facsimile edition 1979, Gareth Powell Ltd

Ellenberg, Heinz (1988) *Vegetation Ecology of Central Europe*. CUP

Godwin, Sir Harry (1975) *History of the British Flora*. CUP

Greig, James (1991) The botanical remains. *In* Stuart Needham, *Excavation and salvage at Runnymede Bridge, 1978*. British Museum Press and E.H. 234-212

Heer, O. (1865) *Die Pflanzen der Pfahlbauten*. Neujahrsblatt der Naturforschenden Gesellschaft Zürich für das Jahr 1866, 68: 1-54

Jones, Martin (1981) The Development of Crop Husbandry. *In* M. Jones and G. Dimbleby. *The Environment of Man. The Iron Age to the Anglo-Saxon Period.* B.A.R. **87,** 95-121

Pliny. *Natural History, VIII-XIX* (trans. Rackham, H.) London 1967

Readers Digest (1981) *Field Guide to the Wild Flowers of Britain*

Roach, F.A. (1985) *Cultivated Fruits of Britain*. Blackwell

Robinson, M. and Hubbard, R.N.L.B. (1977) The transport of pollen in the bracts of hulled cereals. *J.A.S*. **4,** 197-199

Robinson, M (1979) Biological Evidence. *In,* George Lambrick and Mark Robinson, *Iron Age and Roman riverside settlements at Farmoor, Oxfordshire*. Ox Arch Unit Rep. **2,** 77-123

Robinson, Mark (1989) Seeds and other plant macrofossils. *In,* P. Ashbee, M.Bell and E. Proudfoot, *Wilsford Shaft: Excavations 1960-62*. E.H.Arch.Rep. **11,** 78-103

Stace, Clive (1991) *New Flora of the British Isles*. CUP

Straker, Vanessa (1991) Charred Plant Macrofossils. *In,* Jacqueline A. Nowakowski, Trethellan Farm, Newquay: Excavation of a Lowland Bronze Age Settlement and Iron Age Cemetery. *Cornish Archaeology* no. **30**, 161-179

Straker, Vanessa (1990) Charred plant macrofossils. *In* M.Bell, *Brean Down excavations 1983-1987.* English Heritage Arch. Rep. **15,** 211-219

Appendix 1: habitat groups used in Figures 1–11

Woods/scrub/hedgerow
Alnus glutinosa (L.) Gaertner - alder
Cornus sanguinea L. - dogwood
Corylus avellana L. - hazel
Crataegus monogyna Jacq. - hawthorn
Frangula alnus Miller – alder buckthorn
Moehringia trinervia (L.) Clairv. – three-nerved sandwort
Prunus spinosa L. - sloe
Prunus bullace-type
Prunus cf. *padus* L. – cf. bird cherry
Prunus sp.
Prunus/Crataegus-type thorn
Rhamnus cathartica L. - buckthorn
Rubus sect. *Glandulosus* - bramble
Rubus/Rosa-type thorn
Salix sp. – willow catkin bud
Sambucus nigra L.- elder
Solanum dulcamara L. - bittersweet
Stachys sylvatica L. – hedge woundwort
Taxus baccata L. - yew
Viola sp. - violet

Heath
Calluna vulgaris (L.) Hull – heather shoot tip
Erica/Calluna sp. – heath/heather capsules
Erica tetralix L. – cross-leaved heath leaf

Aquatic
Callitriche sp. – water-starwort
Glyceria sp. – sweet-grass
Lemna sp. - duckweed
Oenanthe sp. – water-dropwort
Polygonum hydropiper (L.) Spach – water-pepper
Ranunculus flammula L. – lesser spearwort
R. sceleratus L. celery-leaved buttercup
Ranunculus subg. *Batrachium* – water-crowfoots

Wet grassland/marsh/bankside
Barbarea vulgaris R. Br. – winter-cress
Bidens tripartita L. – trifid bur-marigold
Conium maculatum L. - hemlock
Eleocharis subg. *Palustres* – spike-rush
Filipendula ulmaria (L.)Maxim. – meadowsweet
Glechoma hederacea L. – ground-ivy
Hypericum sp. – St John’s wort
Lychnis flos-cuculi L. – ragged robin
Lycopus europaeus L. - gypsywort
Mentha sp. - mint

Montia fontana ssp. *minor* Hayw. - blinks
Persicaria lapathifolia (L.) Gray – pale persicaria
Ranunculus sardous Crantz – hairy buttercup
Rorippa cf. *sylvestris* – cf. creeping yellow-cress
Rumex maritimus L. – golden dock
Thalictrum sp. – meadow-rue

Grassland/waysides
Anthriscus sylvestris (L.) Hoffm. – cow parsley
Ballota nigra L. – black horehound
Bellis perennis L. - daisy
Chaerophyllum temulum L. – rough chervil
Cirsium/Carduus sp. - thistle
Coronopus squamatus (Forsskaol)Asch.– swine-cress
Daucus carota L. – wild carrot
Leontodon autumnalis L. – autumn hawkbit
Leucanthemum vulgare Lam. – oxeye daisy
Linum catharticum L. – purging flax
Malva sylvestris L. – common mallow
Marrubium vulgare L. – white horhound
Onopordum acanthium L. – cotton thistle
Pastinaca sativa var. *sylvestris* (Miller)DC. – wild parsnip
Plantago lanceolata L. – ribwort plantain
P. major L. –greater plantain
Poaceae NFI
Potentilla anserina L. - silverweed
Potentilla sp. - cinquefoil
Prunella vulgaris L. – self-heal
Ranunculus acris/bulbosus/repens - buttercup
Rhinanthus sp. – yellow-rattle
Rumex acetosella L. – sheep's sorrel
Stellaria graminea L. – lesser stitchwort
Taraxacum sp. - dandelion
Torilis japonica (Houtt.) DC. – upright hedge-parsley

Disturbed/cultivated ground
Aethusa cynapium L. – fool's parsley
Atriplex patula/prostrata - orache
Brassica/Sinapis sp. – charlock, mustard etc
Capsella bursa-pastoris (L.) Medikus – shepherd's purse
Cerastium sp. – mouse ear
Chenopodium album L. – fat hen
C. polyspermum L. – many-seeded goosefoot
Euphorbia peplus L. – petty spurge
Fallopia convolvulus (L.) A. Love – black-bindweed
Fumaria sp. - fumitory
Galeopsis tetrahit L. – common hemp-nettle
Galium aparine L. - cleavers
Hyoscyamus niger L. - henbane
Lapsana communis L. - nipplewort

Persicaria maculosa Gray - redshank
Polygonum aviculare L. - knotgrass
Rumex cripsus L. – curled dock
R. obtusifolius L. – broad-leaved dock
R. conglomeratus Murray – clustered dock
Rumex sp. - dock
Solanum nigrum L. – black nightshade
Sonchus asper (L.) Hill – prickly sow-thistle
S. oleraceus L. – smooth sow-thistle
Stellaria media (L.) Villars – common chickweed
Urtica dioica L. –common nettle
U. urens L. – small nettle

Arable weeds
Anthemis cotula L. – stinking mayweed
Aphanes arvensis L. – parsley-piert
Odontites vernus/Euphrasia sp. – red bartsia/euphrasia
Papaver dubium L. – long-headed poppy
P. rhoeas/argemone L. – common/prickly poppy
Papaver sp. - poppy
Ranunculus parviflorus L. – small-flowered buttercup
Scleranthus annuus L. - annual knawel
Spergula arvensis L. – corn spurrey
Thlaspi arvense L. – field penny-cress
Tripleurospermum inodorum (L.) Schultz-Bip. – scentless mayweed
Valerianella locusta (L.) Laterr. – common cornsalad

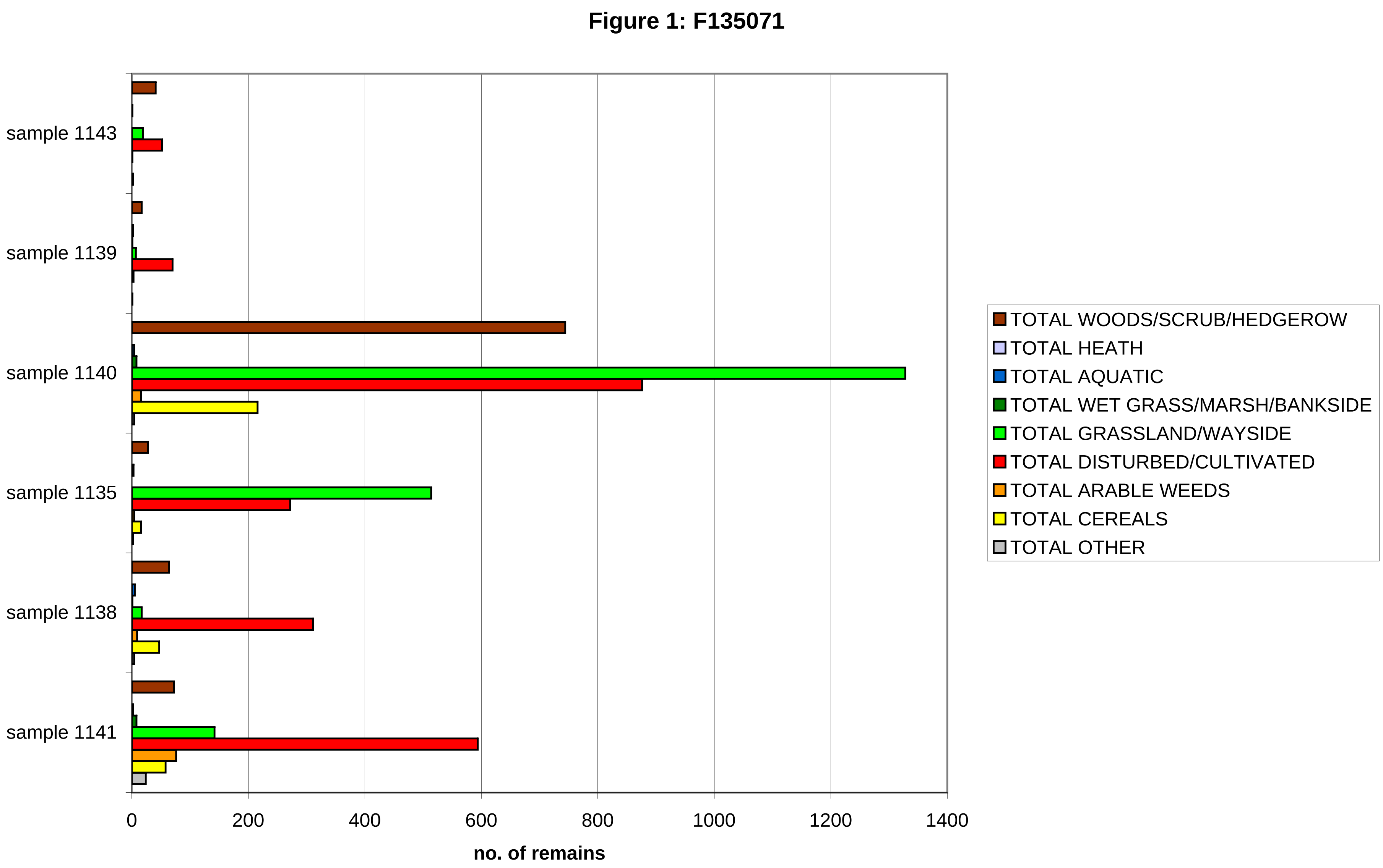
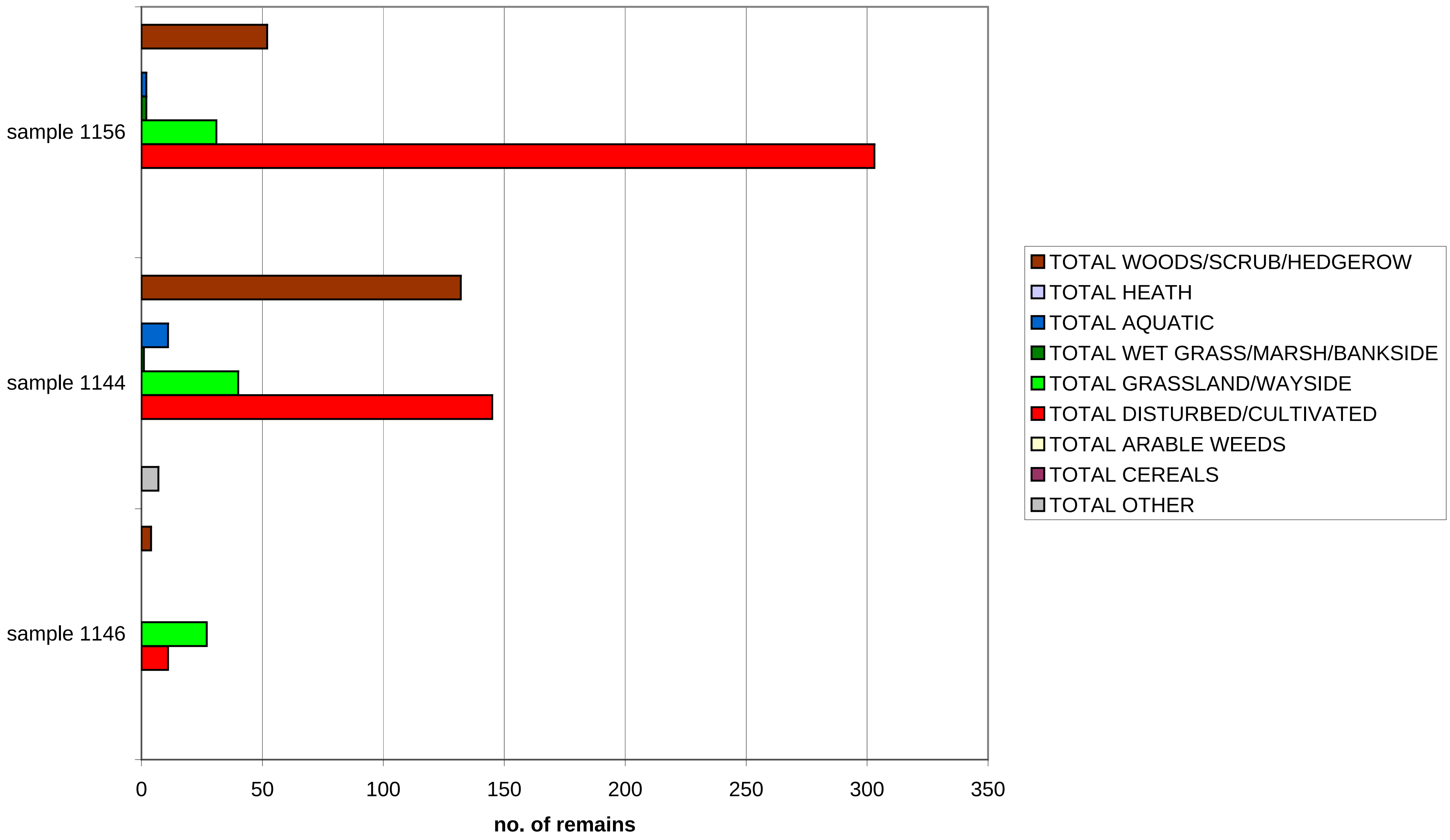


Figure 1: F135071
sample 1143
sample 1139
sample 1140
sample 1135
sample 1138
sample 1141
0
200
400
600
800
1000
1200
1400
no. of remains
TOTAL WOODS/SCRUB/HEDGEROW
TOTAL HEATH
TOTAL AQUATIC
TOTAL WET GRASS/MARSH/BANKSIDE
TOTAL GRASSLAND/WAYSIDE
TOTAL DISTURBED/CULTIVATED
TOTAL ARABLE WEEDS
TOTAL CEREALS
TOTAL OTHER

Figure 2: F141024



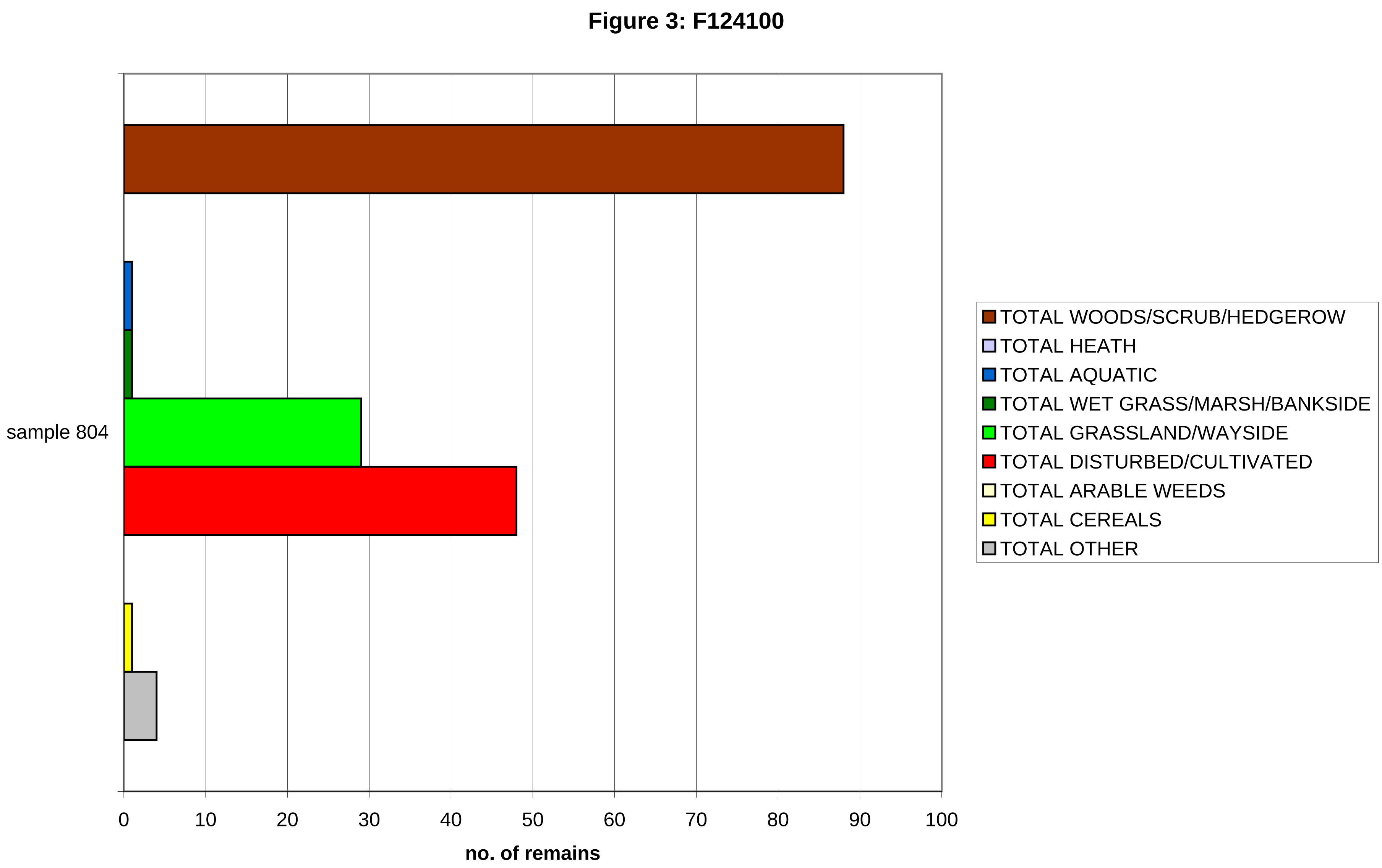


Figure 3: F124100
sample 804
0
10
20
30
40
50
60
70
80
90
100
no. of remains
TOTAL WOODS/SCRUB/HEDGEROW
TOTAL HEATH
TOTAL AQUATIC
TOTAL WET GRASS/MARSH/BANKSIDE
TOTAL GRASSLAND/WAYSIDE
TOTAL DISTURBED/CULTIVATED
TOTAL ARABLE WEEDS
TOTAL CEREALS
TOTAL OTHER

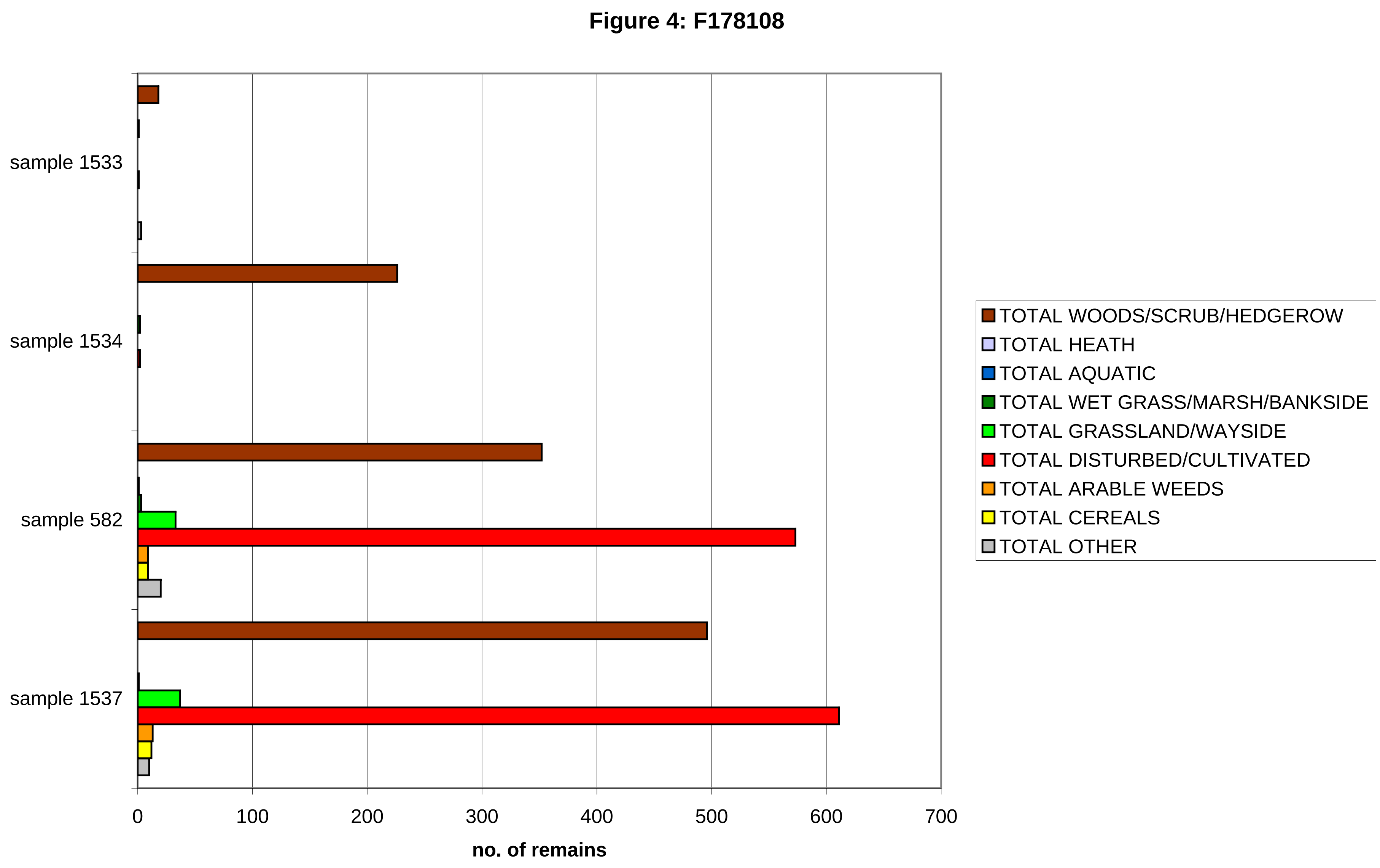


Figure 4: F178108
sample 1533
sample 1534
sample 582
sample 1537
0
100
200
300
400
500
600
700
no. of remains
TOTAL WOODS/SCRUB/HEDGEROW
TOTAL HEATH
TOTAL AQUATIC
TOTAL WET GRASS/MARSH/BANKSIDE
TOTAL GRASSLAND/WAYSIDE
TOTAL DISTURBED/CULTIVATED
TOTAL ARABLE WEEDS
TOTAL CEREALS
TOTAL OTHER

Figure 5: POK 96 F

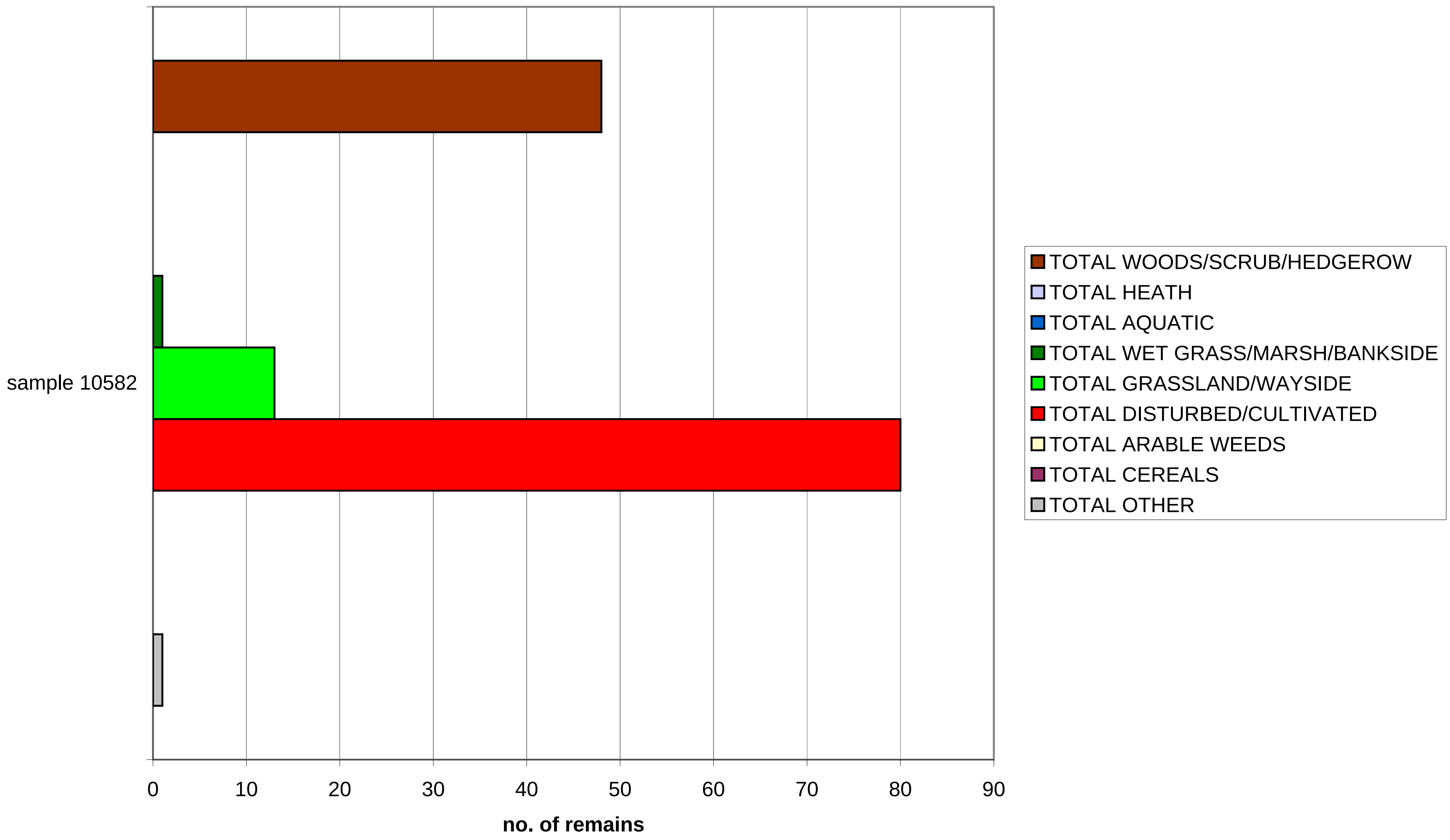


Figure 6: F156031

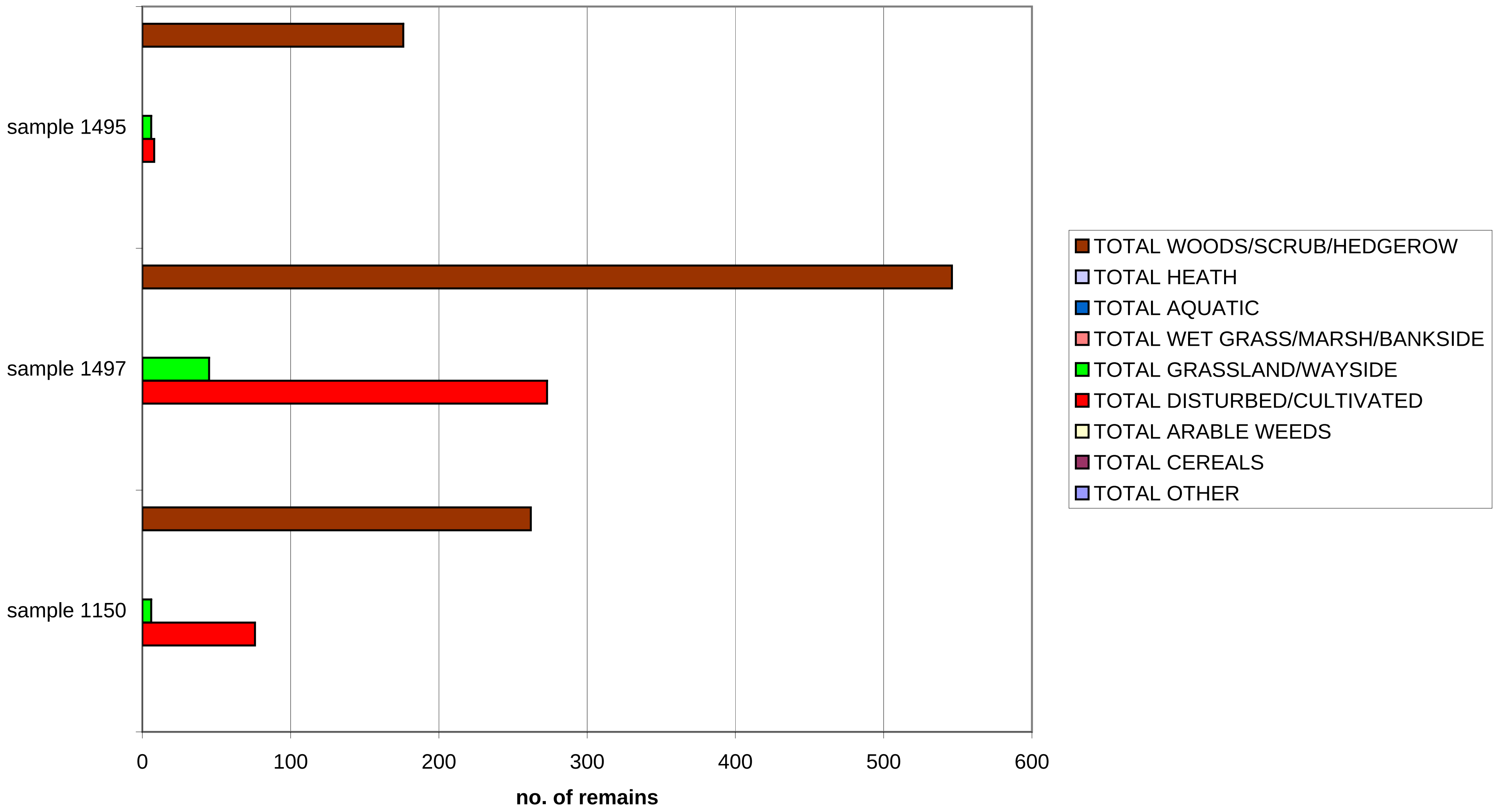


Figure 7: F136194

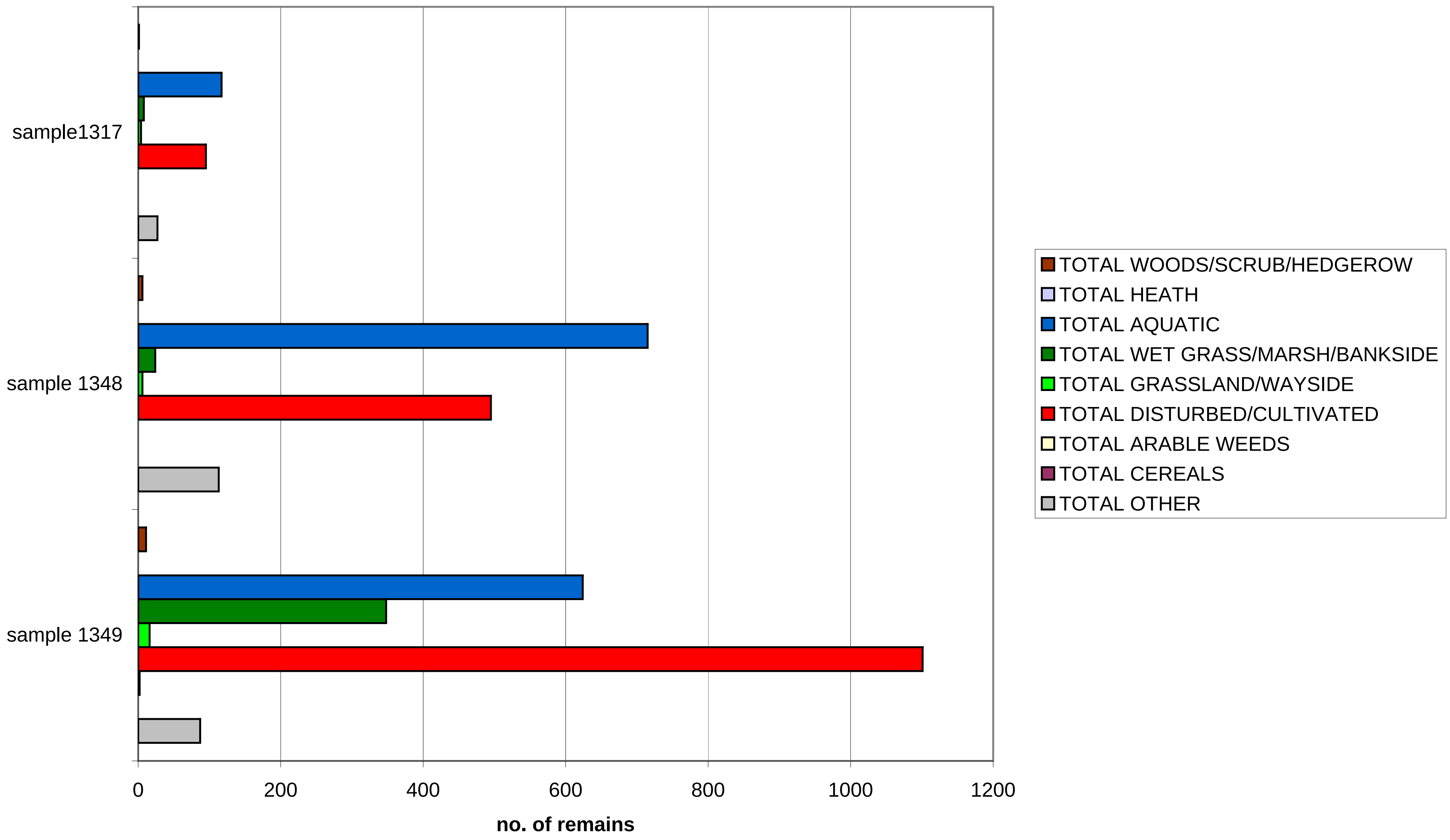


Figure 8: F180080

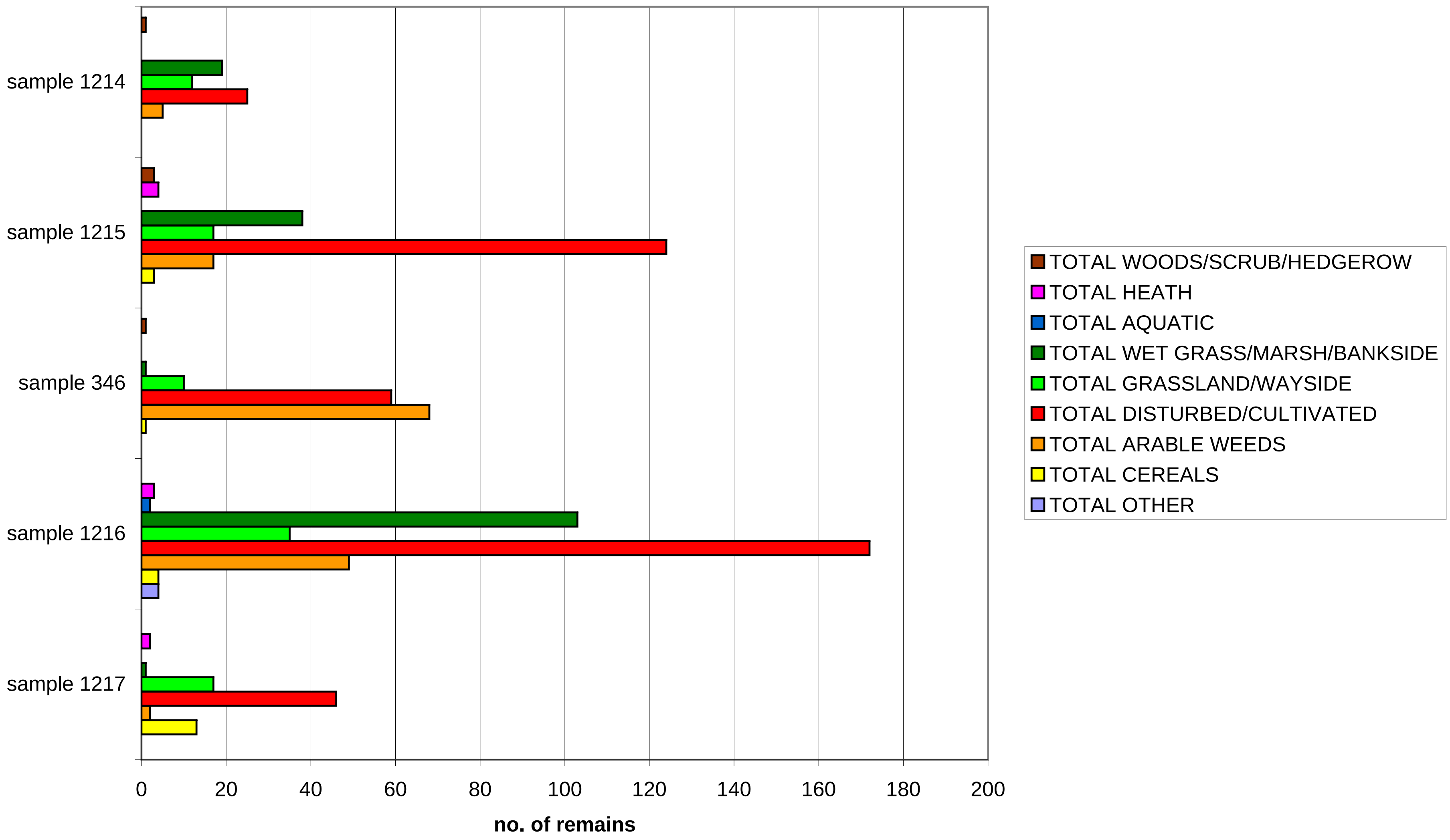


Figure 9: F133196

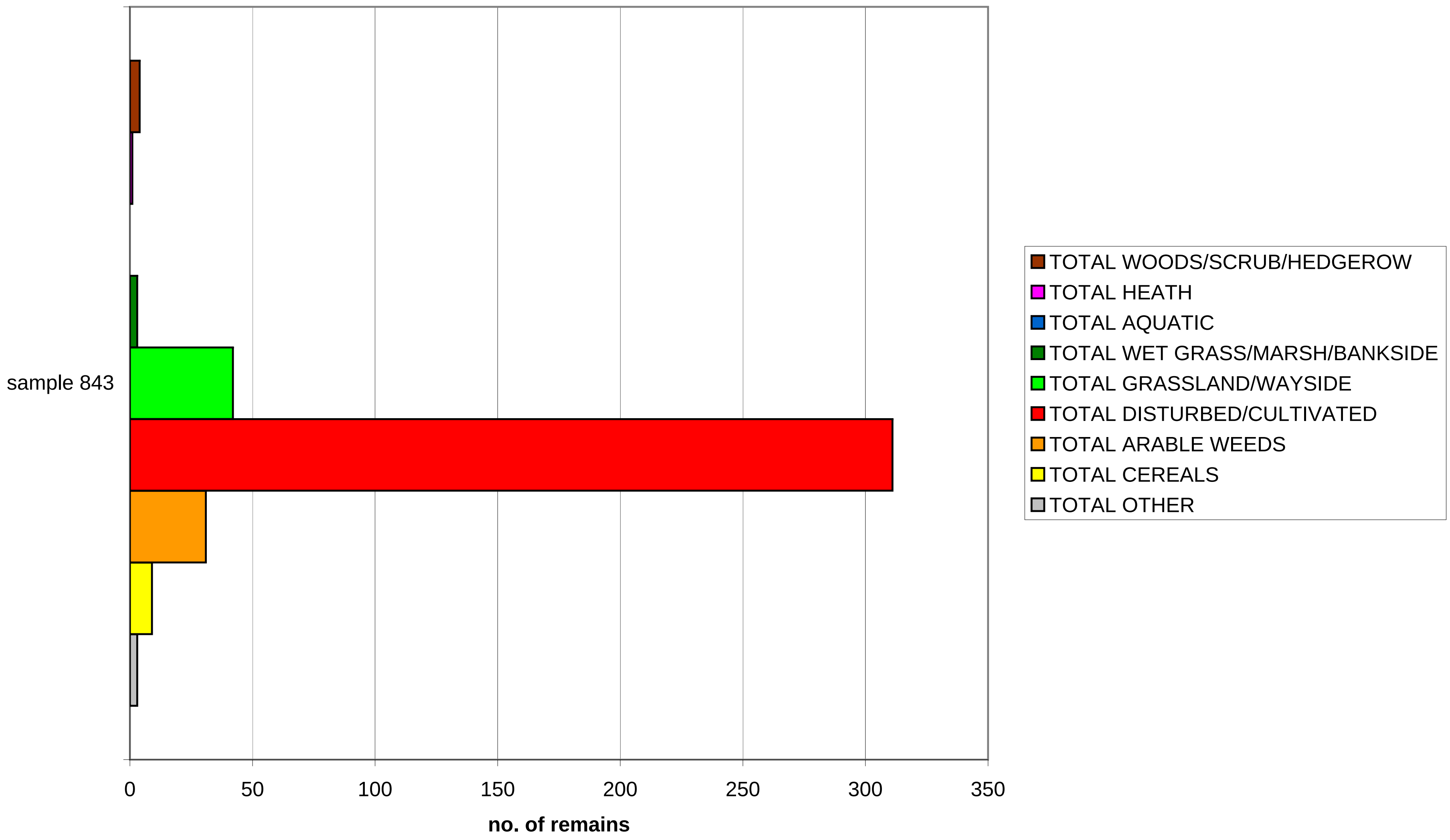


Figure 10: F174009

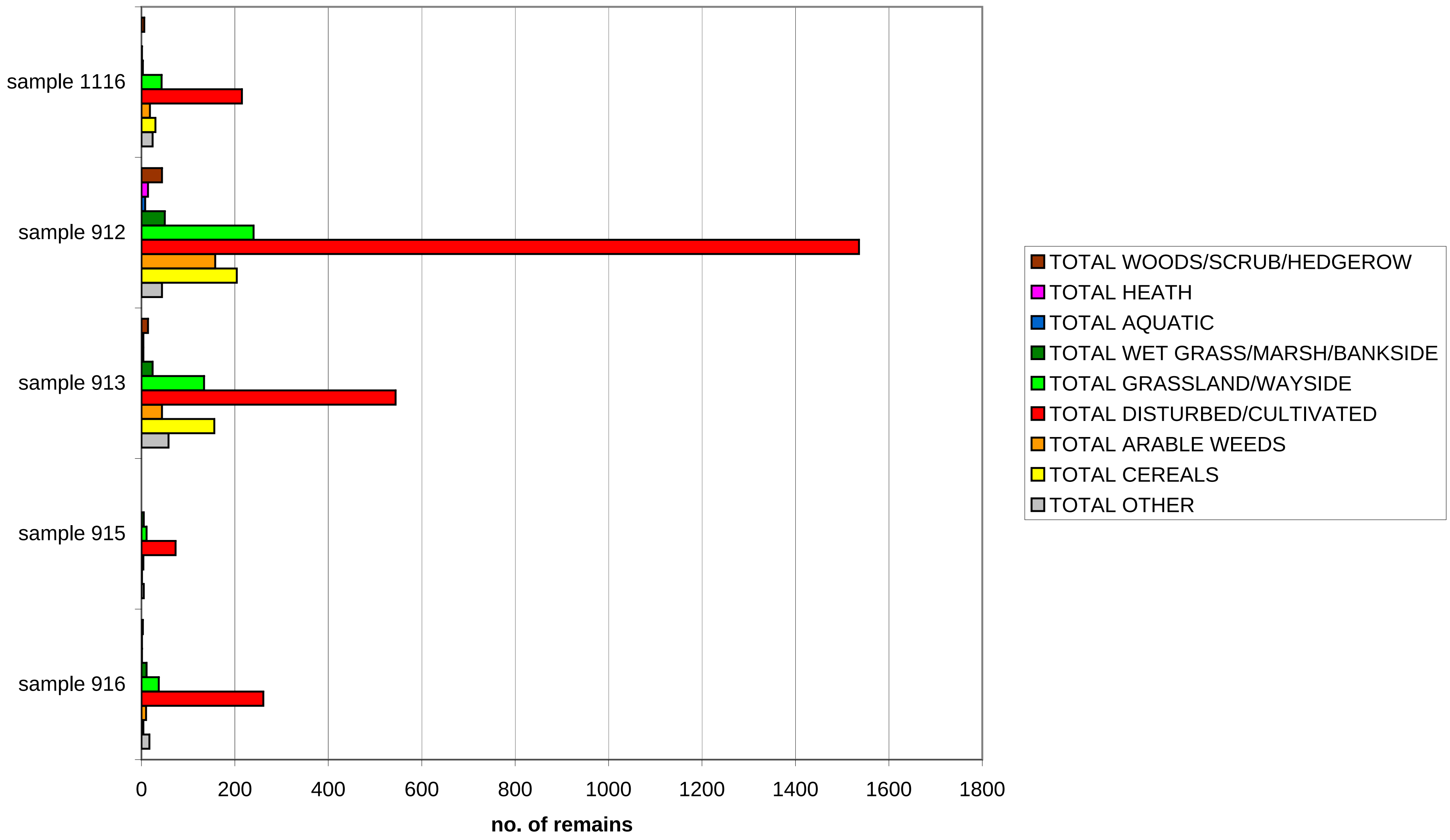


Figure 11: F135087

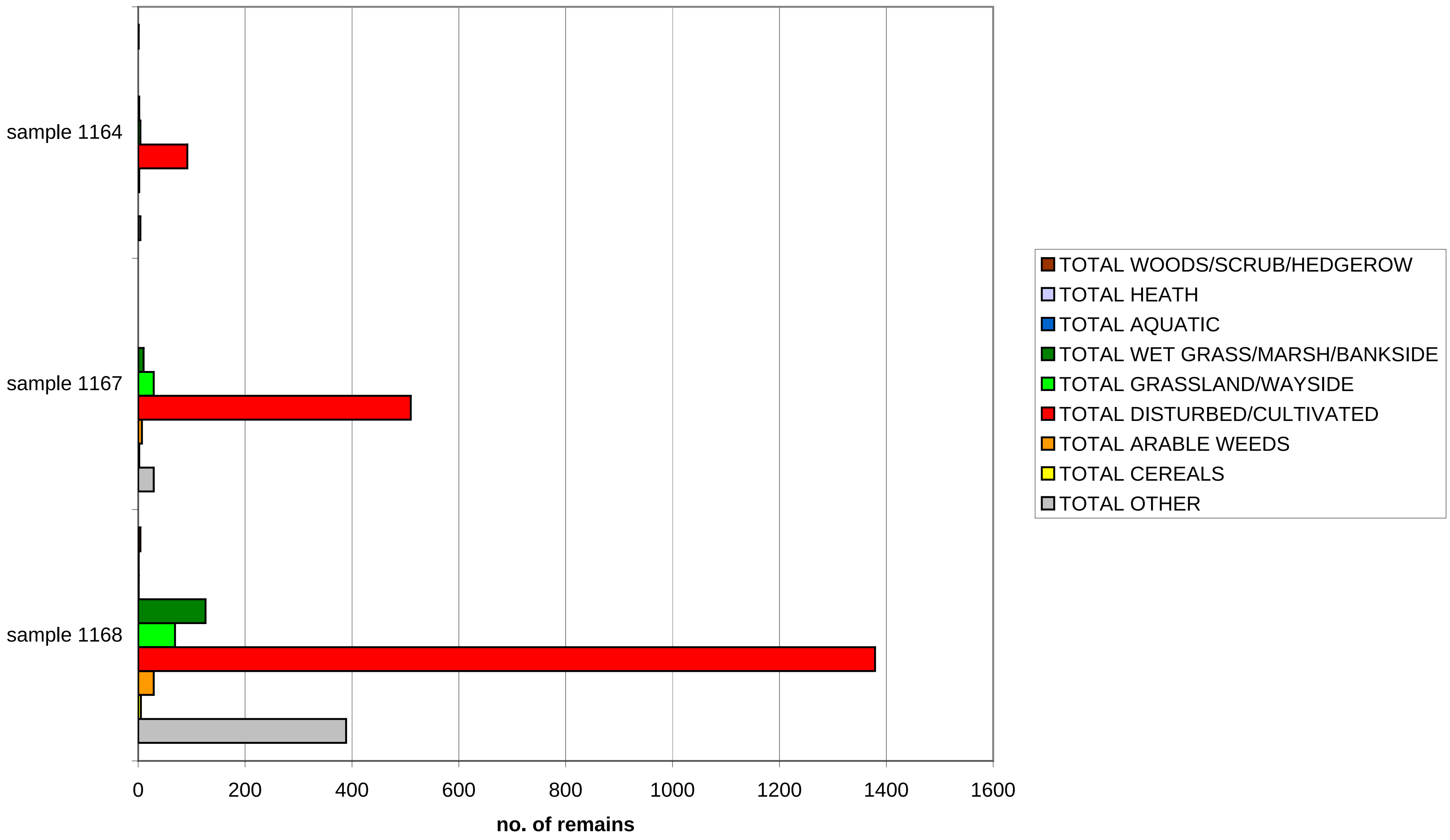


TABLE 1

Feature	135071	135071	135071	135071	135071	135071	141024	141024	141024	124100	178108	178108	178108	178108	POK96	156031	156031	156031	136194	136194	136194	180080	180080	180080	180080	180080	133198	174009	174009	174009	174009	174009	135087	135087	135087
Deposit	135040	135037	155028	135034	135035	135027	121045	121044	121042	124102	178131	178120	178137	178136	960605	156020	155190	156020	136193	136193	136193	180087	180086	180086	180085	180085	133085	174047	174047	174039	174034	174039	135078	135077	135073
Sample no.	1141*	1138	1135	1140*	1139	1143	1146	1144	1156	804	1537	582	1534	1533	10582	1150*	1497*	1495*	1349	1348	1317	1217	1216	346	1215	1214	843	916	915	913*	912*	1116	1168	1167	1164
Cut date	MBA	MBA	MBA	MBA	MBA	MBA	MBA	MBA	MBA	M/LBA	M/LBA	M/LBA	M/LBA	M/LBA	M/LBA	LBA/EIA	LBA/EIA	LBA/EIA	EIA	EIA	EIA	EIA	EIA	EIA	EIA	EIA	ERB	RB	RB	RB	RB	RB	LRB	LRB	LRB
feature type	WH	WH	WH	WH	WH	WH	WH	WH	WH	WH	P	P	P	P	WH	W	W	W	P	P	P	W	W	W	W	W	WH	WH	WH	WH	WH	WH	P	P	P
% flot sorted	50	100	100	25	100	100	100	100	100	100	100	100	100	100	100	50	11	50	100	100	100	100	100	100	100	100	100	100	100	50	50	100	100	100	100
charred cereal remains	+		+						+		+		+	+	+							+				+	+	+	+	+	+			+	
waterlogged cereal caryopses		16	2	44							6	2										12	1	1	3					6	2				
cf. Bromus sect. Bromus (chess caryopsis)	2	3	2	8																															
Triticum dicoccum/spelta (emmer/spelt glume bases)	28	6		8							2	2											1				9	3	1	56	112	20			
cf. T. spelta (cf. spelt glume base)	4																																		
T. spelta (spelt glume base)																						1								26	10		1		
cf. T. dicoccum (cf. emmer glume base)	8		2							1																									
T. dicoccum (emmer glume base)																														16	12	1			
T. dicoccum/spelta (emmer/spelt) spiklet forks	10	17	8	96																			1							26	26	4			
cf. T. spelta (cf. spelt spikelet fork)		2	1	4																															
T. spelta (spelt spikelet fork)		1																												2	4		1		
cf. T. dicoccum (cf. emmer spikelet fork)		2		4																															
T. dicoccum (emmer spikelet fork)												1																		10	22	1			
Hordeum sp. (barley rachis frag.)	6																						1					1		6	16	3	1		
cereal-sized culm node			1	52							4	4																		8		1	2	2	
Taxus baccata (yew seed)																2																			
Ranunculus repens/acris/bulbosus (buttercup achene)	46	1	2	4		1		2	6	15	3	5				2	9	2	3	3					3	1	2	6	2	18	10	3	1	1	1
R. sceleratus (celery-leaved buttercup achene)												1																							
R. flammula (lesser spearwort achene)						1													8	38										4	6				
R. parviflorus (small-flowered buttercup achene)	14	2	1	8	1	1						2										1		3		2									
Ranunculus subg. Batrachium (water-crowfoot achene)																			1	13	18							1							
Papaver dubium (long-headed poppy seed)	2				1							1												1											
P. rhoeas/argemone (common/prickly poppy seed)	10										5	3											1		1		2								
Papaver sp. (poppy seed)																													1						
Fumaria sp. (fumitory achene)	2	1	1					1	1					1	6				2	1									1	2	2				
Urtica dioica (common nettle achene)	34	4	53	320	11	41	8	86	244	37	364	325	1		20	4	9	4	11	2	1			2	61	1	178	163	63	312	998	143	4		
Urtica urens (small nettle achene)	2		4								1											17	18	15	13		12	1		42	114	12	13		
Alnus glutinosa (alder seed)	2											1																							
Corylus avellana (hazel nut shell frag.)																																	1		
Montia fontana (blinks seed)	2			4								1			1				1	1		1	103	1	38	19			1		6				
Chenopodium album (fat-hen seed)	54	7	57	144	27			4	2		9	21			29	4	27	2	1			1	67	1	5	3	4	11	4	18	72	3	20	11	1
C. polyspermum (many-seeded goosefoot seed)	4				1						2	2							681	375	84	2					10	25				1			
Atriplex patula/prostrata (orache seed)	102	18	13	44	1						6	1			16	8	55		1				1			3	10	24	1	2	6	1	157	8	1
Arenaria serpyllifolia (thyme-leaved sandwort seed)	8																																		
Moehringia trinervia (three-nerved sandwort seed)	4		1		2		1	9	12								18	32																	
Stellaria media (common chickweed seed)	168	250	86	88	5	4	2	6	1	3	147	114			1	2			1	1		3	47	4	25	10	6	9		32	70	9	337	11	1
S. graminea (lesser stitchwort seed)	6	1						1		2	2	2								1								2			6			1	
Cerastium sp. (mouse-ear seed)	20							3			3	2										9	1	8	2		5				2				
Scleranthus anuus (annuual knawel achene)	2																																		
Spergula arvensis (corn spurrey seed)			1																				1												
Lychnis flos-cuculi (ragged robin seed)																			1									1		2	2				
Silene sp. (campion seed)																							2												
Persicaria maculosa (redshank nutlet)																			372	101	8										2	1	1		
P. lapathifolia (pale persicaria nutlet)																			334	14	3							2							
Polygonum hydropiper (water-pepper nutlet & perianth)										1									76	62	4														
P. aviculare (knotgrass nutlet)	128	17	10	28	3			1		1	19	14	1		1	2	9		26	15		12	24	10	8	4	24	5		26	46	14	50	18	
Fallopia convolvulus (black bindweed nutlet)	8		2	16							1	3					9		1															1	
Rumex acetosella (sheep's sorrel nutlet)	20																		1				15		4	3		1		4	2	1			
R. crispus (curled dock nutlet & perianth)	10	3		4																							1			28	4	1			
R. obtusifolius (broad-leaved dock nutlet & perianth)																															18	5	269	26	
R. crispus/obtusifolius																															24				
R. conglomeratus (clustered dock nutlet & perianth)		1		4				20		1	34	46							1											2	2		4		
R. maritimus (golden dock nutlet & perianth)																																	29	4	
Rumex sp. (dock nutlet)		1	7	8	1	5	1	15	55	3	11	14							1		1		5				49	11	2	58	156	25	258	415	88
Hypericum sp. (St John's wort seed)							1	3	1																										
Malva sylvestris (common mallow nutlet)		1	64	108							2																			2	10				
Malva sylvestris (common mallow capsule fg.)	2		44	68	1																						3				2		2		
Viola sp. (violet seed)	6						1	2	4	1															3	1									
Salix sp. (willow catkin bud)			1				1	3		2	4	7			2												3								
Barbarea vulgaris (winter-cress seed)	2																																		
Rorippa cf. sylvestris (cf. creeping yellow-cress seed)																			11																
Capsella bursa-pastoris (shepherd's purse seed)	2	1	1					2			2	2										2	2	19	10	3		1			2		2	1	
Thlaspi arvense (field penny-cress)																											1	1							
Coronopus squamatus (swine-cress half silicula)																															2		285	18	1
Brassica/Sinapis sp. (mustard, charlock etc. seed)			1																				4												
Erica sp./Calluna vulgaris (heath/heather capsule)																									1			1			2				
Erica tetralix (cross-leaved heath leaf)																						1			1						8				
Calluna vulgaris (heather shoot tip)																						1	3		2		1			4	4		1		
Filipendula ulmaria (meadowsweet achene)																							1					1		2	6	1			
Rubus sect. Glandulosus (bramble seed)	44	31	19	624	11	33		99	25	45	48	18	12		39	134	227	114	5					1				1		2	8		2		
Agrimonia eupatoria (agrimony achene)																																	3		
Potentilla anserina (silverweed achene)																						1											1	3	
Potentilla sp. (tormentil etc. achene)	20									2					1				1	1				1				6		18	10	2	6	4	
Aphanes arvensis (parsley piert achene)	28	1	2	4	1						5	3							2				18	62	6			1			2	1		1	1
Rose/bramble-type thorn	14	32	6	116	3	8		1		5	5	1			3	38	90	2			1						1			2	2				
sloe/hawthorn-type thorn		1		4				1			1	1				6	18		1	4											6				
Prunus spinosa (sloe stone)								1		4						6			1													1			
Prunus cf. domestica ssp. insititia (bullace-type stone)																2			1																
Prunus cf. padus (cf. bird cherry stone)																		2																	
Prunus sp. (stone)									1		1	1			1			4																	
Crataegus monogyna (hawthorn seed)					1			2	1	14						2	27	2	1	1															
cf. immature hawthorn fruits										8																									
Cornus sanguinea (dogwood seed)																		2																	
Euphorbia peplus (petty spurge seed)																										1									
Rhamnus cathartica (buckthorn seed)							1	1	1	5								8		1															
Frangula alnus (alder buckthorn seed)								5	1	2	8				1	60	136	2																	
Linum catharticum (purging flax seed)										4																		2		4	14	6	4		
Linum usitatissimum (cultivated flax capsule frag.)	2	2									1																								
Acer campestre (field maple seed)									1		1	3																							
Chaerophyllum temulum (rough chervil mericarp)	2		1								7	4			1			2																	
Anthriscus sylvestris (cow parsley mericarp)												6																							
Oenanthe sp. (water-dropwort mericarp)																															2	1	1		
Aethusa cynapium (fool's parsley mericarp)	20	1	1	4	1			1			1				3				1																
Conium maculatum (hemlock mericarp)																											3	5	3	8	12	1	97	5	2
Torilis japonica (upright hedge-parsley mericarp)	4	1				4			2																								3		
Torilis sp. (hedge-parsley mericarp)				4																											6				
Pastinaca sativa var. sativa (wild parsnip mericarp)	4	1	341	988	1	1						2					9										1					1			
Daucus carota (wild carrot mericarp)				4		1			1																								1		
Hyoscyamus niger (henbane seed)																							2				3	2		4	4		1		1
Solanum dulcamara (bittersweet seed)										2								6													2	1			
S. nigrum (black nightshade seed)			2					3			3	2				50	155	2									1	9	2	10	14		1		
Solanum sp. fg.																														4					
Stachys sylvatica (hedge woundwort nutlet)								5	1																										
Ballota nigra (black horehound nutlet)			1				2	5	3		2	1						2	3								4			6	2				
Galeopsis tetrahit (common hemp-nettle nutlet)	2																9		2		1		1												
Marrubium vulgare (white horehound nutlet)	2		9	12		2		2	2	1	10	3			8		18									1	11	14	6	70	142	27	13	5	2
Glechoma hederacea (ground-ivy nutlet)				4																															
Prunella vulgaris (self-heal nutlet)	14					1		3	1	3	2	1													1			2		2	18		2		
Mentha sp. (mint nutlet)									1	1	1								1	6	4										2			1	
Lycopus europaeus (gypsywort nutlet)					1				1			2																			2				
Callitriche sp. (water-starwort nutlet)																			500	500	48														
Plantago lanceolata (ribwort plantain seed)	2																																		
Plantago major (greater plantain seed)	2							11																1			4						5	2	
Verbascum sp. (mullein seed)	2																																		
Veronica sp. (speedwell seed)								5													2														
Odontites verna/Euphrasia sp. (red bartsia/eyebright seed)	8	4																																	
Rhinanthus sp. (yellow rattle seed)											2	1																							
Galium aparine (cleavers nutlet)	2																																		
Sambucus nigra (elder seed)	2		1					3	5		428	320	214	18	2	12	27	2	2									2		10	26	4	1		1
Valerianella locusta (common corn salad fruit)				4																						1									
Arctium lappa (greater burdock achene)	1																																		
Cirsium/Carduus sp. (thistle achene)		1	9	44		7	1	1	15	2	3	2				2						6	14	4		1	7			2	4		18	7	
Onopordum acanthium (cotton thistle achene)			1																								6				6				
Lapsana communis (nipplewort achene)	2		5	24	2	1		2		2	2	14			4	2																			
Leontodon autumnalis (autumn hawkbit achene)																	9										1	1		4	4		1		
Sonchus asper (prickly sow-thistle achene)	20	4	23	156	17	1		1		1	4	4				4											8						263	19	
Sonchus oleraceus (smooth sow-thistle achene)	14	3	6	36	1						2	9																							
Taraxacum sp. (dandelion achene)	2			4																		1		1									1		
Bellis perennis (daisy achene)																						1													
Anthemis cotula (stinking mayweed achene)																											23	7	2	42	150	16	29	6	1
Leucanthemum vulgare (oxeye daisy achene)																															4	1			
Tripleurospermum inodorum (scentless mayweed achene)	12	2									3											1	29	2	10	2	5	1	1	2	6	1			
Bidens tripartita (trifid bur-marigold achene)								1																											
cf. Senecio sp. (cf. ragwort achene)																																	1	1	
Lemna sp. (duckweed seed)	2	5	3	4	2			11	2																										
Juncus sp. (rush seed)	++		++	+++	+	+++		++	+	+	++			++++			+		+++	+++	+++		++		+	+	++	++	++	+++	++	++	+	+++	++
Luzula sp. (wood-rush seed)	4					1																	1												
Eleocharis subg. Palustres (spike-rush nutlet)	4	1											2							3	1							3	1	14	26	2			
Cyperaceae (nutlet)																			1				1												
Carex sp. (trigonous sedge nutlet)	2			4							2			1	1						1							9	2	28		14	1	5	1
Carex sp. (lenticular sedge nutlet)	4	2	2		1					3	4			2					1		2							1		6		5	1		
Glyceria sp. (sweet-grass caryopsis)														1					39	102	47		2												
Poaceae (indeterminate small grass caryopsis)	16	11	42	88	5	2	23	12			4	6			3	2			8	1	4	8	6	3	9	6	3	3	3	4		2	11	6	1
?legume pod fgs								2			2	19																					1		
TOTAL REMAINS per kg soil	975	458	839	3192	101	115	42	336	390	171	1180	999	230	23	143	344	864	190	2104	1246	230	81	373	140	206	62	401	339	96	970	2280	339	1906	582	103
TOTAL CEREALS	58	47	16	216	0	0	0	0	0	1	12	9	0	0	0	0	0	0	0	0	0	13	4	1	3	0	9	4	1	156	204	30	5	2	0
TOTAL ARABLE WEEDS	76	9	4	16	3	1	0	0	0	0	13	9	0	0	0	0	0	0	2	0	0	2	49	68	17	5	31	10	4	44	158	18	29	7	2
TOTAL DISTURBED/CULTIVATED	594	311	272	876	70	52	11	145	303	48	611	573	2	1	80	76	273	8	1101	495	95	46	172	59	124	25	311	261	73	544	1536	215	1379	510	92
TOTAL GRASSLAND/WAYSIDE	142	17	514	1328	7	19	27	40	31	29	37	33	0	0	13	6	45	6	16	6	4	17	35	10	17	12	42	37	11	134	240	43	69	29	4
TOTAL WET GRASS/MARSH/BANKSIDE	8	1	0	8	1	0	0	1	2	1	1	3	2	0	1	0	0	0	348	24	8	1	104	1	38	19	3	11	5	24	50	3	126	10	2
TOTAL AQUATIC	2	5	3	4	2	1	0	11	2	1	0	1	0	1	0	0	0	0	624	715	117	0	2	0	0	0	0	1	0	4	8	1	1	0	0
TOTAL HEATH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	4	0	1	1	0	4	14	0	1	0	0
TOTAL WOODS/SCRUB/HEDGEROW	72	64	28	744	17	41	4	132	52	88	496	352	226	18	48	262	546	176	11	6	1	0	0	1	3	1	4	3	0	14	44	6	4	0	1
TOTAL OTHER	24	4	2	4	1	2	0	7	0	4	10	20	0	3	1	0	0	0	87	113	27	0	4	0	0	0	3	17	5	58	44	24	389	29	4

TABLE 2

Feature	sample	TOTAL REMAINS per kg soil	% CEREALS	% ARABLE WEEDS	% DIST/CULT	% GRASS/WAYSIDE	% WET GRASS/MARSH/BANKS	% AQUATIC	% HEATH	% WOOD/SCRUB/HEDGE	% OTHER
135071	1141	974	6	8	61	15	1	0	0	7	2
	1138	458	10	2	68	4	0	1	0	14	1
	1135	839	2	0	32	61	0	0	0	3	0
	1140	3192	7	1	27	42	0	0	0	23	0
	1139	101	0	3	69	7	1	2	0	17	1
	1143	115	0	1	45	17	0	1	0	36	2
141024	1146	42	0	0	26	64	0	0	0	10	0
	1144	336	0	0	43	12	0	3	0	39	2
	1156	390	0	0	78	8	1	1	0	13	0
124100	804	171	1	0	28	17	1	1	0	51	2
178108	1537	1180	1	1	52	3	0	0	0	42	1
	582	999	1	1	57	3	0	0	0	35	2
	1534	230	0	0	1	0	1	0	0	98	0
	1533	23	0	0	4	0	0	4	0	78	13
POK 96	10582	143	0	0	56	9	1	0	0	34	1
156031	1150	344	0	0	22	2	0	0	0	76	0
	1497	864	0	0	32	5	0	0	0	63	0
	1495	190	0	0	4	3	0	0	0	93	0
136194	1349	2104	0	0	52	1	17	30	0	1	4
	1348	1246	0	0	40	0	2	57	0	0	9
	1317	230	0	0	41	2	3	51	0	0	12
180080	1217	81	16	2	57	21	1	0	2	0	0
	1216	372	1	13	46	9	28	1	1	0	1
	346	140	1	49	42	7	1	0	0	1	0
	1215	206	1	8	60	8	18	0	2	1	0
	1214	62	0	8	40	19	31	0	0	2	0
133198	843	401	2	8	78	10	1	0	0	1	1
174009	916	339	1	3	77	11	3	0	0	1	5
	915	96	1	4	76	11	5	0	0	0	5
	913	970	16	5	56	14	2	0	0	1	6
	912	2280	9	7	67	11	2	0	1	2	2
	1116	339	9	5	63	13	1	0	0	2	7
135087	1168	1906	0	2	72	4	7	0	0	0	20
	1167	582	0	1	88	5	2	0	0	0	5
	1164	103	0	2	89	4	2	0	0	1	4