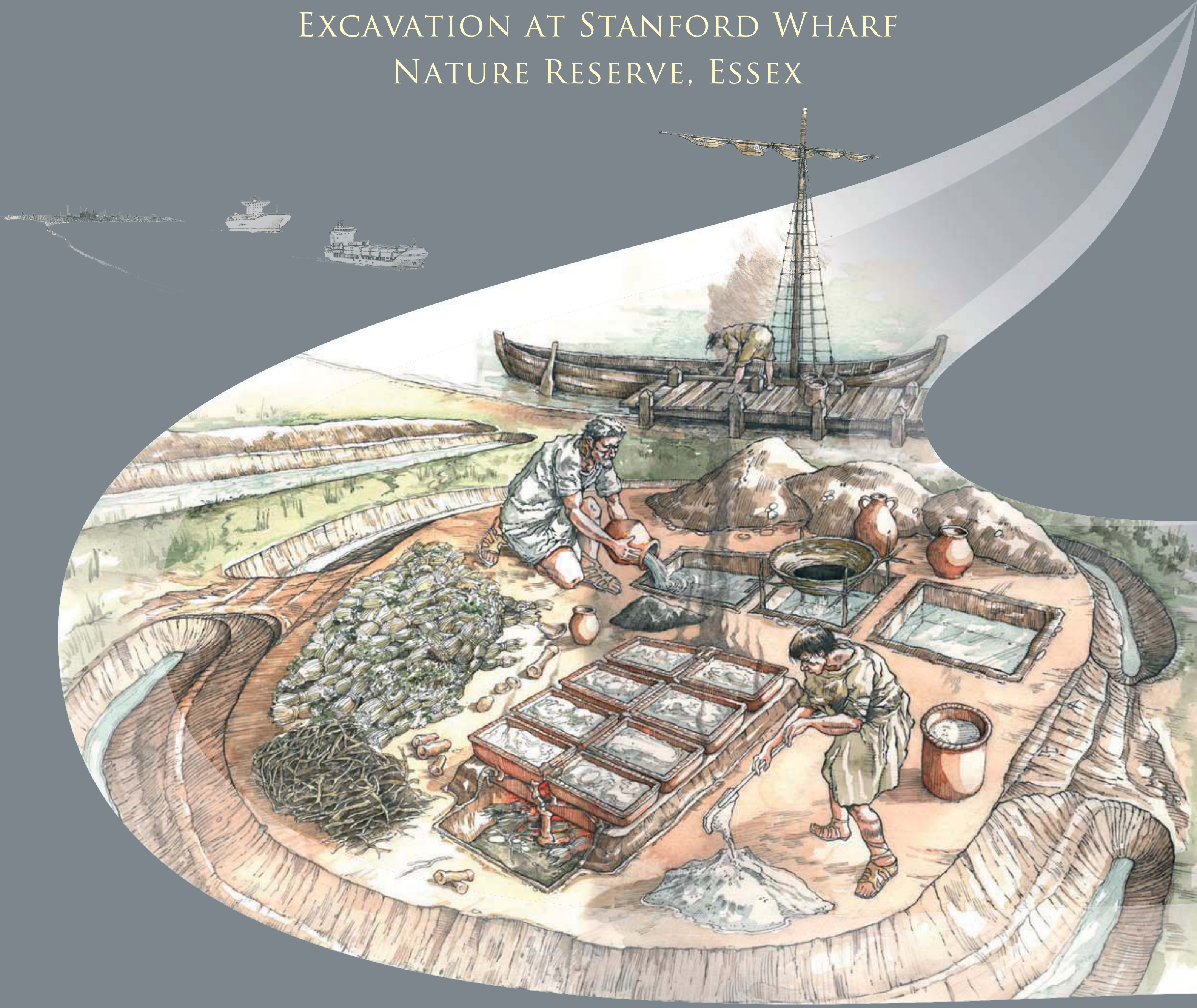
London Gateway

Iron Age and Roman Salt Making in the Thames Estuary

Excavation at Stanford Wharf Nature Reserve, Essex



Specialist Report 18

Insect Remains

by Enid Allison

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Introduction

Four samples from waterlogged deposits dating to the Iron Age and Roman period were submitted for examination of insect remains. Sample selection was based on observations of insect remains in particular samples during assessment of plant macrofossils (Smith 2010).

Three sediment samples with volumes of 5 litres and one with a volume of 8 litres were wet-sieved with flotation by Oxford Archaeology staff. Residues and flots were collected on 0.25mm mesh and both fractions were submitted for insect analysis. Paraffin flotation was carried out to extract insect remains following the methods of Kenward *et al.* (1980) with remains recovered on 0.3mm mesh.

Beetles (Coleoptera) and bugs (Hemiptera) were removed from the paraffin flots onto moist filter paper for identification using a low-power zoom microscope (x10–x45). Identification was by comparison with modern insect material and reference to standard published works. Numbers of individuals and taxa of beetles and bugs were recorded, and taxa were divided into broad ecological groups for interpretation following Kenward *et al.* (1986) and Kenward (1997) (see Table 18.1 for groups used). The state of preservation of remains was recorded using the system of Kenward and Large (1998), where fragmentation (F) and erosion (E) are scored on a scale from 0.5 (superb) to 5.5 (extremely decayed or fragmented). The abundance of other invertebrates in the flots was recorded on a three point scale as present, common or abundant. Nomenclature follows Duff (2008) for Coleoptera, and Nau (2006) for Hemiptera/Heteroptera. The paraffin flots are currently stored in jars of industrial methylated spirits (IMS).

Results

Details of the insect samples and the condition of the insect assemblages is recorded in Table 18.2, and lists of insect and other invertebrates for each sample are given in Table 18.3. The main statistics used in interpretation are presented in the appendix.

Iron Age peat deposit (Context 1915, sample 1125)

Waterlogged seeds from the peat, which lay under alluvium G39a (sequence 8), were radiocarbon dated to 980-820 cal. BC (95.4%; 2755 ± 30 BP: OxA-24899). Beetle and bug remains were common and the assemblage as a whole was indicative of deposition in a saltmarsh environment, with hints of transitional habitats to marsh or fen with possibly fresher water. Aquatic beetles accounted for 8% of the whole assemblage, and insects from damp ground and waterside habitats for 43% of the terrestrial fauna. *Ochthebius dilatatus* was the most common water beetle with seven individuals. It is regarded as halobiotic in Scandinavia (Hansen 1987, 39-40), but is more euryoecious in Britain, occurring in muddy, fresh or brackish, mainly stagnant water (Friday 1988, 151). Two other *Ochthebius* species, *O marinus* and *O ?viridis*, are found in saltmarsh with shallow brackish pools. *Cyphon* also indicated shallow standing water with abundant waterside vegetation or litter. Fen-like conditions with still or slowly flowing water, probably of low salinity, were suggested by two other water beetles *Coelostoma orbiculare* and *Cymbiodyta marginellus*, and *Cercyon tristis* and *C sternalis* found in fen litter were both common. A variety of ground beetles (Carabidae) were represented, and *Bembidion assimile*, which lives among dense vegetation and reeds in wetland and saltmarsh, was particularly abundant. This species can be found inland, but where it is coastal in distribution, it occurs in the upper parts of saltmarshes (Luff 1998, 51). *Bembidion minimum* or *normannum* and *Pogonus chalceus* are both found in saltmarsh and under tidal litter (Luff 2007, 97, 103), and *Dyschirius salinus* lives on clay or fine silt/sand banks in coastal locations (Luff 2007, 62). *Bembidion varium* is found on bare ground near water, most frequently in saltmarshes in south-east England (Luff 1998, 77). Another common beetle was *Pterostichus vernalis* from damp or shaded lowland habitats, especially grassland with litter (Luff 1998, 93; 2007, 115).

There were a few indications of specific plants from phytophagous insects. Planthoppers (*Delphacidae* and *Auchenorhyncha* spp.) were well represented and included *Conomelus anceps*, which is common on rushes (*Juncus*) (LeQuesne 1960, 38). There were also several *Limnobaris dolorosa*, a weevil found in wetland areas on sedges (*Carex*). *Rhinoncus* species are associated with *Persicaria* and docks (*Rumex*), and *Meligethes* with crucifers.

Decomposers accounted for 15% of the terrestrial fauna, none of which are regarded as synanthropic. Over half of the group had rather generalized feeding habits and would have colonised naturally occurring accumulations of moist decaying plant matter, but several species of *Aphodius* associated with fouler material were recorded. *Aphodius* are primarily associated with herbivore dung, but since some species exploit decaying plant material or overwinter in flood debris (Jessop 1986, 20-25), their presence does not necessarily indicate grazing animals in the immediate vicinity. The dung beetle group made up 4% of the terrestrial assemblage (21% of the decomposer group), suggesting that if there were animals grazing drier parts of the marsh or grassland, they were present in fairly low densities or at some distance from the point of sampling.

Fill of Roman ditch (Context 4255, sample 4005)

The ditch fill was dated on pottery evidence to AD 200-300. Although the sample was identified during the plant macrofossil assessment as having a high potential for insect analysis, only a small assemblage of beetles and bugs (12 individuals of 12 taxa) was recovered by paraffin flotation from the sediment submitted for analysis. Despite the small numbers of remains, *Ochthebius dilatatus* and *Bembidion minimum* or *normannum* together provided indications for muddy, brackish water and saltmarsh conditions. Other beetle taxa included *Pterostichus vernalis*, *Bembidion* (*Ocydromus*), *Heterocerus*, *Anotylus rugosus*, and *Aphodius*, the group as a whole suggesting that organic litter and waterside mud were present. A statoblast of the bryzoan *Cristatella mucedo* found on various substrates in sheltered areas of still or, more usually, slowly moving water with low wave action and current (Nederlandse zoetwater bryozo□n (mosdieren) website) was also noted.

Fill of mid-late Roman cess pit 1249 (Context 1248, sample 1356)

The pit was located in the north-eastern corner of enclosure 9502. It was thought to have possibly been initially dug for brickearth extraction, and then subsequently used as a refuse or cess pit. The lower fills were waterlogged.

Beetle and bug remains were abundant and very well-preserved. The assemblage consisted almost entirely of terrestrial forms, nearly half of them decomposers. The only water beetles recorded were two *Ochthebius dilatatus* and single individuals of two *Helophorus* species.

The composition of the much of the assemblage was consistent with the presence of foul organic matter within the pit. Bean or seed weevils (*Bruchinae*) were common and are often associated with deposits that appear to have contained cess, where it is presumed they were eaten with infested pulses and subsequently voided in faeces. The species most commonly recorded from archaeological deposits is *Bruchus rufimanus* which develops in medium or large legume seeds, especially in field beans (*Vicia faba*) (Hoffman 1945, 43). However, both of the two species represented here were smaller than *B rufimanus*. Some of the smaller bruchine species may be more common in cess deposits from southern England, sometimes occurring with *B rufimanus* (eg Carrott *et al*. 1996; Allison 2011). Other possibilities are that the beetles came from spoiled pulses dumped into the pit, from leguminous plant growing very close by, or even in the dung of animals feeding on pulses, but the most likely explanation is that they originated in human faeces. A fair proportion of insect sclerites recovered from the sample were commonly encrusted with orange-coloured cess-like material.

Although taxa other than bruchine weevils would not have been present in faeces when it was voided from the body, many of the beetles recovered from the sample were characteristic members of a cess pit fauna (Carrott and Kenward 2001). Taxa tolerant of foul to very foul conditions were common (16% of terrestrial insects, 35% of the decomposer component) and included *Cercyon unipunctatus*, *C ?terminatus*, *C haemorrhoidalis*, *Aleochara ?lanuginosa* and several species of scarabaeid dung beetles. The most numerous dung beetles were *Aphodius granarius* and *A prodromus* and/or *sphacelatus*, all commonly associated with foul waste other than herbivore dung and often found in deposits associated with human habitation. Human faeces is regarded by Jessop (1988, 5) as the most effective attractant for collecting modern dung beetles, and many of the species noted above would have rapidly invaded the foul waste. Fly puparia were abundant in the sample but did not form part of the analysis. Eurytopic decomposer beetles included taxa such as *Corticaria* and *Ptenidium*, and there was a sizable group of oxyteline beetles that would have lived in wet organic-rich mud within, and perhaps around, the pit. A nettle ground bug *Heterogaster urticae* may have arrived from stands of nettles (*Urtica*) growing on nitrogen enriched ground close by. Seeds of the small nettle (*Urtica* *urens*) were quite common in the same deposit (Kath Hunter, pers. comm.).

Another large and distinctive group of decomposer beetles typical of rather dry, mouldy organic material (15% of the terrestrial fauna, and 32% of the decomposers) indicated that material other than faeces was present in the pit. *Enicmus* was especially numerous, and other species represented were *Latridius minutus* group, *Ephistemus globulus*, *Typhaea stercorea*, *Atomaria* spp., *Cryptophagus* spp. and a spider beetle (*Ptininae*). All these are typical of a fauna that would have formed within a building (Hall and Kenward 1990; Kenward and Hall 1995). Woodworm beetles (*Anobium punctatum*) and powder-post beetle (*Lyctus linearis*) probably also belong with the same group, since they commonly infest structural timber. The occurrence of such a large group of these beetles is highly suggestive of litter from a building of some sort having been introduced into the pit. Single individuals of two grain pests, a saw-toothed grain beetle (*Oryzaephilus surinamensis*) and a small-eyed flour beetle (*Palorus ratzeburgi*), were recorded. The remains were notable because sclerites of each were a pronounced red colour. This was in contrast to the rest of the insect material, suggesting that the remains had undergone some decomposition before arrival in the pit. Some grain pests, especially the grain weevil (*Sitophilus granarius*), are sometimes recorded in deposits containing human faeces, implying that they were consumed with the grain products. However, the saw-toothed grain beetle is often common in very spoiled grain, and the small-eyed flour beetle is a particular indicator of foul grain and other rotting residues, and records of these species in Roman deposits are often indicative of stable litter. Animals are likely to have been fed poorer quality grain than humans, and any residues building up in stables may have become rather rotten. Eurytopic decomposers represented included *Acritus nigricornis*, which is often typical of the rather loose textured type of organic-rich substrate found in stable litter. If an element of stable waste is represented in the pit fill, some of the foul decomposer group mentioned above may have arrived with it.

A considerable number of insects in the assemblage appeared to have come from habitats outside the pit, suggesting that it had remained open for some time. Insects from definite ‘outdoor’ habitats (unable to live in decaying organic material or within buildings) accounted for 28% of the terrestrial beetles, and they provided some indications of the surroundings of the pit. They included *Calathus mollis* found mainly in coastal dunes (Luff 2007, 122), and *Brachinus crepitans* which occurs on chalky soils in grasslands and waste ground, often in coastal locations, where the larvae are parasitic on pupae of other beetles (Luff 2007, 33). *Bembidion varium* is found on bare and partly vegetated ground near water (Luff 2007, 84), and a number of other ground beetles were indicative of open ground in the vicinity of the pit, with grassland and disturbed or waste ground. *Anchomenus dorsalis*, *Harpalus ?tardus* and *Microlestes maurus* were all suggestive of dry soils.

A range of plant-feeding beetles and bugs from grassland and disturbed or waste ground habitats were also common. It is possible that grassland species in particular could have been introduced with litter from a building, but the number and excellent condition of the remains, combined with the proportion of other ‘outdoor’ beetles, suggests that most could have come from plants growing close to the pit. Their states of preservation contrasted strongly with the grain pests, for example, which are thought to have been secondarily deposited. Some of the plant-feeders were identified closely enough to indicate particular plants: nymphs of *Coreus marginatus* develop on docks (*Rumex*), although the adults can be found searching for seeds on a variety of plants in the later part of the year (Southwood and Leston 1959, 59-61), *Malvapion malvae* is associated with mallows (*Malvaceae*), especially *Malva sylvestris* (Morris 1990, 39), *Sitona* and *Tychius* with clovers and other *Papilionaceae*, and *Mecinus pascuorum* with plantains (*Plantago*). Several other *Apionidae* species, and *Hypera* and *Longitarsus* were also recorded, all indicating herbaceous vegetation.

Fill of a mid-late Roman pot within pit 1249 (Context 6584, sample 1377)

Sample 1377 was taken to establish whether the pot contents were the remains of food, or simply consisted of a general fill of the pit.

Insect remains were very well preserved but their concentration was lower than in the sample from the general fill. Fragmentation of sclerites was particularly low, and it is possible that the enclosed conditions within the pot protected remains from compression by accumulating deposits, resulting in somewhat better preservation of material. The insect assemblage was very similar to the previous sample, both in terms of species represented and in implication. Groups of decomposers associated with foul matter and with relatively dry mouldy material were both common, outnumbering species with general habitat requirements. The foul group accounted for 15% of the terrestrial assemblage (44% of the decomposers), and the ‘dry’ group for 12% (34% of the decomposers). The latter contained typical elements of a building fauna, including woodworm and powder post beetles. Single individuals of two bruchine weevils were recorded.

Insects from outdoor habitats were very well represented (37% of terrestrial forms) and encompassed species recorded from the previous sample, with the addition of *Calathus fuscipes* found on relatively dry soils, *Pterostichus macer* found on clay soils in habitats ranging from saltmarsh to open grassland (Luff 1998, 89), and two harpaline ground beetles. The range of plant feeders associated with herbaceous vegetation was also very similar to those recorded from the general fill, and included *Meligethes* found on crucifers, *Mecinus pascuorum*, *Tychius*, *Sitona*, and several species of *Apion*.

Discussion and conclusions

Three of the four samples examined produced sizeable assemblages of beetles and bugs. The assemblage from an Iron Age peat deposit within alluvium was indicative of swampy saltmarsh with shallow brackish water and a rich vegetation that included sedges and rushes. The proportion of *Aphodius* dung beetles may indicate that grazing animals were present in fairly low densities or at some distance from the point of sampling, although it should be remembered that some *Aphodius* dung beetles are, less commonly, found in flood debris and decaying litter.

Muddy, still or slowly flowing brackish water and saltmarsh conditions, with moist organic litter and waterside mud, were indicated by a small group of beetles and bugs recovered from a Roman ditch fill (context 4255).

The last two samples from the general fill of pit 1249 and the fill of a pot within it both produced similar insect assemblages. The similarities in composition suggests that, even if some food remains *per se* were present in the pot when it entered the pit, almost all of the insect assemblage was associated with cess, dumped litter, or habitats outside the pit. Much of both assemblages was consistent with the use of the pit as a cess pit and beetles attracted to foul organic material were abundant. Flies also appear to have bred in some numbers. Bruchine weevils were common and are most likely to have entered the deposit in faeces, having been present in infested pulses. There was little evidence of pulses among the waterlogged plant remains in the pit, but this is not particularly surprising since their remains are generally uncommon unless charred or mineralised (eg Allison and Hall 2001). Remains of charred legumes including beans, peas and large vetches were present among some of the charred plant assemblages from the site (Kath Hunter pers. comm.). Another sizeable group of decomposer beetles associated with relatively dry mouldy organic material indicated that litter from within a building had been dumped in the pit. This may not merely have been to dispose of it, but could have been an attempt to contain unpleasant smells and reduce the number of flies. The presence of a few grains pests associated with very foul grain and rotting residues may indicate that some of the introduced litter was from stables but the considerable overlap between species that would be attracted to cess and that would colonise stable litter makes it difficult to say for certain what type of building any dumped litter might have come from.

A fairly high proportion of the beetles and bugs in the two samples from pit 1249 were from 'outdoor' habitats. The pit appears to have acted as a pitfall trap for various ground beetles from the immediate surroundings of the pit. They included species indicating open ground with relatively dry soils, dunes, grassland, and waste or disturbed ground, and also bare and only partially vegetated ground near water. It is difficult to identify from insect remains whether disturbed land was cultivated, but it is worth noting that some of the species recorded, such as *Pterostichus melanarius*, *Harpalus rufipes* and a turnip mud beetle (*Helophorus* (*Empleurus*)), are favoured by cultivation. The nettle ground bug *Heterogaster urticae* is found on nettles (*Urtica*) in warm, sunny, open fields and wastelands (Southwood and Leston 1959, 79), and they probably grew close to the pit on nitrogen-enriched ground, and may also have colonised litter if it was left standing as a midden for a time before eventual disposal. Nymphs of another bug *Coreus marginatus* live on docks (*Rumex*), seeds of which were identified among the plant remains.

A range of plant-feeding weevils from grassland and disturbed or waste ground habitats were common, including species found on mallows (*Malvaceae*), especially *Malva sylvestris*, clovers and other *Papilionaceae*, and plantains (*Plantago*). The possibility that grassland species could have been introduced with litter from a building should be considered, since on urban archaeological sites the presence of certain groups of weevils (particularly *Apionidae*, *Mecinus pascuorum* and *Sitona*, all represented here) is often suspected to be linked to the presence of hay. In a rural location such as this, however, they are equally or more likely to have come from vegetation growing in the vicinity, particularly since other species from grassland habitats that are unlikely to have arrived in hay were common. None of the weevils were unexpanded newly emerged individuals, which are thought to be characteristic of hay (Kenward and Hall 1997; Kenward 2009, 290). Additionally, the number and excellent condition of the remains suggest that most of the weevils came from plants growing close to the pit. Many species of *Apionidae* and *Sitona* feed on vetches, clovers and grassland trefoils, and Robinson (2002, 26) has suggested that high numbers of these genera may be indicative of ungrazed grassland vegetation, since they require their host plants to achieve maturity, rather than being constantly eaten to ground level. Robinson suggested that these taxa would account for 2.5-5% of an assemblage where grassland was not heavily grazed, but only for 1% in overgrazed pasture. These figures should be used with caution because of the difficulties of separating isolated sclerites of the closely similar species in these two groups, and some *Apionidae* are not associated with grassland plants, but the two groups accounted for 4-5% of the assemblages from the general fill of the pit and the pot. If all the taxa probably associated with grassland habitats are considered they account for 7-10% of the assemblages in the two deposits, strongly suggesting that local grassland was allowed to grow to maturity and was not heavily grazed.

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Insect Remains Tables

TABLE 18.1: ECOLOGICAL GROUPS USED IN ANALYSIS FOLLOWING KENWARD ET AL. (1986) AND KENWARD (1997)

d – damp ground or waterside taxa

g – grain-associated taxa

l – wood-associated taxa

m – moorland taxa

oa – certain outdoor taxa (unable to live and breed either within buildings or in accumulations of organic material)

ob – probable outdoor taxa

p – strongly plant-associated taxa

rd – dry decomposers

rf – foul decomposers

rt – generalized decomposers

RT - total decomposers (rd+rf+rt)

w – aquatic

u - uncoded

ss – strong synanthropes (very rare in natural habitats)

st – typical synanthropes (typically present in man-made habitats but capable of living in natural situations)

sf – facultative synanthropes (found in man-made and natural habitats)

S - total synanthropes (ss+st+sf)

TABLE 18.2: DETAILS OF SAMPLES EXAMINED FOR INSECT REMAINS. SCORES FOR FRAGMENTATION AND EROSION FOLLOW KENWARD AND LARGE (1998) USING A SCALE RANGING FROM 0.5 (SUPERB) TO 5.5 (EXTREMELY DECAYED OR FRAGMENTED)

Context	Sample	Period	Sample volume (litres)	Volume paraffin flot (ml)	MNI beetles and bugs	Fragmentation of insect sclerites	Erosion of insect sclerites
1915	1125	Iron Age	5	15	180	2 – 3.5 (mode 3)	2 – 4 mode 3)
1248	1356	Mid-late Roman	8	45	278	1.5 – 3 (mode 2)	1.5 – 3.5 (mode 2.5)
6584	1377	Mid-late Roman	5	40	95	1.5 – 2.5 (mode 2)	2 – 4 (mode 2.5)
4255	4005	AD200-300	5	5	12	Not recorded	Not recorded

TABLE 18.3: INSECTS AND OTHER INVERTEBRATE RECORDED FROM THE SAMPLES. ECOLOGICAL CODES ARE SHOWN IN SQUARE BRACKETS, SEE TABLE 1. ABUNDANCE OF INVERTEBRATES OTHER THAN BEETLES (COLEOPTERA) AND BUGS (HEMIPTERA) WAS ESTIMATED ON A THREE-POINT SCALE AS + PRESENT, ++ COMMON AND +++ ABUNDANT

Context	**1915**	**4255**	**1248**	**6584**
Sample	**<1125>**	**<4005>**	**<1356>**	**<1377>**
Sample Volume	**5 litres**	**5 litres**	**8 litres**	**5 litres**
Foraminifera sp.	+	-	-	-
Cladocera spp. (ephippia)	-	-	+	-
Dermaptera sp. [u]	-	-	+	-
Coreus marginatus (Linnaeus) [oa-p]	-	-	1	-
Heterogaster urticae (Fabricius) [oa-p]	-	-	1	1
Lygaeidae spp. [oa-p]	-	-	2	-
Saldidae sp. [oa-d]	3	-	1	-
Heteroptera sp.	1	-	1	-
Conmelus anceps Germar [oa-p]	2	-	-	-
Delphacidae spp. [oa-p]	9	-	-	-
Auchenorhyncha spp. [oa-p]	5	1	4	1
Aphidoidea sp.	-	-	-	+
Diptera spp. (adults)	-	-	++	+++
Diptera spp. (puparia)	++	++	+++	++
Hymenoptera Aculeata sp.	+	-	-	-
Hymenoptera Parasitica spp.	+	-	+	-
Brachinus crepitans (Linnaeus) [oa]	-	-	2	4
Nebria brevicollis (Fabricius) [oa]	-	-	2	1
Elaphrus cupreus Duftschmid [oa-d]	1	-	-	-
Dyschirius globosus (Herbst) [oa]	3	-	-	-
Dyschirius salinus Schaum [oa]	2	-	-	-
Trechus obtusus or *quadristriatus* [oa]	-	-	5	-
Bembidion (*Notaphus*) *varium* (Olivier) [oa-d]	2	-	-	-
Bembidion (*Ocydromus*) sp. [oa]	-	1	-	-
Bembidion (*Diplocampa*) *assimile* Gyllenhal [oa-d]	17	-	-	-
Bembidion (*Emphanes*) *minimum* or *normannum* [oa]	1	1	-	-
Bembidion (*Phyla*) *obtusum* Audinet-Serville [oa]	-	-	3	2
Bembidion spp. [oa]	1	-	-	-
Pogonus chalceus (Marsham) [oa]	2	-	-	-
Pterostichus macer (Marsham) [oa]	-	-	-	1
Pterostichus melanarius (Illiger) [ob]	-	-	1	-
Pterostichus vernalis (Panzer) [oa-d]	5	1	-	-
Pterostichus spp. [oa]	-	-	5	-
Calathus fuscipes (Goeze) [oa]	-	-	-	1
Calathus mollis (Marsham) [oa]	-	-	1	-
Calathus sp. [oa]	-	-	1	-
Anchomenus dorsalis (Pontoppidan) [oa]	-	-	3	1
Amara sp. [oa]	-	-	1	-

Context	**1915**	**4255**	**1248**	**6584**
Sample	**<1125>**	**<4005>**	**<1356>**	**<1377>**
Sample Volume	**5 litres**	**5 litres**	**8 litres**	**5 litres**
Harpalus rufipes (De Geer) [oa]	-	-	1	-
Harpalus ?tardus (Panzer) [oa]	-	-	1	-
Ophonus sp. [oa]	-	-	-	2
Harpalus or *Ophonus* sp. [oa]	-	-	-	2
Microlestes maurus (Sturm) [oa]	-	-	2	-
Carabidae spp. [ob]	3	-	1	3
Helophorus (Empleurus) sp. [oa]	-	-	1	-
Helophorus spp. [oa-w]	-	-	2	-
Cymbiodyta marginellus (Fabricius) [oa-w]	1	-	-	-
Hydrophilinae spp. [oa-w]	1	-	-	-
Coelostoma orbiculare (Fabricius) [oa-w]	2	-	-	-
Cercyon haemorrhoidalis (Fabricius) [rf-sf]	-	-	5	-
Cercyon marinus Thomson [oa-d]	5	-	-	-
Cercyon pygmaeus (Illiger) [rt]	-	-	-	1
Cercyon sternalis Sharp [oa-d]	6	-	-	-
Cercyon ?terminatus (Marsham) [rf-st]	-	-	1	-
Cercyon tristis (Illiger) [oa-d]	15	-	-	-
Cercyon unipunctatus (Linnaeus) [rf-st]	-	-	6	2
Cercyon analis (Paykull) [rt-sf]	-	-	1	-
Cercyon sp. [u]	1	-	2	2
Megasternum concinnum (Marsham) [rt]	2	-	2	1
Sphaeridium sp. [rf]	-	-	2	-
Acritus nigricornis (Hoffman) [rt-st]	-	-	1	-
Margarinotus ?purpurascens (Herbst) [rt]	-	-	1	-
Histeridae sp. [u]	-	-	1	-
Hydraena spp. [oa-w]	-	1	-	-
Ochthebius dilatatus Stephens [oa-w]	7	1	2	-
Ochthebius ?marinus (Paykull) [oa-w]	2	-	-	-
Ochthebius ?viridis Peyron [oa-w]	1	-	-	-
Ochthebius sp. and sp. indet. [oa-w]	1	-	-	1
Ptenidium sp. [rt]	-	-	2	-
Acrotrichis spp. [rt]	6	-	1	-
Cholevinae sp. [u]	-	-	1	2
Silphidae sp. [u]	-	-	1	-
Omalium sp. [rt]	-	-	2	-
Omaliinae sp. [u]	-	-	1	-
Micropeplus sp. [rt]	1	-	1	-
Pselaphinae spp. [u]	1	-	2	-
Tachinus sp. [u]	-	-	1	-
Tachyporus sp. [u]	-	-	2	-
Aleochara ?lanuginosa Gravenhorst [rf]	-	-	8	2
Aleochariinae spp. [u]	3	-	12	1
Anotylus complanatus (Erichson) [rt-sf]	-	-	2	1
Anotylus nitidulus (Gravenhorst) [rt-d]	-	-	5	-
Anotylus rugosus (Fabricius) [rt]	3	1	-	-
Anotylus sculpturatus group [rt]	-	-	7	3

Context	**1915**	**4255**	**1248**	**6584**
Sample	**<1125>**	**<4005>**	**<1356>**	**<1377>**
Sample Volume	**5 litres**	**5 litres**	**8 litres**	**5 litres**
Platystethus cornutus group [oa-d]	1	-	2	-
Platystethus nitens (Sahlberg) [oa-d]	1	-	5	1
Platystethus arenarius (Fourcroy) [rf]	-	-	1	-
Bledius spectabilis Kraatz [oa-d]	3	-	-	-
Bledius sp. [oa]	-	-	-	1
Carpelimus spp. [u]	4	-	1	-
Stenus spp. [u]	6	-	1	-
Lathrobium spp. [u]	-	-	2	2
Ochthephilum collare or *fracticorne* [oa-d]	1	-	-	-
Paederus sp. [oa-d]	1	-	-	-
Paederinae sp. [u]	3	-	1	-
Neobisnius ?villosulus (Stephens) [u]	-	-	1	1
Ocypus olens (Müller) [u]	-	-	1	-
Gyrohypnus angustatus Stephens [rt-st]	-	-	1	-
Gyrohypnus fracticornis (Müller) [rt-st]	-	-	1	1
Xantholinini spp. [u]	3	-	-	-
Staphylininae spp. [u]	5	-	4	4
Staphylinidae sp. [u]	-	-	-	1
Geotrupes sp. [oa-rf]	-	-	1	1
Aphodius ater (De Geer) [oa-rf]	1	-	-	-
Aphodius granarius (Linnaeus) [ob-rf]	-	-	6	1
Aphodius ?sphacelatus (Panzer) [ob-rf]	-	-	-	3
Aphodius prodromus or *sphacelatus* [ob-rf]	-	-	8	2
Aphodius contaminatus (Herbst) [oa-rf]	-	-	3	-
Aphodius spp. [ob-rf]	5	1	3	2
Oxyomus sylvestris (Scopoli) [rt]	-	-	2	-
Onthophagus sp. [oa-rf]	-	-	1	-
Clambus sp. [rt-sf]	-	-	1	-
Cyphon sp. [oa-d]	2	-	-	-
Heterocerus sp. [oa-d]	4	1	-	-
Elateridae spp. [ob]	1	-	3	2
Lyctus linearis (Goeze) [l-sf]	-	-	1	1
Ptininae sp. [rd]	-	-	1	-
Anobium punctatum (de Geer) [l-sf]	-	-	9	3
Meligethes sp. [oa-p]	1	-	-	1
Monotoma sp. [rt-sf]	-	-	1	-
Oryzaephilus surinamensis (Linnaeus) [g-ss]	-	-	1	-
Phalacridae spp. [oa-p]	1	-	1	-
Cryptophagus spp. [rd-sf]	-	-	6	4
Atomaria spp. [rd]	2	-	4	1
Ephistemus globulus (Paykull) [rd-sf]	-	-	2	1
Orthoperus sp. [rt]	-	-	1	-
Corylophidae sp. [rt]	3	-	-	-
Latridius minutus group [rd-st]	-	-	5	3
Enicmus sp. [rd-sf]	-	-	21	1
Corticaria sp. [rt-sf]	-	-	4	-

Context	**1915**	**4255**	**1248**	**6584**
Sample	**<1125>**	**<4005>**	**<1356>**	**<1377>**
Sample Volume	**5 litres**	**5 litres**	**8 litres**	**5 litres**
Corticariinae spp. [rt]	-	-	6	-
Typhaea stercorea (Linnaeus) [rd-ss]	-	-	1	1
Palorus ratzeburgii (Wissman) [g-ss]	-	-	1	-
Anthicidae spp. [rt]	1	-	1	1
Bruchinae spp. [u]	-	-	11	2
Plateumaris sp. [oa-p-d]	1	-	-	-
Chrysomelinae sp. [oa-p]	-	-	1	-
Longitarsus spp. [oa-p]	-	-	2	1
Alticini spp. [oa-p]	-	-	4	-
Chrysomelidae spp. [oa-p]	2	-	-	-
Malvapion malvae (Fabricius) [oa-p]	-	-	1	-
?*Oxystoma* spp. [oa-p]	-	-	1	-
Apionidae spp. [oa-p]	3	1	9	7
?*Anthonomus* sp. [oa-p]	-	-	-	1
Mecinus pascuorum (Gyllenhal) [oa-p]	-	-	2	1
Tychius sp. [oa-p]	-	-	1	1
Limnobaris dolorosa (Goeze) [oa-p-d]	3	-	-	-
Rhinoncus sp. [oa-p]	1	-	-	-
Ceutorhynchinae sp. [oa-p]	-	-	2	1
Sitona sp(p). [oa-p]	-	-	1	1
Hypera sp. [oa-p]	-	-	2	-
Curculionidae spp. [oa-p]	-	-	7	2
Coleoptera spp. [u]	6	2	5	4
Insecta spp. indet. larval fragments	++	-	-	-
Acarina spp.	+	+	+++	-
Aranae sp.	+	-	+	-
Pseudoscorpiones sp.	-	-	+	-
Cristatella mucedo (statoblast)	-	+	-	-
TOTAL INDIVIDUALS BEETLES AND BUGS	180	12	278	95

APPENDIX: MAIN STATISTICS FOR THE THREE LARGER BEETLE AND BUG ASSEMBLAGES. PERCENTAGES HAVE BEEN ROUNDED UP TO THE NEAREST WHOLE NUMBER. THE ABUNDANCE OF GROUPS OTHER THAN AQUATICS IS EXPRESSED AS A PROPORTION OF TERRESTRIAL FORMS. ECOLOGICAL GROUPS ARE BASED ON KENWARD ET AL. (1986B) AND KENWARD (1997) (SEE TABLE 18.1 FOR CODES USED)

Context	**1915**	**1248**	**6584**
Sample	**1125**	**1356**	**1377**
Total individuals	180	278	95
Total taxa	84	143	71
Number of aquatic individuals	15	4	1
% aquatic individuals	8%	1%	1%
Number of aquatic taxa	7	3	1
% aquatic taxa	8%	2%	1%
Terrestrial individuals	165	274	94
Terrestrial taxa	77	140	70
Number of RT individuals	24	127	32
% RT of terrestrial individuals	15%	46%	34%
Number of RT taxa	11	44	22
% RT terrestrial taxa	14%	31%	31%
Number of rd individuals	2	40	11
% rd of terrestrial individuals	1%	15%	12%
Number of rd taxa	1	9	8
% rd of terrestrial taxa	1%	6%	11%
Number of rf individuals	6	45	14
% rf of terrestrial individuals	4%	16%	15%
Number of rf taxa	4	13	9
% rf of terrestrial taxa	5%	9%	13%
Number of rt individuals	16	42	7
% rt of terrestrial individuals	10%	15%	8%
Number of rt taxa	6	22	5
% rt of terrestrial taxa	8%	16%	7%
%rd/RT individuals	7%	32%	34%
%rf/RT individuals	21%	35%	44%
%rt/RT individuals	55%	33%	22%
Number of g individuals	0	0	0
% g of terrestrial individuals	0%	0%	0%
Number of g taxa	0	0	0
% g of terrestrial taxa	0%	0%	0%

Context	1915	1248	6584
Sample	**1125**	**1356**	**1377**
Number of l individuals	0	10	4
% l of terrestrial individuals	0%	4%	4%
Number of l taxa	0	2	2
% l of terrestrial taxa	0%	1%	3%
Number of d individuals	71	13	1
% d of terrestrial individuals	43%	5%	1%
Number of d taxa	18	4	1
% d of terrestrial taxa	23%	3%	1%
Number of p individuals	28	40	18
% p of terrestrial individuals	17%	15%	19%
Number of p taxa	19	33	14
% p of terrestrial taxa	25%	24%	20%
Number of m individuals	0	0	0
% m of terrestrial individuals	0%	0%	0%
Number of m taxa	0	0	0
% m of terrestrial taxa	0%	0%	0%
Number of oa individuals	108	76	35
% oa of terrestrial individuals	66%	28%	37%
Number of oa taxa	44	51	25
% oa of terrestrial taxa	57%	36%	36%
Number of oa+ob individuals	114	98	48
% oa+ob of terrestrial individuals	69%	36%	51%
Number of oa+ob taxa	48	60	35
% oa+ob of terrestrial taxa	62%	43%	50%
Number of S individuals	0	71	18
% S of terrestrial individuals	0%	26%	19%
Number of S taxa	0	23	7
% S of terrestrial taxa	0%	16%	10%
Number of ss individuals	0	3	1
% ss of terrestrial individuals	0%	1%	1%
Number of ss taxa	0	3	1
% ss of terrestrial taxa	0%	2%	1%
Number of st individuals	0	15	6
% st of terrestrial individuals	0%	6%	6%
Number of st taxa	0	6	3
% st of terrestrial taxa	0%	4%	4%

Context	**1915**	**1248**	**6584**
Sample	**1125**	**1356**	**1377**
Number of sf individuals	0	53	11
% sf of terrestrial individuals	0%	19%	12%
Number of sf taxa	0	14	3
% sf of terrestrial taxa	0%	10%	4%

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