Insect remains from post-medieval features at Broadgate, (Crossrail project)

(Site Code XSM10)

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Introduction

Nine samples from post-medieval deposits were submitted for extraction and analysis of insect remains, seven from the fills of two ditches that were backfilled in the 16th century (S109 and S107), and two from the fills of a later cess pit (S119). Insect assemblages from five of the ditch samples were fully analysed and the rest were scanned.

Methods

The material consisted of five bulk sample flots that had been recovered using a Siraf flotation tank and had previously been examined for plant remains, and a further four samples of raw sediment that had been wet-sieved specifically for the recovery of insect remains. Recovery in both cases was to 0.25mm. Paraffin flotation to extract insect remains was carried out following the methods of Kenward *et al*. (1980) with recovery on 0.3mm mesh. The paraffin flots are currently stored in industrial methylated spirits (IMS).

For the five samples that were fully analysed, beetle (Coleoptera) and bug (Hemiptera) sclerites were removed from the paraffin flots onto moist filter paper for examination under a low-power stereoscopic zoom microscope (x10 – x45). Identification was by comparison with modern comparative 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 based on those used by Kenward *et al*. (1986) and Kenward (1997). Aquatic taxa were subtracted from the rest of the assemblage to calculate percentages for particular ecological groups among the terrestrial fauna; waterside taxa were included among the terrestrial group. Insects other than beetles and bugs were recorded semi-quantitatively on a four-point scale: + 1 - 3 individuals; ++ 4 - 10 individuals; +++ 11 - 50 individuals; ++++ 50+ individuals.

The remaining paraffin flots were scanned (x10 – x45) in IMS in a petri dish and the abundance of insect taxa was recorded semi-quantitatively using the same four-point scale. Invertebrates other than insects in all samples were recorded as P – present, C – common, A – abundant. Nomenclature follows Bantock and Botting (2012) for Hemiptera/Heteroptera and Duff (2012a) for Coleoptera. Information on the food plants of phytophagous species has chiefly been obtained from Cox (2007), Morris (1990; 2002; 2008; 2012), and Southwood and Leston (1959).

THE INSECT ASSEMBLAGES

The insect remains in most of the ditch fills were well-preserved with few sclerites showing significant erosion. The exception was the uppermost of the three samples examined from ditch S107 (context [6371], sample {317}) where many of the sclerites were both fragmented and significantly eroded. Remains recovered from cess pit S119 were also poorly preserved.

The insect assemblages and other invertebrate remains recovered from the samples are described below in chronological order by period and area of activity. Proportions of taxa representing selected ecological groups in the fully analysed samples are shown in Figure 1 and lists of taxa recorded from each sample in Table 1.

Period 803 – circa 1500/1569

Ditch S109

This ditch might have originally been dug for drainage, but by the late 16th century it had been backfilled with refuse. Insects from four samples were examined and samples {47} and {25} represented the earliest fills (Group 200). Almost half of the assemblage from sample {47} (context [1036]) consisted of synanthropic beetles that had clearly originated in occupation waste. There was a particularly clear component from within buildings (52 individuals of 19 taxa, 15% of the terrestrial fauna). This group included *Sphodrus leucophthalmus*, a very large exclusively synanthropic ground beetle that occurs in cellars, stables, bakeries, mills and similar buildings, sometimes in company with *Laemostenus terricola* and *Blaps* (Lindroth 1986, 267), both of which were also recorded in this sample. Other species that would have inhabited a similar range of buildings were *Tipnus unicolor* (a spider beetle), two-spotted carpet beetle (*Attagenus pellio*), mealworm beetles (*Tenebrio obscurus* and *T. molitor*), and lesser mealworm beetle (*Alphitobius diaperinus*). Human fleas (*Pulex irritans*) were also identified.

Several other distinctive groups of beetles, in combination with the fauna from buildings, suggest that at least some of the waste may have been stable manure (Kenward and Hall 1997; where 'stable' is used in the broad sense of any building that housed animals). Grain pests could represent fodder, residues of grain within bedding material, or dung (*Sitophilus granarius*, *Oryzaephilus surinamensis* and *Cryptolestes ferrugineus*); 'barn beetles' are found in association with stored hay (*Typhaea stercorea* and *Omonadus floralis*/*formicarius*); *Acritus nigricornis*, *Oxytelus sculptus* and lesser earwigs (*Labia minor*) all exploit open-textured nutrient-rich organic matter; and the hydrophilid beetles *Cercyon terminatus*, *C. unipunctatus*, *C. impressus*, *C. obsoletus*, *C. haemorhoidalis*, *C. nigriceps* and *Cryptopleurum minutum*) are found in foul to very foul matter and dung. Human fleas can be associated with domestic mammals and stables as well as with humans and may occur in large numbers in pig-sties (Smit 1957, 22; George, 2008, 14).

Given the evidence from plant macrofossils for seeds derived from human faeces (Karen Stewart, plant report), it is clear that several types of waste had been dumped into the ditch, some of which were very foul. Beetles associated with foul organic matter accounted for a quarter of the terrestrial fauna: *Platystethus arenarius* was particularly common and the dung beetles *Aphodius granarius* and *A. fimetarius* were both well-represented. *Aphodius* species

in general primarily exploit herbivore dung but both these species commonly exploit decaying plant material or other foul occupation waste (Jessop 1986, 20-25).

Beetle associated with wood, and structural timbers in particular, were fairly common. At least some probably arrived in the deposit with other material from buildings, but rotten timbers might also have been dumped along with other refuse, and all three species are likely to have formed part of the 'background fauna' of an area where old timber buildings and structures were common. The common woodworm beetle (*Anobium punctatum*) was the most numerous of the group. Larvae of powder-post beetle (*Lyctus linearis*) bore in the dry sapwood of hardwoods reducing it to fine powder, while those of death-watch beetle (*Xestobium rufovillosum*) primarily infest oak timbers that have been subject to microbial attack following exposure to damp.

The limited range of taxa from outdoor habitats (i.e. insects unable to live and breed either within buildings or in accumulations of decomposing organic matter) included a small group of water beetles (3% of the whole assemblage), with *Ochthebius* cf *dilatatus* providing a hint of muddy water. Plant-associated insects were similarly poorly represented (3% of terrestrial taxa) but they included *Coreus marginatus* and *Gastrophysa viridis* which are associated with docks (*Rumex*), although adults of *C. marginatus* feed on seeds of diverse plants, including brambles (*Rubus fructicosus* agg.), in the later half of the year. Two species of bark beetles (Scolytinae) were recorded: *Phloeotribus rhododactylus* found on broom (*Cytisus*) and gorse (*Ulex*), and *Hylesinus varius* which occurs primarily on ash (*Fraxinus*). While both may point to trees and shrubs growing close to the ditch, *H. varius* is often found in association with building faunas, probably being brought into houses in infested ash logs used as firewood or emerging from ash timbers used structurally (Carrott and Kenward 2001). Several ground beetles (Carabidae) also provided an indication of local habitats: *Harpalus rufipes* is typical of open, relatively dry places, often on cultivated or waste ground (Luff 1998, 139) and *Pterostichus melanarius* is also favoured by cultivation, while *Paranchus albipes* is typically found at water margins in open sites on almost barren soil (Lindroth 1986, 279).

The insect assemblage from sample {25} from context [708], also from the earliest fills, was very different to that from sample {47} and chiefly indicative of natural habitats. Insects associated with organic occupation waste were very poorly represented. Aquatic beetles and bugs accounted for 24% of the whole assemblage and were typical of a shallow, stagnant, well-vegetated lowland ditch. They included saucer bug (*Ilyocoris cimicoides*), minute water cricket (*Microvelia*), lesser silver water beetle (*Hydrochara caraboides*), *Enochrus testacea*, *Coelostoma orbiculare, Hydraena testacea*, and whirligig beetles (*Gyrinus*). Wet waterside mud was indicated by *Cercyon ustulatus* and two species of *Dryops*.

Vegetation within the ditch would have included fully aquatic, emergent and marginal plants. Beetles indicative of particular species were *Tanysphyrus lemnae* found on duckweed (*Lemna*), *Donacia versicolorea* which occurs on pondweeds (*Potomogeton*), *Notaris acridulus* found on reed sweet-grass (*Glyceria maxima*), and *Donacia marginata* and *D. simplex* both of which are associated with bur-reeds (*Sparganium*). Stands of nettles were

indicated by *Nedyus quadrimaculatus*. Ground beetles were quite common and were mainly characteristic of damp waterside locations. They included *Pterostichus gracilis* found among damp lush vegetation on soft soils or mud (Hyman and Parsons 1992, 148). A bark beetle (*Scolytus*) might perhaps have come from trees growing locally. The few beetles that are regarded as synanthropic included *Leptacinus batychrus* which at the present day is found in dung heaps, and the grain pest *Cryptolestes ferrugineus*.

Sample {420} taken from a secondary fill of the ditch [6640] (Group 201) was very rich in insect remains: a one-litre sub-sample processed specifically for their recovery produced an estimated 569 beetles and bugs. Insects characteristic of organic occupation waste were present in only moderate numbers but they included taxa that had clearly been derived from within buildings (5% of the terrestrial fauna); waste dumping may have been on a limited scale, at least in this location.

Outdoor insects were common indicating very similar conditions and vegetation as the earlier sample {25}. Water beetles (17% of the whole assemblage) were characteristic of shallow, still or slowly flowing, richly vegetated water: *Cymbiodyta marginellus, Coelostoma orbiculare* and *Hygrotus inaequalis* were all well-represented and are typical of such conditions. The lesser silver water beetle (*Hydrochara caraboides*) currently has a very local distribution in Britain but, where it can still be found, it generally breeds in shallow, stagnant, open, fish-free waters with a floating raft of densely matted vegetation at their centre, and areas of shallow, open water with isolated stands of emergent vegetation (Guest 1996; Foster 2010). The occurrence of *Spercheus emarginatus* was of note (see below). In Central Europe it is typically found in lowland ponds with marginal vegetation over mud (Foster 2010, 98). The only 20th century record from Britain was from a marsh drain with much floating duckweed (Forster 1956). Coincidentally, *Tanysphyrus lemnae* which feeds on duckweed (*Lemna*), was especially common in this sample.

The water margins were probably clayey or muddy and richly vegetated, and the habitats and food preferences of some beetles and bugs provided information on particular plants growing within the ditch. *Hebrus* (a tiny aquatic bug) is usually found in waterside moss, and several species were indicative of taller wetland plants: *Notaris acridulus* is primarily associated with reed sweet-grass (*Glyceria maxima*) and *Donacia simplex* usually with bur-reeds (*Sparganium*), while the ground beetles *Odocantha melanura* and *Agonum thoreyi* are often found together on clayey or muddy water margins with a rich vegetation of tall plants, often in floating heaps of dead reeds (Lindroth 1986, 293, 416). The chinchbug (*Ischnodemus sabuleti*) and *Coccidula rufa* (a spotless ladybird) are also typically found among such wetland vegetation, the ladybird commonly feeding on aphids on rushes (*Juncus*) (Majerus 1994, 142). A range of insects found on nettles (*Urtica*) indicated that stands grew within or very close to the ditch (*Heterogaster urticae*, *Brachypterus*, *Nedyus quadrimaculatus*, *Taenapion urticarium*, and shed skins of *Trioza urticae* nymphs).

Disturbed or cultivated ground probably existed close to the ditch and a group of insects that feed on wild and cultivated Brassicaceae was particularly well-represented (*Phyllotreta* spp.,

Ceutorhynchus contractus, *C. pallidactylus*, other *Ceutorhychus* spp., and probably three species of *Meligethes* which feed on brassicas at the larval stage). The ground beetles *Pterostichus melanarius* and *Harpalus rufipes* are found in a variety of habitats but both are especially favoured by cultivation (Luff 2007, 113, 151). Other plants were indicated by *Chaetocnema concinna*/*picipes* found on knotweeds (Polygonaceae) including *Polygonum* and docks (*Rumex*), *Oxystoma* found on vetches (*Lathyrus and Vicia*), and *Sitona* which feed on various leguminous plants (Fabaceae). *Bruchus* cf *rufimanus* is also associated with legumes, the larvae developing in species with large and medium-sized seeds, particularly in field beans (*Vicia faba*). The species is frequently found in archaeological cess deposits, having been consumed in infested pulses and subsequently voided in faeces, and this record may therefore tie in with the limited evidence of food plants in this deposit (Karen Stewart, plant report). No pulses were identified among the plant assemblage but this is not unusual in waterlogged deposits since legume seeds that are neither charred nor mineralised do not preserve well (e.g. Allison and Hall 2001; Carruthers and Allison 2015). The occurrence of three species of bark beetles may suggest trees or shrubs growing close to the ditch but *Hylesinus varius* (the ash bark beetle) in particular might instead be associated with the fauna from buildings. *Scolytus rugulosus* is usually associated with woody Rosaceae.

Sample {44} from later fill [1034] (Group 219) was dominated by synanthropes, with a large component from within houses or other buildings (45% of the terrestrial fauna). *Tipnus unicolor*, by far the most numerous beetle in the assemblage with 76 individuals, is strongly synanthropic and rare in natural habitats although it has sometimes been recorded from birds' nests (e.g. Hinton 1941; Linsley 1944, Palm 1959). In reviewing its archaeological occurrence, Kenward (2009, 308-310) concluded that that it is generally a good indicator of long-lived high status buildings, with numbers appearing to increase in proportion with general cleanliness. It is often particularly well-represented in post-medieval domestic assemblages. Other synanthropic species included the yellow mealworm beetle (*Tenebrio molitor*), two-spotted carpet beetle (*Attagenus pellio*) and bacon beetle (*Dermestes lardarius*). Bacon beetle, as its common name suggests, can become a nuisance in butcher's shops and premises where meat is stored, and carpet beetle larvae feed primarily on wool, fur and skins, but both species can become household and warehouse pests feeding on a wide range of materials of animal origin (Peacock 1993, 49-53).

Woodworm (*Anobium punctatum*), powder post (*Lyctus linearis)* and deathwatch (*Xestobium rufovillosum*) beetles, and *Pseudophloeophagus aeneopiceus,* a weevil that lives in rotten wood, all probably infested structural timber. *Mycetaea subterranea* is strongly synanthropic and would also have lived within buildings. Modern records are mainly from decaying straw and wood in dry cellars, barns and stables and in association with the dry rot fungus *Merulius lacrymans* (Hinton 1945, Palm 1959). Given the abundance of taxa associated with houses and buildings in this assemblage and the limited range of outdoor insects, the bark beetle *Hylesinus varius* probably originated in firewood rather than a living ash tree.

Remains of fleas were common, the majority being of human flea, but dog fleas (*Ctenocephalides canis*) and cat fleas (*C. felis*) were also present. Dogs and foxes are the

principal hosts of the dog flea, but they occur on cats when dogs and cats live in close proximity, while cat fleas feed on both cats and dogs and will readily bite humans (Whitaker, 2007, 32-34). The presence of cat fleas is of particularly interest here since they appear to be favoured by warm and dry conditions (George 2008, 17) adding to evidence for waste from domestic or similar buildings that may have been heated. Teasel (*Dipsacus*) seeds were particularly abundant in this sample (Karen Stewart plant report) and combined with the abundant house fauna this plausibly suggests that at least some of the waste that entered the ditch was from dwellings or workshops associated with textile production.

Outdoor insects were poorly represented and aquatic beetles were scarce (1% of the whole assemblage). Plant-associated taxa included *Coreus marginatus* whose larvae develop on docks, *Chaetocnema concinna*/*picipes* which feed on Chenopodiaceae (knotweeds) including *Polygonum* and docks, *Ceratapion carduorum* found on thistles (*Cirsium* and *Carduus*), and *Hydrothassa* found on Ranunculaceae. *Chaetocnema arida* group is associated with various grasses, sedges and rushes.

Summary of results from ditch S109

Aquatic conditions and the local environment
Aquatic insects were well represented in two deposits ([708] and [6640], samples {25} and {420}), the range of water beetles and bugs indicating shallow, still to slowly flowing water and a rich vegetation of aquatic and emergent plants. Whirligig beetles (*Gyrinus*) may have been a noticeable presence in parts of the ditch because of their habit of swimming rapidly in a seemingly random gyratory fashion on the water surface. The low proportions of aquatic insects in the other deposits probably indicate that the fills in those locations consisted largely of occupation waste since, with the exception of the lowest sample, water flea (Cladocera) ephippia and ostracods were common or abundant throughout the sequence. Ephippia are resting eggs that can survive drying and other adverse conditions and their presence in a deposit does not necessarily indicate permanent water. However, the good preservation of the insects remains, which are particularly prone to damage due to drying of deposits, in all the samples from this feature, suggests that standing water was present for much of the time, and that the deposits generally remained wet even if there were fluctuations in water level.

Samples {25} and {420} provided the best, and very similar, evidence for natural habitats and vegetation which accords well with the plant remains from the same samples. The water margins were probably clayey or muddy and richly vegetated. The food preferences of particular species indicate that plants included pondweed (*Potamogeton*), duckweed (*Lemna*), moss, and taller vegetation such as reed sweet-grass (*Glyceria maxima*) and bur-reeds (*Sparganium*). Insects found on nettles (*Urtica*) and docks (*Rumex*) indicated that both plants grew within or very close to the ditch. Land around the ditch was probably rather open, with some disturbed and/or cultivated ground. There were hints in some assemblages for the presence of trees and shrubs, perhaps including ash (*Fraxinus*), woody Rosaceae, and gorse (*Ulex*) or broom (*Cytisus*). The evidence for this was somewhat equivocal however, particularly in the case of *Hylesinus varius* (the ash bark beetle), since on urban

archaeological sites it commonly appears in association with a house fauna probably due to importation of infested logs as firewood.

Refuse disposal
It is clear from both insect and plant remains that a variety of waste material was deposited in the ditch. The contrast between the insect assemblages dominated by synanthropes indicating waste dumping, and those where insects from natural habitats were more abundant, suggests that dumping activity occurred to a greater extent in some parts of the ditch than others, and probably varied throughout the time the sequence of fills accumulated. The difference between the insect assemblages from samples {25} and {47} was particularly striking since both represent the earliest fills.

Insects from three of the four samples provided good evidence for the disposal of waste from within buildings, most abundantly in contexts [1036] and [1034] (samples {47} and {44}). Distinguishing the types of buildings that waste might have come from is often not possible: from a beetle's point of view human dwellings, particularly if floors were strewn with cut vegetation or other organic litter, may have included many of the same habitats as stables. A number of characteristic indicator groups for the presence of stable manure and foul organic matter were particularly abundant in sample {47} however, and the same groups were represented in lesser amounts in two other samples. The combination of insect and plant evidence from sample {44} was particularly suggestive of floor litter from a relatively dry and warm house or workshop where textiles were being processed. It therefore seems likely that waste, litter or sweepings from various buildings regularly entered the ditch, but stable waste because of its bulk probably formed a large part of this. Stables, it is stressed, would include any buildings where animals were housed. The large amounts of waste produced would have presented a particular problem for disposal in an urban environment.

Remains of food plants and cereal bran are likely to have come from human faeces or animal dung, and grain pests may well have been a component in dung of cereal-fed animals and stable manure, or perhaps in human faeces. Occasional bean weevils (*Bruchus* cf *rufimanus*) may have originated in human faeces having been consumed in infested pulses.

Ditch S107

Three samples were examined: two from the primary fills (sampled in separate slots), and the third representing disuse. The assemblage from sample {319} representing primary fill [6397] (Group 232) was recorded by scanning. Insects characteristically associated with human occupation and activities were present, including a distinctive house or building fauna. High numbers of flax seeds in this sample may be a result of waste deposition, perhaps coming from buildings where flax or linen processing was taking place (the evidence from plant remains alone was equivocal; Karen Stewart, plant report). There was also a sizeable component from natural habitats, the latter indicating shallow well-vegetated water in the ditch. There was probably waterside moss and wet litter at the water's edge, while *Notaris*

acridulus and *Prasocuris phellandrii* suggest that plants included *Glyceria* and waterside Ranunculaceae perhaps including marsh marigold (*Caltha palustris*). Occasional statoblasts (resting eggs) of the bryozoan *Lophopus crystallinus* suggested a slight current.

Sample {404} was also from a primary fill ([8236], Group 232) but it contained a much higher proportion of insects associated with decomposing organic matter. Almost three-quarters of the insect assemblage belonged to this group, the majority clearly indicating the presence of occupation waste. A distinctive fauna from within buildings (14% of terrestrial insects) included spider beetles (*Tipnus unicolor* and *Ptinus*), *Sphodrus leucopthalmus*, *Blaps, Attagenus pellio*, and fleas of humans, dogs and cats. Although various buildings might have contributed waste, a large group of beetles were present that appear to be especially characteristic of man-made accumulations of foul, open-textured matter with an ammoniacal smell – the typical decomposer element in archaeological stable manure (Carrott and Kenward 2001; Kenward and Hall 1997). This group included *Acritus nigricornis*, *Oxytelus sculptus*, *Cryptopleurum minutum*, various *Cercyon* species associated with foul matter and dung, and several *Monotoma* species. 'Barn beetles (*Typhaea stercorea* and *Anthicus floralis*/*formicarius*) and grain pests were also recorded. Cereal bran, found in the dung of corn-fed animals, was not recorded from this sample (Karen Stewart plant report) but the diet of some domestic animals need not have included a high amount of cereals.

A group of beetles that at the present day are typical of compost heaps and dung heaps were common (e.g. *Phacophallus parumpunctatus*, *Leptacinus batychrus*, *L. pusillus*, *Gauropterus fulgidus* and lesser earwig (*Labia minor*). This might suggest that stable manure, perhaps with other litter and waste, was initially accumulated in middens before eventual disposal in the ditch. *Aphodius granarius* was abundant; this dung beetle is one of the most commonly occurring *Aphodius* in urban archaeological contexts and it was probably a common element in the background fauna of an area where dung and other foul waste was common.

Trox scaber, a hide beetle, was recorded in notable numbers (if present elsewhere it was only as single individuals). It is rare at the present day, usually occurring in birds' nests especially where bones or dried animal matter are present (Jessop 1986, 14). It is regularly recorded from urban archaeological sites, however, where it appears to be especially associated with the floors of ancient buildings, which presumably provided a comparable habitat. In some cases there appears to be a connection with the working and tanning of skins, leather working or horn processing and it is certainly possible that some of the litter deposited in the ditch came from workshops connected with some of these craft activities. Another possibility is that dumped material may have included tanning waste. Incidences where *Trox* has been found in association with tree bark and where a connection to the tanning process and tanning waste has been identified have been summarized by Hall and Kenward (2011). Wood fragments were common in this sample (Karen Stewart, plant report) but may simply have come from discarded timber. The same range of timber-infesting beetles seen in other samples containing occupation waste was recorded (*Anobium punctatum*, *Xestobium rufovillosum*, *Lyctus linearis*, *Pseudophloeophagus aeneopiceus*).

Although relative numbers of aquatics and other outdoor insects were limited, some nevertheless provided an indication of conditions within or close to the ditch. *Hygrotus inaequalis* suggested shallow, permanent, vegetated water, and occasional statoblasts (resting eggs) of *Lophopus crystallinus* a slight current. Various plant-associated beetles were indicative of duckweed and other marginal or emergent plants: *Prasocuris phellandrii* is associated with marsh marigold (*Caltha palustris*) and other waterside Ranunculaceae, *Notaris* ?*acridulus* with reed sweet-grass (*Glyceria maxima*) and *Phaedon tumidulus* generally with umbellifers. A range of insects found on nettles indicated that stands probably grew within the ditch or very close by (*Heterogaster urticae*, *Trioza urticae* nymph, *Taenapion urticarium*, *Nedyus quadrimaculatus*). Grassy and weedy vegetation also appears to have existed, probably on drier ground: the ground beetles *Harpalus rufipes* and *H. affinis* are suggestive of relatively dry open soils, *Malvapion malvae* is found on mallows, especially common mallow (*Malva sylvestris*), *Ceutorhynchus* species on wild and cultivated Brassicaeae, and *Neocrepidodera ferruginea*, *Sitona,* and *Mecinus pascuorum* are typical grassland species, the last species being found on ribwort plantain (*Plantago lanceolata*).

Sample {317} came from later fill [6376] (Group 233). Insect remains were moderately to poorly preserved with significant erosion and reddening of many sclerites. The assemblage was recorded by scanning. Small numbers of *Daphnia magna* group (a water flea) suggested the presence of water in the ditch for at least some of time but the only aquatic beetle was *Tanysphyrus lemnae* found on duckweed (*Lemna*). The majority of taxa were typical of accumulations of rather foul decaying organic material with *Oxytelus sculptus* and *Cercyon nigriceps* among the commoner species identified. *Tipnus uniolcor* and *Blaps,* both typical members of a building fauna, and the grain pests *Sitophilus granarius* and *Oryzaephilus surinamensis* were also recorded. All of these suggest some input of material from within buildings, possibly stables.

Summary of results from ditch S107

Aquatic conditions and the local environment
The earliest sample from this ditch provided evidence for shallow well-vegetated water with duckweed (*Lemna*). Occasional statoblasts of the bryozoan (*Lophopus cristallina*) were recorded in the lower two samples. These obscure creatures form small colonies on aquatic plants or on debris. They are rare throughout Europe at the present day but appear to have been more common in the past. They rely on a slight current to deliver nutrients. They are associated with naturally eutrophic waters and are tolerant of some pollution unless it reaches a level that affects the growth of aquatic plants to which they anchor themselves (Pond Conservation website). Various plant-associated beetles were indicative of marginal or emergent plants such as reed sweet-grass, umbellifers and Ranunculaceae. Nettles would have grown either within the ditch or very close by, and there was probably grassy and weedy vegetation on drier ground. The poor condition of insect material in the uppermost sample suggests that partial drying of the upper fills may have taken place, perhaps seasonally.

Refuse disposal

All of the three samples examined contained insects typical of accumulations of organic matter and litter/sweeping from within buildings, being most abundant in sample {404} from an early fill. Waste disposal may have been at a lower level in the similarly dated fill revealed in a separate slot (sample {319}), but there were indications that it included litter from a house or workshop where flax and/or textiles were being processed. Waste from buildings that housed domestic animals was probably represented in both of the other samples. Cereal bran, which can be found in the dung of corn-fed animals, was not recorded (Karen Stewart plant report), but the diet of some domestic animals need not have included a high amount of cereals.

Period 10: 1 March 1739 – July 1823

Cesspit S119

Two samples were recorded by scanning. Sample {304} from the primary fill [3849] (Group G5167) produced a small, moderately to poorly preserved beetle assemblage. No fly puparia were noted. Several taxa were represented only by small elytral fragments. All of the remains showed significant degrees of erosion, with various degrees of colour loss. This suggests that anoxia was incomplete in the deposit for at least some of the time, and there may consequently have been loss of some more delicate forms of organic material. Most of the taxa recorded are typical members of a house or building fauna suggesting that litter or sweepings from within a building had been added to the pit, perhaps to help dampen smells.

Sample {301} came from secondary fill [3704] (Group 5168). A somewhat larger but more poorly preserved insect assemblage was recovered. Occasional fragments of large fly puparia were noted together with mineralised pupae of a smaller fly. The latter would originally have been contained within puparia suggesting they preserved poorly in these deposits. Woodworm beetle was the most common beetle and, as with the earlier fill, most other taxa were typical of a house or building fauna, bread beetle (*Stegobium paniceum*), spider beetles (*Ptinus*), saw-toothed grain beetle (*Oryzaephilus surinamensis*), and *Nausibius clavicornis* all being associated with stored products.

Summary Period 10

The poor preservation of the insect assemblages in the two samples from cesspit S119 suggests that some remains, including fly puparia and possibly some categories of plant material, may have been lost from the archaeological record. The chief implication of the insect assemblages was for the disposal of litter or sweepings from a house/building where foodstuffs were stored. *Nausibius clavicornis* is a New World species that may have originally become associated with stored products in the Caribbean. It is found in various dry foodstuffs including sugar and is now established throughout the world (Halstead 1993).

Notable insect taxa

Spercheus emarginatus
This aquatic beetle is now thought to be extinct in the British Isles. The only 20th century record is from Suffolk in the 1950s, a site described as a marsh drain with much floating duckweed (Forster 1956). Foster (2010, 98) considered that the 'loss of fenland habitats, in particular the Cambridgeshire Fens and the built-up areas around and in London, have contributed to the loss of this species'. Two individuals were recorded from sample {420} and the abundance of *Tanysphyrus lemnae* which feeds on duckweed, was notable in the same sample.

Hydrochara caraboides
The lesser silver water beetle is currently very locally distributed in Britain, but was formerly more widespread. At present it is found only in the Somerset Levels and a few localities in Cheshire and North-East Wales and its status is Near Threatened (Foster 2010, 66-67). It was present in samples {420} and {25}, and also recorded from similarly dated deposits in the moat of a late medieval and Tudor mansion at Stepney Green (Allison ?forthcoming).

Sphodrus leucophthalmus
This very large ground beetle is an exclusive synanthrope, occurring in cellars, stables, bakeries, mills and similar buildings, usually in urban areas (Lindroth 1986, 267). It appears to prey on *Blaps* larvae, and both *Sphodrus* and *Blaps* occurred in the same samples here (samples {47} and {404}). It became increasingly rare during the 20th century, undoubtedly due to improved hygenic conditions within buildings, and has not been recorded in Britain since 1979 (Duff 2012b, 199).

Ctenocephalides felis (cat flea)
Cat fleas (*Ctenocephalides felis*) were identified from samples ({44} and {404}) from ditch S109, the fills of which accumulated in the 16th century. The cat flea is currently regarded as the most important ectoparasite of cats and dogs worldwide (Rust and Dryden 1997), and it is by far the most numerous flea in domestic situations throughout Britain. Archaeological records are rare however, and these appear to be the earliest. The lack of records might possibly be due in part to its similarity to the dog flea (*Ctenocephalides canis*), and perhaps may also reflect the general attitude towards cats up to the late medieval period (being useful for their rodent catching abilities rather than as household companions). There might also be a connection with conditions within human dwellings since they appear to be favoured by the warm and dry conditions prevalent in modern homes (George 2008, 17). Cat fleas have previously been identified from 18th century deposits elsewhere in London (Girling 1984), and there are earlier records from two French sites dating to the 13th century (Yvinec *et al*. 2000). In Egypt they have been recorded from deposits dating to the second millennium BC from Egypt (Panagiotakopolu 2004).

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Figure 1. XSM10 Ditches S107 & S109: proportions of insect taxa representing different ecological groups. Proportions of aquatics have been calculated as percentages of the whole assemblage, the remaining groups as percentages of terrestrial taxa. Some taxa belong to more than one group