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Caught in a trap: Landscape and climate implications of the insect fauna from a Roman well in
Sherwood Forest

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Abstract

Sherwood Forest in Nottinghamshire is often considered a well preserved ancient landscape, subsequently having survived by way of centuries of management as a hunting preserve. Archaeological evidence suggests otherwise, with an enclosed landscape beginning in the pre-Roman Iron Age and continuing through the Roman period. Due to the nature of the region's soils, however, there is little empirical, palaeoecological evidence on its environmental history prior to the medieval period. This paper presents an insect fauna from a Roman well in a small enclosure in north Nottinghamshire, on the edge of Sherwood Forest, and its interpretation in terms of contemporary land use. Wells and small pools act as large pitfall traps and may effectively sample aspects of the local and regional insect fauna. The Wild Goose Cottage fauna and its environmental implications are also compared with a number of archaeologically and geographically similar contexts.

Keywords: Roman; Insects; Well; Wood pasture; Sherwood Forest; Landscape Change.

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Introduction

Setting aside myth, Sherwood Forest in Nottinghamshire is best known for its old oaks (Rotherham 2013) and 'old forest' insect fauna (Alexander 2011), both indicators of former wood pasture. The survival of both reflects not only its medieval status as a royal hunting preserve and its poor soils but also habitat continuity extending much further back. This narrative is, however, problematic in the light of archaeological evidence. The aerial surveys of North Nottinghamshire and South Yorkshire carried out by Derrick Riley in the 1970s fundamentally altered preconceived images of a prehistoric landscape of thinly populated heath and woodland to one of large, ditched rectangular fields and associated small settlements, extending over most of the area of the medieval forests of Sherwood and Hatfield Chase and continuing northwards beyond the river Don (Riley 1980; Roberts 2010), indicating an extensive and intensively managed landscape. Subsequent excavations have shown these systems to have evolved over several hundred years from the Late Iron Age into the Roman period (Garton 1987; 2008; Chadwick 1995; 2010; Jones 2007). The well-drained acid soils of the Triassic and overlying sand and gravel deposits, however, provide few localities where plant and animal remains are well preserved and there has been limited palaeoecological research (Monckton 2006). The site near Wild Goose Cottage in Lound parish, north Nottinghamshire, was located from the air by Riley in the 1970s (Riley 1980) and destroyed by gravel extraction in 1992. Within the small subrectangular enclosure, a timber-lined well (Garton & Salisbury 1995) provides one of the few sources of palaeoecological information contemporary with the Roman landscape.

Location

The Wild Goose Cottage site lay on a slight promontory on the west side of the river Idle floodplain at 7.0m O.D. (fig. 1; National Grid Ref. SK703874; Lat. 53° 22' 43.6" N, Long. 000° 56' 40.8" W). The substrate consists of cryoturbated sands and gravels (Smith & Goossens 1973), which further north Gaunt and others (1972) have shown to be partly of interglacial origin, mapped as the Older River Gravel (Gaunt 1994), and to the west, of earlier fluvio-glacial origin, although the boundary between these two units may be unclear. To the north and east the site is flanked by Late Holocene alluvium, deposited by the Idle and a tributary stream. It is probable that the floodplain topography contemporary with the site has been masked by Roman and later alluviation (Buckland & Sadler 1985). North-westwards below the till capped Blaco Hill, the Permo-Triassic Sherwood Sandstone provides the surface outcrop and this, with the similarly well drained sands and gravels, is particularly responsive to site detection through aerial photography (Riley 1980). Riley's detailed photography and mapping, recently updated by Roberts (2010), shows that much of the sandstone and sand and gravel Drift outcrop has a system of large rectangular fields, oblique to the modern boundaries, within which more complex smaller enclosures occur. The relationship between the latter, which sometimes include evidence of circular huts, and the larger fields is often obscure, and the dating evidence is disputed, vacillating between those who believe all things rectangular must be Roman (e.g. Branigan 1989) and those who accept the field evidence with Roman structures, both roads and military, cutting across the field systems indicating an earlier origin (Roberts 2010). At Wild Goose Cottage the relationship between the brickwork pattern of fields and enclosure is uncertain since the two cannot be directly related. Despite this, the photographs of the site are

particularly clear, (Fig. 2), and Garton and Salisbury (1995) provide a detailed interpretation. In summary, a subrectangular enclosure, approximately 60 m by 40 m, defined by a large ditch with slight traces of a possible entrance to the east facing onto the river floodplain, contains a circular drip channel, 12 m in diameter, presumably around a hut, in the north-west corner (Fig. 3). It is uncertain what the relationship is between the enclosure and the plethora of other cropmarks, although the two U-shaped ditches to the west and proximate to it appear to define related compounds, whilst the lighter, presumably shallower linear features seem at least in part to be later. The well shows as a dark grey dot to the south of the circular drip channel.

The well

All trace of the enclosure and associated features was effectively destroyed in the gravel extraction process, where over two metres of 'overburden', consisting of the more clayey sand and gravel component, were cleared from the site before mining. The truncated wood lining of the well was noticed during this operation. This consisted of a square, planked box frame, roughly one metre across, which had been set into the north-west corner of a larger construction pit (fig. 4). The tightly constructed lining was of oak planks, jointed with both mortice and tenon and half-lap joints, held in place by a combination of iron nails and dowels (Garton & Salisbury 1995); it survived to a basal depth of 1.9m. A horse skull, pushed down the back of the lining, had been used to render the lining vertical, although there had been some subsequent distortion. The infilling could be divided into three units, a basal 0.6m of grey slightly organic sand with some wood fragments [12A], a middle layer of grey sandy silt with large stones, including a topstone of a Millstone Grit beehive quern, twigs and other organic debris [12B] and an upper layer [12C] of light grey sand. The upper two units probably represent the deliberate backfilling of the well after abandonment, but the interface between 12A and 12B was marked by a darker, much more organic layer with more wood fragments and this probably accumulated whilst the well was in use. This layer was sampled separately and processed for insect remains.

It is unfortunate that the pottery which can be clearly associated with the use of the well, the large bowls and narrow-necked jar, belongs to forms which have a long currency in the local Lincolnshire and South Yorkshire manufactories (cf. Buckland *et al.* 1980; Darling & Precious 2013). The presence of sherds from a Dales Ware jar in the construction pit indicates a date after AD 200, although the type remained current throughout the third century (Loughlin 1977); in Doncaster the form is replaced by similar vessels with a 'double lid-seat' by the middle of the fourth century (Buckland & Magilton 1985). Straight-sided flanged bowls, of which one was recovered from the same context, emerge about the same time, and continue to be produced until the end of local pottery production. In the filling of the well, the segmental flanged bowl with white painted triangles on the rim can be paralleled amongst the material produced at the Goodison Boulevard group of kilns at Cantley, dated by Buckland and Magilton (2005) to the early fourth century, whilst the inturned flanged rim fits better with the later fourth century Swanpool products (Webster & Booth 1947; Darling & Precious 2013), as do the large bowls with S-shaped profile, a rare form in the South Yorkshire potteries. In such a small, largely task specific assemblage one cannot argue from absences, the paucity of colour-coated vessels for example, and the best estimate would be for an early fourth century date for abandonment of the well.

The Insect fauna

A subsample of one litre of the more evidently organic material (12A/B) was disaggregated over a 300µm sieve. This was found to be so rich in insect remains that paraffin (kerosene) flotation (cf. Coope & Osborne 1968) was deemed unnecessary and all the material retained on the sieve was sorted. Insects, represented by individual sclerites, were picked out under a low power binocular microscope and stored in 70% ethanol. Identification was achieved by use of reference material in Doncaster Museum and relevant entomological keys. Table 1 lists the minimum number of individuals (mni) of the taxa found; taxonomy for Coleoptera follows Böhme (2005), Diptera (Chandler 1998), Hemiptera (www.britishbugs.org.uk) and other groups as entered in the BugsCEP database (www.bugscep.com; Buckland & Buckland 2006). A total of 821 individuals (mni) representing 211 taxa were recovered, of which 618 individuals and 163 species could be identified to species or species group level.

As Kenward (in Hall et al. 1980) notes, the interpretation of faunas from wells presents considerable taphonomic problems. As well as a fauna which is essentially subterranean, resident in the shaft and in the surrounding soil, it is difficult to differentiate between individuals which have fallen incidentally into the shaft and those which were introduced in other materials which were either deliberately or accidentally thrown into the well. The paucity of well-preserved large, essentially ground living carabids and silphids, however, suggests that there was some barrier around the well which mitigated against it acting principally as a large pitfall trap for the terrestrial fauna. The soil fauna in the Wild Goose Cottage assemblage includes the carabid *Clivina collaris*, which prefers damp, humus- rich soils (Lindroth 1985), the two species of *Rhizophagus* and the now very rare subterranean weevil, *Procas armillatus*. *Rhizophagus parallellocollis*, sometimes called the coffin beetle, is a predator in situations where there are numerous flies breeding, hence its association with corpses (Panagiotakopulu & Buckland 2012), although in association with its congener *R. perforatus*, it is more likely to occur in compost and decaying plant debris (Johnson 1963), and there is therefore some overlap with the extensive community of coprophilous and manure inhabiting species which occur in the well deposit. Most British specimens of the weevil *P. armillatus* are from a single locality in grazed Chalk grassland near Brighton, taken in 1930 (Hyman 1992), but Carr (1916) notes a specimen taken by sweeping along a dry, sandy hedge bank at Edwinstowe in Nottinghamshire. Whilst these records are from dry well-drained localities, on the continent, Koch (1992) notes it from damp places, on floodplains and woodland margins. Morris (2002) suggests an association with fumitory, *Fumaria* sp., for the adult weevil but the larvae are probably root feeders (Duff 1993) on dry soils and since it is fully winged (Jennings 1906), its presence in the well is probably incidental.

Despite the proximity of the Idle, only some 500m to the east, there is limited evidence for either the river or its floodplain. Of the water beetles, individuals of both *Agabus bipustulatus* and *Ilybius ater* could have either flown to light, or with *Anacaena globulus*, *Helophorus* and *Ochthebius* spp., been attracted to ephemeral pools or water troughs around the wellhead. Some suggestion of wet grassland is provided by *Corylophus crassidoides* and *Orthoperus brunripes*, both of which are found in mouldering vegetation on wet ground. Of the phytophages (Table 2), only *Prasocuris phellandrii* feeds on wetland plants, usually on the marsh marigold, *Caltha palustris*, although the adult can be found on a range of other fen and wet grassland plants (Cox 2007). The phalacrid *Stilbus testaceus*, which feeds on smut fungi on grasses, also prefers damp locations, as does the chrysomelid *Gastrophysa viridula*, feeding largely on broad-leaved docks (Koch 1989). The bug *Conomelus anceps* breeds in the stems of the soft rush, *Juncus effusus*. The paucity of aquatic and obligate wetland

species is surprising but, as the form of the present floodplain probably did not develop until the post-Roman period (cf. Buckland & Sadler 1985), one should perhaps envisage damp pasture extending from settlement to river on the east and south side, and drier sandy pastures to the west, a suitable habitat for the species of *Harpalus* and *Ophonus*, and *Calathus*, and several other ground beetles. The most frequent harpaline, *Pseudoophonus rufipes*, is common on dry arable soils (Luff 1998) and might hint at some cultivation, although it is equally common in rough pasture (Lazenby 2011). The dominant species of *Amara*, *A. bifrons* and *A. tibialis*, were also used by Robinson (1981) to suggest tentatively arable cultivation, although most of the published sources (e.g. Koch 1989; Luff 1998) are more circumspect, noting an association with dry sandy, often disturbed soils. There is also a clear preservation bias in the material, particularly of the carabids, in that species of *Pseudoophonus*, *Harpalus* and *Ophonus* are uniformly more eroded than most of the other carabids indicating that they were probably introduced to the deposit in other material, perhaps herbivore faeces or plant litter, rather than by being trapped in the large pitfall provided by the well; some of the weevils show a similar dichotomy in preservation.

A farmyard flora is indicated by several species. Nettles, the host of the pollen beetles of the genus *Brachypterus*, and the weevils, *Taeniapion urticarium*, *Parethelcus pollinarius* and *Nedys quadrimaculatus* (Davis 1983), would have benefitted from the nutrient-rich corners of the enclosure and docks and other weed species would also thrive in the environs of the farm. The small weevil *Ceutorhynchus erysimi* feeds on the common ruderal weed *Capsella bursapastoris*, shepherd's purse; its congener *C. floralis* is more catholic in its taste amongst the Brassicaceae, although again it is common on shepherd's purse (Koch 1992). Clover and vetches, the host plants of several of the weevils (Table 2) are likely to have grown in adjacent pasture, where mallow, *Malva* spp., on which *Aspidapion aeneum* feeds (Morris 1990), and bitter sweet, *Solanum dulcamara*, the usual host of *Epitrix pubescens* (Cox 2007) could grow on the margins. Common fumitory, the usual host of the weevil *Sirocalodes nigrinus* (Morris 2008) and perhaps also *P. armillatus* (Morris 2002), is also characteristic of disturbed ground, including arable fields.

What is immediately apparent from the list, despite the presence of twigs and seeds of *Alnus glutinosa* in the sample matrix, is the paucity of woodland and obligate wetland components. Only one bark beetle, *Leperisinus fraxini*, as its name suggests breeding beneath the bark of ash, *Fraxinus excelsior*, occurs. This is widespread both in flight and attacking ash trees at the present day (Alexander 2002), and its incidental presence in the well is not surprising. Of the anobiids, the furniture beetle or woodworm, *Anobium punctatum* breeds in dry deciduous and coniferous wood, but is inseparable on the fossils from the rare *A. inexpectatum*, breeding in ivy stems (Alexander 2002). *Grynobius planus* occurs in dry timber of a range of deciduous trees, and *Hedobia imperialis* is similarly eclectic in its tastes, breeding in hedgerow and parkland trees, as well as hawthorn and rose stems (Hyman 1992). Although any could have been introduced in timber for structural use, the assemblage may hint at the presence of wood pasture.

In terms of the evidence for the nature of the farm, the dominance of species associated with herbivore dung is apparent in the diverse fauna of flies, scarabaeids and terrestrial hydrophilids, which with coprophilous histerids and staphylinids, account for more than 34% of the fauna, more than three times the figure which Smith *et al.* (2010) use to indicate large herds of herbivores. The assemblage is dominated by *Oxyomus sylvestris* (mni = 48), a species more associated with dung heaps, manure and rotting plant debris than fresh excrement (Jessop 1986). This is a habitat which it

shares with the histerid *Onthophilus striatus*, also present in some numbers (mni = 23). The diversity of species of *Geotrupes* (3 species) and *Aphodius* (at least 9 species) clearly indicates the presence of stock, and it is unfortunate that dung beetles tend to be more specific to the place where the dung is deposited than the source animal (cf. Landin 1961).

The Diptera, represented by puparia, rather than adults, similarly indicate the presence of accumulations of dung, perhaps collected for use as manure, the few occurrences in the well being accidental. Both *Hydrotaea dentipes* and the biting stable fly *Stomoxys calcitrans* are essentially synanthropic, requiring the artificial heat created by decomposition in byres, stables and manure heaps to maintain breeding populations (Skidmore 2010). Whilst essentially marine littoral at the present day, developing in strandline heaps of decaying seaweed, *Thoracocheata zosterae* was apparently widespread inland in accumulations of foul materials from the Roman period into the post-medieval period (cf. Skidmore 1999; Webb et al. 1998); improved hygiene has removed its inland populations. Also associated with the fouler end of the habitat spectrum is *Telomerina flavipes* noted as breeding in corpses (Arnaldos et al. 2014), as well as dog and horse dung and cow manure (Skidmore 2010). The similarity of the assemblage of Dipterous puparia to those described from Roman and medieval Leicester by Skidmore (1999) raises the possibility that, with elements of the Coleoptera associated with foul conditions, part of the fossil fauna reflects a true thanatocoenosis associated with a final phase of use of an abandoned well as a cess pit before its final infilling.

There are further taphonomic problems in using the well assemblage to examine land use. Part of this reflects the fact that the well did not accumulate a random sample of surrounding environments but is probably heavily biased towards immediate farmyard environments. There are few elaterids, click beetles, in the sample but both *Agrypnus murinus* and *Agriotes obscurus* are essentially grassland species, preferring light sandy soils (Skidmore, in Buckland & Buckland 2006). The scarabaeid *Phyllopertha horticola* may be a significant pest in old pasture, again particularly on sandy soils. Despite the more recent taphonomic studies by Smith and others (e.g. Smith *et al.* 2010; 2014; Kenward & Tipper 2008), there has been limited progress since Robinson (1983), based upon comparison of fossil assemblages with pitfall and sweep net results from sites around Oxford, indicated that pastoral to arable ratios were not yet possible from coleopteran assemblages. On balance, however, the Wild Goose Cottage fauna would imply a mixed farming economy, rather than specialist breeding of stock (*contra* Branigan 1989).

The last point is further emphasised by the nature of the synanthropic elements in the fauna. The absence of obligate synanthropes, species which rely on man-made habitats, in particular the fauna of stored grain, probably reflects the status of the site. As Smith and Kenward (2011) note, in the Roman period, this fauna, essentially the triumvirate of *Oryzaephilus surinamensis*, *Cryptolestes ferrugineus* and the grain weevil *Sitophilus granarius*, is restricted to sites, including villas as well as urban centres and forts, having a storage and redistributive functions. The ubiquity of elements of this fauna on these sites implies that Wild Goose Cottage was not part of this network. Another element which appears poorly developed at the site is that associated with storage of hay or other fodder crop. Although the image is inevitably much sharper because of the more limited nature of

the faunas, both modern and fossil assemblages from the purely pastoral farms of the North Atlantic islands are dominated by species associated with stored hay (Buckland *et al.* 1991). Much of this fauna would find suitable environments in other accumulations of decaying plant debris around a farm, and in this more southerly location more natural habitats would be available to them, but notable are the relatively low numbers of cryptophagids and latridiids and the presence of only a single specimen of *Typhaea stercorea*. The evidence, however, is inconclusive and the contiguous enclosures to the south of the main site containing the well may have contained hay ricks invisible in the palaeoecological record. Whilst Jones (1987) has tentatively suggested fodder or at least bedding for animals from the limited charred flora at Dunston's Clump, it should be noted that an extensive pastoral system, utilising an ordered pattern of grazing moving between the large ditched fields evident on Riley's (1978) aerial photographs, would not require intensive cropping and storage of fodder crops.

Discussion

In a recent cogently argued paper Alexander (2012) has pointed to the failure of those working in Quaternary entomology to establish an objective approach to the data, free of the constraints imposed by the dominance of models imposed by paradigms from palynology. Using autecological data, he follows up the alternative interpretation of Vera (2000), which sees more open *natural* landscapes than most palaeoecologists would believe. In terms of Sherwood, where Alexander (2011) has reviewed the saproxylic fauna, it means that habitat continuity for this element lies in wood pasture rather than closed woodland. Wild Goose Cottage would therefore have exploited a landscape of individual trees and grassland, perhaps with hedgerows and hedgerow trees. Kenward (2009), working with modern analogues, has considered the relative visibility of trees and woodland in fossil insect assemblages and it is often quixotic, but insofar as any fossil insect list might be interpreted to imply it, the xylophagous fauna from Wild Goose Cottage, with some of the other phytophages would not be out of place in wood pasture or a hedgerow. Greig (2007) interpreted the plant macrofossils from a ditch in a brickwork field pattern on Balby Carr, near Doncaster, as evidence for managed hedges (see also Greig 1994; Robinson 1978), and the problem of relative visibility also extends to individual trees in the wood pasture landscape which once formed the greater part of Sherwood Forest.

Alexander (2012) further laments the lack of objective science in the subject, although it should be added that observational habitat data are more difficult to convert into statistics than pollen percentages, and that reconstructing a landscape from pollen percentages is also no simple task (e.g. Hultberg *et al.* 2014). Attempts to overcome these problems at least from the climate viewpoint lead to the Mutual Climatic Range (MCR) method (Atkinson *et al.* 1986), most recently implemented in the BugsCEP software (Buckland & Buckland 2006). The habitat classification of Robinson (1983) has been developed in a more transparent form by Buckland and Buckland (2006), using additional information from Koch (1989; 1992) and other sources (see Buckland 2007). This has also been implemented in the BugsCEP database and software as a tool for assisting in the objective environmental interpretation of insect finds, and providing quantitative reconstructions based on the observed habitat preferences of individual taxa. The diversity of insects and their habitats, however, means that any quantitative environmental reconstruction will always need to be accompanied by a species by species review in order to understand the detailed implications of the fauna.

Recently Smith *et al.* (2014) have sampled cattle, horse, boar and deer dung in an attempt to characterise assemblages associated with particular herbivores. Their results, limited to single event collections in widely spaced localities, are, however, inconclusive, the low numbers of *Aphodius* species perhaps reflecting more the impact of biocides like Ivermectin (cf. Sutton *et al.* 2014) on the dung faunas than reality. The small numbers and low diversity of the scarabaeid fauna in their samples contrasts with faunas from the dung of untreated, free-ranging longhorn cattle at Knepp where sampling continued over a summer (Panagiotakopulu, in prep.). Smith *et al.*'s faunas are dominated by generalist predators and grazers in foul materials rather than obligate coprophiles. The results of such studies, however, should always be considered as parts of the bigger pictures, and the comments of an entomologist with many years specialist interest in dung faunas are probably of more value than single collection events. Skidmore (1991 & pers. comm., in Buckland & Buckland 2006) notes that *Onthophilus striatus* is fairly common in horse dung and Jessop (1986) notes a similar preference for *Aphodius obliteratus*. At Wild Goose Cottage, it should be noted, however, that the insect fauna only provides some circumstantial evidence for the presence of horse and is no better than the single horse skull from the back of the well lining in indicating any specialist equine activity at the farm; the remainder of the dung fauna would be equally at home in cattle, sheep and free-range pig dung, provided other factors, from its consistency to exposure were suitable (cf. Landin 1961).

Figure 5 summarises the habitats indicated by the Wild Goose Cottage fauna, utilising the categories in the BugsCEP database. The horizontal axis is scaled to indicate the proportional representation of each habitat type (trait) in the sample as indicated by the preferences of the individual taxa (see table 1 for raw abundance values and the BugsCEP database for species-habitat classifications). This scaling, which shows the relative dominance of each habitat signal on a scale of 0-100, compensates for the effect of variable numbers of species and individuals between samples, and facilitates inter-site comparison of the environmental implications of the insect faunas. It also allows for the comparison of the effects of different statistical treatments, or transformations, on environmental reconstructions. (It should be noted, however, that samples with low diversity and richness should still be treated with caution due to the potential for a single occurrence having a large impact on the results). Figure 5a is based solely on the presence of the species in the sample, whereas 5b takes abundance data into account. Identifications above the species or species group (e.g. *Anobium punctatum* (DeG.) / *inexpectatum* Lohse) level are excluded to avoid habitat generalization due to genera with diverse traits (for a full explanation of the calculations involved see Buckland (2007)).

Although the general pattern of habitats is similar across the two diagrams (5a and 6b), there are some notable differences which serve to illustrate potential issues involved in the environmental interpretation of quantitative biodiversity data. The most immediately apparent difference is perhaps the greater representation of dung related habitats in the abundance weighted figure, a result of the relatively large numbers of dung beetles in comparison to most other species. The abundance weighted figure (5b) also gives considerably less indication of water (aquatics at 0.28% compared with 1.06% for 5a), a pattern repeated at even lower levels for specific indicators for standing water as well as open wet habitats and dry dead wood (all less than 1% and thus excluded from the diagram). Species with low density populations, rare species, or environments in which number of individuals is constrained are often lost in the noise of more naturally abundant species, and these habitat signals may thus be lost if only raw abundance data are used when describing palaeoenvironments. Conversely, environments which support larger numbers of individuals, such as

dung or compost heaps, may be over represented in reconstructions of palaeoenvironments, especially when using scaled visualisations, but also when numbers of individuals are considered to be proportional to extent of habitat. It is therefore extremely important to consider these different statistics when translating faunal habitat signals into interpretations of the geographical or physical extent of the habitats as part of the palaeoenvironment.

The prominence of dung and foul habitats in the abundance weighted results (5b) would suggest an active farmyard environment, whereas the occurrence/incidence based results (5a) may give us an indication of a surrounding, damp, arable landscape. The “wood and trees” signal could represent this landscape’s individual trees and hedgerows and perhaps the structural timber of the well.

Although there are minor differences, the species list from Wild Goose Cottage during the late Roman period is remarkably similar to what could have been collected around a small farm before modern deep ploughing, widespread use of insecticides and herbicides and removal of hedgerows created the modern agri-industrial landscape. This is an aspect shared with several other rural Roman wells (e.g. Buckland 1980; 2000; Coope & Osborne 1968); it is radically different from similar well and waterhole faunas from the Late Bronze Age (cf. Buckland 2009; Osborne 1989), and it is unfortunate that there are currently too few Iron Age sites to narrow down the timing of the change, first noted by Osborne (1982). It is interesting to note that these differences, reflected in the individual taxa present, are more difficult to resolve when looking at the environmental implications of the faunas in terms of their general habitat requirements (Figure 6). As well as highlighting the importance of referring to the archaeological data when interpreting faunas, this also indicates the importance of the surrounding landscape in defining what falls into a well or water hole. A casual glance at the relative proportions of environments indicated by the faunas in figure 6 would suggest wood pasture for all sites, but there are some important differences. For example, aquatic taxa are often under-represented in wells, as a result of their depth, covering or indoor location, when compared to what are probably watering holes at the edges of fields (cf. Pode Hole, Buckland 2009). The well at Skeldergate, York, also has a more distinctive urban signal in terms of synanthropic species, but, with the exception of the small aquatic component, is otherwise hard to distinguish from the Pode Hole samples. There is clearly a need for more work on the use of ecological traits (habitat classifications) as a tool for aiding the interpretation of archaeological deposits.

Some of the changes in fauna reflect Roman introductions or at least expansions of range, which the need to maintain a standing army and more extensive trading networks entailed. The small hydrophilid *Cryptopleurum crenatum*, found in rotting plant debris and dung (Koch 1989; Skidmore 1991), has its earliest British Holocene record in a Late Iron Age / Roman pit at Dragonby in North Lincolnshire (Buckland 1996), although there is an earlier record from Ireland (Reilly 1996); it then appears in a late Roman pit at Alcester in Warwickshire (Osborne 1994) and in a well on the villa site at Whitton in Glamorgan (Osborne 1981). The staphylinid *Omalium rivulare*, which occurs in similar habitats, may also be a Roman introduction, with its earliest record from Claydon Pike in Oxfordshire (Robinson 2007), and Wild Goose Cottage provides the first records both of its congener *O. italicum* and of *Gauropterus fulgidus*, another species of compost (Lott & Anderson 2011). *Philonthus intermedius* from Wild Goose Cottage is a new fossil record, although it may be difficult to separate from *P. laminatus* in fossil material. The large, predatory rove beetle *Creophilus maxillosus* first appears in the Roman period at Lincoln (Carrott *et al.* 1995), but Roman Iron Age coastal records from Dun Vulcan in the Outer Hebrides (Roper 1999) may relate to indigenous populations feeding on

maggots in wrack on the seashore (Buckland, unpubl. obs.). The oldest occurrence of the fungal feeder *Cryptophagus scutellatus* is also from the same site. Largely synanthropic, there are outdoor records from rotten wood (Luff & Eyre 2012), although this seems unlikely in the Outer Isles. Many other elements in the Wild Goose Cottage fauna, associated with decaying plant debris, including *Typhaea stercorea*, only become widespread in the Roman period.

The Climate

Whilst several of the species in the Wild Goose Cottage assemblage now have a more restricted distribution, none are no longer extant in Britain or sufficiently restricted to provide a clear climate signal. Although the use of assemblages from wells, or other anthropogenic contexts, is inadvisable for climate reconstruction due to potential selection biases, the implications of individual species finds may provide useful comparative material. Osborne (1976) suggested that the appearance of *Heptaulacus testudinarius* in late Iron Age deposits at Fisherwick in north Staffordshire might reflect a climate marginally warmer than that of the middle of the last century, before current global warming, and there are now also fossil records from further north in East Yorkshire, from the Roman well at Rudston (Buckland 1980) and an undated Holocene site at Shiptonthorpe (Wagner 1999), where both assemblage overall and stratigraphy would imply a Roman date. Kenward (2004), taking this species along with others, hypothesised that summer average temperatures were of the order of 1°C warmer in the Roman period, although the data remain inconclusive. The species is either a kleptoparasite or inquiline in the burrow of *Geotrupes* sp. (Sopp 1898), preferring sandy soils and again showing a preference for horse dung (Koch 1989b), although this may be a reflection of its xerophilous requirements, needing soils which warm rapidly, principally short-grazed, well drained grassland. Although it is not included as a Nottinghamshire species in Carr's (1916) list, there are a few nineteenth century records from further north, at Sutton on the Forest, near York (Bayford & Lawson 1909) and its decline must partly be a result of expansion of scrub and more recently by the improvement of old established pasture; in the past half century there appears to have been only one British record, that from Lyndhurst in the New Forest (Gardner 1970). Whilst much more frequent in the fossil record, at least until the Roman period (Buckland & Buckland 2006), another scarabaeid, *Oxyomus sylvestris* shows a similar if less severe decline. Skidmore (2006) includes a 1910 record from Thorne Moors in South Yorkshire and Carr (1916) has it from Nottingham in 1912. Eurytopic and more polyphagous than *H. testudinarius* (Landin 1961), its decline may contain a clearer climate signal. Whilst recent human impact may explain the decline in the dung and related faunas, it is more difficult to explain the disappearance of a common feeder upon nettles, the weevil *Taeniapion urticarium*. The species is not listed for Nottinghamshire by Carr (1916) and there appear to be no Yorkshire records (Marsh & Denton 2011). There are other Roman records, however, from Barton-on-Humber in north Lincolnshire (Carrott *et al.* 1993), High Catton in the East Riding of Yorkshire (Kenward *et al.* 2002), West Lilling, North Yorkshire (Hall *et al.* 2002) and York (Hall & Kenward 1990; Kenward *et al.* 1986). A decline in summer temperatures appears to be the most likely explanation, although as there are medieval records from York (Kenward *et al.* 2004) and the Dominican Friary site in Beverley (Allison *et al.* 1996), this may relate to the Little Ice Age. Allen (1990) has commented, however, upon its patchy modern distribution in Kent, "As it lives upon an ubiquitous plant, yet its colonies tend to be very scattered and mostly small, it would seem to have special requirements so far unrecognised." Kenward (2004) has charted the recent northward re-expansion with a warming climate of another nettle feeder, *Heterogaster urticae* (F.). In the Roman period this bug extended at least as far north as the Scottish Border (Kenward 2009), and it has

recently re-invaded Scotland, having been essentially limited to south-east England for much of the period of active biological recording over the past two centuries.

Conclusion

The Wild Goose Cottage insect fauna indicates a stable landscape, probably largely pastoral, with damp grassland on the adjacent floodplain and drier, sandier pastures in hedged fields on the Quaternary deposits and Sherwood Sandstone to the west. It is tempting to interpret the paucity of cropmarks close to the site as a result of arable exploitation in small, less substantially ditched plots immediately surrounding the settlement. Comparison with insect faunas from Roman wells and ditches associated with similar fields are constrained both by the limited amount of published work from the East Midlands and the taphonomy of assemblages. An early study by Alvey (1967) of the contents of a Roman well at Bunny, south of Nottingham, included a few insects picked out of the sieved residue; all suggest an open landscape; Wilson (1968), working with the plant macrofossils from the same deposit, suggested fields with hedges. Alvey also sorted the material from the Empingham Roman well in Rutland and the sample is similarly dominated by the larger taxa, although the fauna is much more extensive (Buckland 2000). There are extensive overlaps with the Wild Goose Cottage assemblage, again indicating an open landscape. Some dead deciduous wood is suggested by the presence of the stag beetle, *Lucanus cervus*. Largely restricted to wood pasture and old established woodland in south-east England at the present day (Harvey et al. 2011), in the Roman period it extended at least as far north as Kirkham in north Lancashire (Carrott et al. 1995). A Roman well, on the Jurassic rather than poorer soils of the Triassic, at Ashby Folville, south-east of Melton Mowbray in Leicestershire, provides further evidence of an open Late Roman landscape (Buckland, in Rackham 2009). This site is strikingly similar to Wild Goose Cottage in terms of the environmental reconstruction provided by BugsCEP (Figure 5), as is Dragonby in North Lincolnshire, although the last has a more prominent aquatic fauna.

Ditches contemporary with the brickwork field systems rarely preserve organic materials. In addition, not only were they frequently recut over the Late Iron Age and Roman periods (e.g. Chadwick 1995; Jones 2007; Richardson 2008), but also samples may reflect accumulation during abandonment rather than use. Despite promising earlier work, samples from Chainbridge Lane just to the south of Wild Goose Cottage proved to lack preservation of organics (Buckland, in Eccles et al. 1988), and the recent loss of the fossil record due to drainage and gravel extraction in the region is extensive. The faunas from ditches bounding a brickwork field system at Balby Carr, south-east of Doncaster, are dominated by the wetland component (Smith & Tetlow 2007), but again the picture is of an essentially open landscape, an interpretation supported by the pollen and plant macrofossil data from the same site (Greig 2007). Recent work on a transect of sites across the southern part of East Yorkshire, from the Ouse at Barmby on the Marsh to the Hull at Swine gives a similar impression (Buckland, in prep.)

The absence of long sequence pollen diagrams in the Idle valley is a problem. Short sequences covering parts of the Roman period are available from the point where the Roman road from Lincoln to York via Littleborough and Doncaster crosses the Idle floodplain at Scaftworth, some 6km north-west of the site, and from the ditch of a Late Roman multivallate enclosure adjacent to the crossing. Both indicate an open landscape with alder carr, presumably adjacent to the river (Gilbertson & Blackham 1985; van de Noort *et al.* 1997). The nearest location where sufficient peat survived to

document the whole of the Late Holocene lies on Hatfield Moors (Smith 2002), some 15 km to the north east, and close to the brickwork field systems between Edenthorpe and Hatfield (Chadwick 1995). The diagrams show a landscape at least as open as the present and whilst the emphasis again seems to be on pastoralism, there are indications of arable in the presence of pollen of both *Triticum* and *Secale cereale*. The latter, rye, is probably a Roman introduction as a widespread crop plant in Britain (Hillman 1981), and its tolerance of poor, acid sandy soils (Cappers & Neef 2012, 269) would have made it an ideal crop for the Sherwood Sandstone and adjacent Drift sands and gravels. It occurs as a macrofossil, along with barley, spelt and bread wheat at the most extensively excavated settlement associated with the Nottinghamshire field systems at Dunstan's Clump (Jones 1987).

Evidence from other sites in the region show that the stable farmed landscape which appears in the Wild Goose Cottage sample is disrupted during the late Roman period, and the adjacent floodplain takes on a different character. The relationships between climate change, weather events and human activities are complex (cf. Macklin 1999; Knight & Howard 2004), but what appears widespread in the Humber Basin is a change in the nature of alluviation during the Roman period, leading to a rapid influx of fine grained sediments onto the floodplains, perhaps apparent at Wild Goose Cottage in the tongue of sediment to the north of the enclosure. This change appears to be diachronous. In the Trent at Littleborough, flooding took place in the late second to mid-third century (Riley et al. 1995), whilst at the Don-Idle confluence at Sandtoft it could only be dated as later than the end of the second century (Samuels & Buckland 1975). Following on from an initial suggestion by Limbrey, Buckland and Sadler (1985) have suggested that the change reflects a move to increased arable and the widespread adoption of a plough able to cut the root mat in the late Roman period, leading to widespread soil erosion.

It is unfortunate that research at Wild Goose Cottage was restricted to the well and that plant macrofossil and pollen data are also not available, but the insect faunas do improve the picture of a third to early fourth century landscape, which was at least as open as the present, and in which the keeping of livestock was an important element. Comparison with the limited amount of other palaeoecological research in the region suggests that this was not unusual, but for those of a more ecological than archaeological inclination, the immediate question is where were the refuges for the *Urwald* insect faunas for which Sherwood is justly important (cf. Carr 1916; Alexander 2013). If the landscape was one of wood pasture, or at least one in which old trees survived in hedgerows, then late or post-Roman abandonment of the brickwork pattern of field, apparent in Smith's (2002) pollen diagrams from both Thorne and Hatfield Moors, would have allowed the development of more extensive stands which eventually became the wood pasture of Sherwood. In agreement with Kenward (2004), there is some evidence for slightly warmer summers during the time the sample from the well accumulated, and this more continental climate may have continued until the late medieval shift to a Little Ice Age regime (Buckland & Wagner 2001). Survival of some elements would have been facilitated by this and others probably hung on until modern farming elements removed them from the landscape. It is a salutary tale that the Wild Goose Cottage fauna, like other contemporary faunas, differs little from what could be collected on a small farm a century ago.

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References

- Alexander KNA (2002) The invertebrates of living and decaying timber in Britain and Ireland - a provisional annotated checklist. English Nature Research Report 467, Peterborough
- Alexander KNA (2011) A review of the saproxylic invertebrate assemblages at Birklands & Bilhaugh sites of Special Scientific Interest, Sherwood Forest, Nottinghamshire. Natural England Commissioned Report NECR 072, Peterborough
- Alexander KNA (2012) What do saproxylic (wood-decay) beetles really want? Conservation should be based on practical observation rather than unstable theory. In: Rotherham ID, Handley C, Agnoletti I, Samojlik T (eds) *Trees beyond the wood*. Sheffield, Wildtrack Publ, pp 33-46
- Alexander KNA (2013) Ancient trees, grazing landscapes and the conservation of deadwood and wood decay invertebrates. In: Rotherham ID (ed) *Trees, forested landscapes and grazing animals: a European perspective on woodlands and grazed treescapes*. Abingdon, Routledge, pp 330-338
- Allen AA (1990) *Apion urticarium* Hbst. (Col.: Apionidae) in a suburban garden. *Entomologist's Rec & J Variation* **102**:248
- Allison EP, Hall AR, Kenward HK, McKenna B, Nicholson CM, O'Connor TP (1996) Environmental evidence. In M. Foreman, *Further Excavations at the Dominican Priory, Beverley, 1986-89*, Sheffield Excavation Reports 4, Sheffield, pp 195-212
- Alvey RC (1967) A Roman Well at Bunny, Nottinghamshire. *Trans Thoroton Soc Nottinghamshire* 71: 5-10
- Bayford EG, Lawson-Thompson M (1907) Insects - Coleoptera. In: Page JG (ed) *Victoria County History. A History of Yorkshire 1*. London, Archibald Constable & Co, pp 219-244
- Böhme, J (2005) *Die Käfer Mitteleuropas. K. Katalog (Faunistische Übersicht)* (2nd ed.). Munich, Spektrum Academic.
- Branigan K (1989) An early landscape revisited. In: Kennedy D (ed) *Into the Sun. Essays in air photography in archaeology in honour of Derrick Riley*. Sheffield, University of Sheffield, pp161-166
- Buckland PC (1980) Insect remains from the well. In: Stead IM, *Rudston Roman Villa*. Yorkshire Archaeological Society, Leeds, pp 162-67
- Buckland, PC (1996) Insects. In: May J, Dragonby, *Report on Excavations at an Iron Age and Romano-British Settlement in North Lincolnshire*. Oxbow Monograph 61, Oxford, pp 165-170
- Buckland PC (2000) An Insect Fauna from a Roman Well at Empingham, Rutland. In: Cooper NJ, *The Archaeology of Rutland Water: Excavations at Empingham in the Gwash Valley, Rutland, 1967-73 and 1990*. Leicester Archaeology Monograph 6, University of Leicester Archaeological Services, pp 136-139

- Buckland PC (2009) Insect remains. In: Daniel P (Richmond A, Coates G (eds.)), *Archaeological excavations at Pode Hole Quarry. Bronze Age occupation on the Cambridgeshire Fen-edge*, British Archaeological Reports 484, Oxford, pp 102-104; 189-195
- Buckland PC, Dugmore A, Sadler JP (1991) Faunal Change or taphonomic problem? A Comparison of modern and fossil insect faunas from south-east Iceland. In: Maizels JK, Caseldine C. (eds) *Environmental Change in Iceland Past and Present*. Dordrecht, Kluwer, pp 127-146
- Buckland PC, Magilton JR, Dolby MJ (1980) The Roman Pottery Industries of South Yorkshire. *Britannia* 11:145-164
- Buckland PC, Magilton JR (1986) The archaeology of Doncaster. 1. The Roman civil settlement. Oxford, British Archaeological Reports 148
- Buckland PC, Magilton JR (2005) Late Roman pottery kilns at Goodison Boulevard, Cantley, Doncaster: excavations by JR Lidster 1957 and 1962. *J Roman Pottery Studies* 12:36-53
- Buckland PC, Sadler JP (1985) Late Flandrian Alluviation in the Humberhead Levels. *East Midland Geographer* 8:239-251
- Buckland PC, Wagner P (2001) Is there an insect signal for the Little Ice Age? *Climate Change* 48:137-149
- Buckland PI (2007) The development and implementation of software for palaeoenvironmental and palaeoclimatological research: the Bugs Coleopteran Ecology Package (BugsCEP). *Archaeol and Environment* (Umeå) 23 <http://urn.kb.se/resolve?urn=urn:nbn:se:umu:diva-1105>
- Buckland PI, Buckland PC (2006) Bugs Coleopteran Ecology Package (Versions: BugsCEP v7.56; Bugsdata v7.11; BugsMCR v2.0; BugStats v1.2) [Downloaded: 15.03.14] www.bugscep.com
- Cappers RT J, Neef R (2012) *Handbook of Plant Palaeoecology*. Groningen, Barkhuis
- Carr JW (1916) *The Invertebrate Fauna of Nottinghamshire*. J & H Bell for Nottingham Naturalists' Society, Nottingham
- Carrott J, Hall A, Issitt M, Kenward H, Large F, McKenna B (1995) Plant and invertebrate remains from excavations at Dowbridge Close, Kirkham, Lancashire (site code KD94). Reports from the Environmental Archaeology Unit, York, 95/2. York
- Carrott J, Hall A, Kenward H, Large F, Milles A (1993) Plant and invertebrate remains from two fill contexts from a Romano-British pit at Glebe Farm, Barton-on-Humber, S. Humberside (site code GFA92). Reports from the Environmental Archaeology Unit, York, 93/13. York
- Carrott J, Issitt M, Kenward H, Large F, McKenna B, Skidmore P (1995) Insect and other invertebrate remains from excavations at four sites in Lincoln (site codes WN87, WNW88, WF89 and WO89). Reports from the Environmental Archaeology Unit, York, 95/10. York
- Chadwick AM (1995) Further work on the Iron Age and Romano-British landscape at Edenthorpe. In: Cumberpatch CG, McNeil J, Whiteley SP (eds) *Archaeology in South Yorkshire 1994-1995*. Sheffield, South Yorkshire Archaeology Service, pp. 41-49
- Chadwick A (2010) *Fields for discourse: landscape and materialities of being in South and West Yorkshire and Nottinghamshire during the Iron Age and Romano-British Periods. A study of people and place*. Dissertation, Dept of Archaeology. University of Wales, Newport
- Chandler P (1998) *Checklists of Insects of the British Isles (New Series) Part 1 Diptera*. Royal Entomological Society of London
- Coope GR, Osborne PJ (1968) Report on the Coleopterous Fauna of the Roman Well at Barnsley Park, Gloucestershire. *Trans Bristol and Gloucestershire Archaeol Soc* 86:84-87
- Cox ML (2007) *Atlas of the seed and leaf beetles of Britain and Ireland*. Pisces Publ., Newbury
- Darling M, Precious B (2013) *A Corpus of Roman pottery from Lincoln*. Oxbow Books, Oxford
- Davis BNK (1983) *Insects on nettles*. Cambridge University Press, Cambridge
- Duff A (1993) *Beetles of Somerset: their status and distribution*. Somerset Archaeological & Natural History Society, Taunton
- Duff AG (ed) (2012) *Checklist of beetles of the British Isles (2nd ed)*. Pemberley Books, Iwer
- Eccles J, Caldwell P, Mincher R (1988) *Salvage excavations at a Romano-British site at Chainbridge Lane, Lound, Nottinghamshire, 1985*. *Trans Thoroton Soc Nottinghamshire* 92:15-21

- Gardner AE (1971) [no title]. *Proc Brit Entomol and Natural Hist Soc* (1970-71):60
- Garton D (1987) Dunston's Clump and the Brickwork plan field-systems at Babworth, Notts: excavations 1981. *Trans Thoroton Soc Nottinghamshire* 91:16-73
- Garton D (2008) The Romano-British landscape of the Sherwood Sandstone of Nottinghamshire. *Trans Thoroton Soc Nottinghamshire* 112:15-110
- Garton D, Salisbury CR (1995) A Romano-British wood-lined well at Wild Goose Cottage, Lound, Nottinghamshire. *Trans Thoroton Soc Nottinghamshire* 99:15-43
- Gaunt GD (1994) Geology of the country around Goole, Doncaster and the Isle of Axholme. *Memoir of the British Geological Survey Sheets 79 and 88 (England and Wales)*. HMSO, London
- Gaunt GD, Coope GR, Osborne P J, Franks JW (1972) An interglacial deposit near Austerfield, southern Yorkshire. HMSO, London
- Gilbertson DD, Blackham A (1985) Scaftworth Roman 'fortlet'. In: Briggs D J, Gilbertson DD, Jenkinson RDS (eds) *Peak District and Northern Dukeries Field Guide*. University of Sheffield, pp 107-123
- Greig J (1994) A possible hedgerow flora of Iron Age date from Alcester, Warwickshire. *Circaea, J Assoc Environ Archaeol* 11:7-16
- Greig J (2007) Pollen and plant macrofossils. In: Jones L, *Archaeological excavation of a brickwork plan field system at Catesby Business Park, Balby Carr, Doncaster, South Yorkshire, 2002*. *Yorkshire Archaeol J* 79:17-53
- Hall AR, Jaques D, Rowland S, Kenward H, Carrott J (2002) Technical report: Biological remains from excavations at a site near West Lilling, North Yorkshire (site codes: OSA99EX03 and BPTSEP169). Reports from the Environmental Archaeology Unit, York 2002/1. York
- Hall AR, Kenward HK (1990) Environmental evidence from the Colonia. *Archaeology of York, The Environment*, 14/6. Council for British Archaeology for York Archaeological Trust, London
- Hall AR, Kenward HK, Williams D (1980) Environmental evidence from Roman deposits in Skeldergate. *Archaeology of York*, 14/3. Council for British Archaeology for York Archaeological Trust
- Harvey DJ, Gange AC, Hawes CJ, Rink M (2011) Bionomics and distribution of the stag beetle, *Lucanus cervus* (L.) across Europe. *Insect Conservation and Diversity* 4:23-38
- Hillman G (1981) Reconstructing crop husbandry practices from charred remains of crops. In: Mercer R (ed) *Farming Practice in British Prehistory*. Edinburgh University Press, Edinburgh, pp 123-162
- Hultberg T, Gaillard MJ, Grundmann B, Lindbladh M (2014) Reconstruction of past landscape openness using the Landscape Reconstruction Algorithm (LRA) applied on three local pollen sites in a southern Swedish biodiversity hotspot. *Vegetation Hist and Archaeobot* 24:253-266
- Hyman PS (1992) Review of the scarce and threatened Coleoptera of Great Britain. Part 1. Joint Nature Conservancy Council, Peterborough
- Jennings FB (1906) *Procas armillatus*, F. near Dartford. *Entomologist's Mon Mag* 42, 138
- Jessop L (1986) Dung beetles and chafers. Coleoptera: Scarabaeoidea. Royal Entomological Society of London Handbooks for the Identification of British Insects 5,11, London
- Johnson C (1963) The British Species of the Genus *Rhizophagus* Herbst. (Col., Rhizophagidae). *Proc & Trans Manchester Entomol Soc* (1961-63):3-9
- Jones G (1987) The plant remains. In: Garton, D, Dunston's Clump and the Brickwork plan field-systems at Babworth, Notts: excavations 1981. *Trans Thoroton Soc Nottinghamshire* 97:58-63
- Jones L (2007) Archaeological excavation of a brickwork plan field system at Catesby Business Park, Balby Carr, Doncaster, South Yorkshire, 2002. *Yorkshire Archaeol J* 79:37-49
- Kenward, HK (2004) Do insect remains from historic-period archaeological occupation sites track climate change in Northern England? *Environ Archaeol* 9:47-60
- Kenward, H. K. (2006) The visibility of past trees and woodland: testing the value of insect remains. *J Archaeol Sci* 33:1368-1380

- Kenward HK (2009) Insect remains. In: Passmore DG, Waddington C, Managing archaeological landscapes in Northumberland. Till Tweed studies 1. Oxbow Books, Oxford, pp 232-241 + 381-390
- Kenward HK, Hall AR, Jaques D, Johnson K, Carrott J (2004) Technical Report: biological remains from excavations at the former D. C. Cook site, off Lawrence Street, York (site code: YORYM 2001.9444). Palaeoecology Research Services 2004/04. Shildon, Co Durham
- Kenward HK, Hall AR, Jaques D, Rowland S, Carrott J (2002) Technical Report: Biological remains from a site east of High Catton, East Riding of Yorkshire (site code: TSEP222). Reports from the Environmental Archaeology Unit, York, 2002/12. York
- Kenward HK, Hall AR, Jones AKG (1986) Environmental evidence from a Roman well and Anglian pits in the Legionary fortress. Archaeology of York, 14/5. Council for British Archaeology for York Archaeological Trust, London
- Kenward H, Tipper J (2008) Insect invaders of reconstructed Anglo-Saxon houses at West Stow, Suffolk, England. *Environ Archaeol* 13:51-57
- Knight D, Howard AJ (2004) Trent valley landscapes. Heritage Publ, King's Lynn
- Koch K (1989; 1992) Ökologie 1-3. Die Käfer Mitteleuropas. Goecke & Evers, Krefeld
- Landin B-O (1961) Ecological Studies on Dung-Beetles. *Opuscula Entomologica Suppl.* 19
- Lazenby AS (2011) Ground beetles of the Sorby area. *Sorby Record Special Ser* 15:1-56
- Lindroth CH (1985) The Carabidae (Coleoptera) of Fennoscandia and Denmark. EJ Brill, Leiden
- Lott DA, Anderson R (2011) The Staphylinidae (rove beetles) of Britain and Ireland Parts 7 & 8: Oxyporinae, Steninae, Euaesthetinae, Pseudopsinae, Paederinae, Staphylininae. Handbooks for the Identification of British Insects, 12, Part 7. Royal Entomological Society, St. Albans
- Loughlin N (1977) Dales Ware: a contribution to the study of Roman coarse pottery. In: Peacock DPS (ed) Pottery and early commerce. Characterization and trade in Roman and later ceramics. Academic Press, London, pp 85-162
- Luff ML (1998) Provisional atlas of the ground beetles (Coleoptera, Carabidae) of Britain. Centre for Ecology & Hydrology, Biological Records Centre, Abbots Ripton
- Luff ML, Eyre MD (2012) Further records of new or local Coleoptera from north-east England. *Coleopterist* 21:41-45
- Macklin MG (1999) Holocene river environments in prehistoric Britain: human interaction and impact. *J Quaternary Sci* 14:521-530
- Marsh R., Denton M (2011) Checklist of Yorkshire Coleoptera 2011. Yorkshire Naturalists' Union, Leeds
- Monckton A (2006) Environmental Archaeology in the East Midlands. In: Cooper NJ (ed) The Archaeology of the East Midlands. An archaeological resource assessment and research agenda. Leicester Archaeology Monograph 13, Leicester, pp 259-286
- Morris MG (1990) Orthocerous Weevils. Coleoptera Curculionoidea (Nemonychidae, Anthribidae, Urodontidae, Attelabidae and Apionidae). Handbooks for the Identification of British Insects, 5, 16. Royal Entomological Society of London
- Morris MG (2002) True Weevils (Part 1) Coleoptera: Curculionidae (Subfamilies Raymondionyminae to Smicronychinae). Handbooks for the identification of British insects, 3, 17b. Royal Entomological Society & Field Studies Council, London.
- Morris MG (2008) True Weevils (Part 2) Coleoptera: Curculionidae (Subfamilies Ceutorhynchinae). Handbooks for the identification of British insects, 5, part 17c. Royal Entomological Society & Field Studies Council, St Albans
- Osborne PJ (1976) Evidence from the insects of climatic variations during the Flandrian period a preliminary note. *World Archaeol* 8: 150-158
- Osborne PJ (1981) The insect fauna. In: Jarrett MG, Wrathmell S, Whitton. An Iron Age and Roman Farmstead in South Glamorgan. University of Wales Press, Cardiff, pp 245-248

- Osborne PJ (1982) Some British later prehistoric insect faunas and their climatic implications. In: Harding A (ed) *Climatic Change in Later Prehistory*. Edinburgh University Press, Edinburgh, pp 68-74
- Osborne PJ (1989) Insects. In: Ashbee P, Bell M, Proudfoot E (eds), *Wilsford Shaft, Excavations 1960-62*. English Heritage, London, pp , 96-99 + fiche C1-7
- Osborne PJ (1994) Insect remains from pit F and their environmental implications. In: Cracknell S, Mahany C (eds) *Roman Alcester: Southern Extramural Area. 1964-1966 Excavations, Part 2: Finds and Discussion*. Council for British Archaeology Research Report 97, London, pp 217-220
- Panagiotakopulu E, Buckland, PC (2012) Forensic archaeoentomology – an insect fauna from a burial in York Minster. *Forensic Sci Int* 221:125-130
- Rackham J (2009) Environmental archaeology. In: Moore R, Ashby Folville to Thurstaston: the archaeology of a Leicestershire pipeline part 2: Iron Age and Roman sites. *Trans Leicestershire Archaeol & Hist Soc* 83:53-55
- Reilly E (1996) The insect fauna (Coleoptera) from the Neolithic trackways Corlea 9 and 10: the environmental implications. In: Raftery B: *Trackway excavations in Mount Dillon Bogs, Co. Longford, 1985-1991*, Irish Archaeol Wetland Unit Trans 3. Crannog Publications, Dublin, pp 403-409
- Richardson J (2008) *The Late Iron Age and Romano-British rural landscape of Gunhills, Armthorpe, South Yorkshire*. WYAS Archaeological Services, Wakefield
- Riley DN (1980) *Early Landscape from the Air*. J Collis Publ., University of Sheffield
- Riley DN, Buckland PC, Wade J (1995) Excavations and aerial reconnaissance at Littleborough on Trent, Nottinghamshire. *Britannia* 25:253-284
- Roberts I (2010) *Understanding the cropmark landscapes of the Magnesian Limestone*. WYAS Archaeological Services & English Heritage, Wakefield
- Robinson M (1978) The problem of hedges enclosing Roman and earlier fields. In Bowen HC, Fowler PJ (eds) *Early Land Allotment*. British Archaeological Reports 48, Oxford, pp 155-158
- Robinson M (1981) The Iron Age to Early Saxon environment of the Upper Thames terraces. In: Jones M, Dimbleby G. (eds) *The environment of Man: the Iron Age to Anglo-Saxon period*. British Archaeological Reports 87, Oxford, pp 251-286
- Robinson MA (1983) Arable/Pastoral ratios from insects. In: Jones M (ed) *Integrating the Subsistence Economy*. British Archaeological Reports S181, Oxford, pp 19-47
- Robinson MA (2007) The environmental archaeology of the Cotswold Water Park. In: Miles D, Palmer S, Smith A, Jones GP, *Iron Age and Roman settlement in the Upper Thames Valley: excavations at Claydon Pike and other sites within the Cotswold Water Park*. Thames Valley Landscapes Monograph 26, Oxford, pp 355-363
- Roper T (1999) The beetles. In: Parker Pearson M, Sharples N: *Between land and sea. Excavations at Dun Vulan, South Uist*. Sheffield Academic Press, Sheffield, pp 55-56; 192-194; 290-297
- Samuels J, Buckland PC (1978) A Romano-British settlement at Sandtoft, South Humberside. *Yorkshire Archaeol J* 50:65-75
- Skidmore P (1991) *Insects of the British Cow-Dung Community*. Fields Study Council, Preston Mountford
- Skidmore P (1999) The mineralised flies. In: Connor A, Buckley, N (eds) *Roman and medieval occupation in Causeway Lane, Leicester*. Leicester Archaeological Monographs 5. University of Leicester, pp 341-343
- Skidmore P (2006) *An inventory of the invertebrates of Thorne and Hatfield Moors*. Thorne & Hatfield Moors Conservation Forum, Doncaster
- Skidmore P (2010) Dung. In: Chandler P (ed) *A Dipterist's Handbook (2nd ed.)*, Orpington, Amateur Entomologist, pp 157-165
- Smith BM (2002) *A palaeoecological study of raised mires in the Humberhead Levels*. British Archaeological Reports 336, Oxford

- Smith D, Tetlow E (2007) The insect remains. In: L. Jones, Archaeological excavation of a brickwork plan field system at Catesby Business Park, Balby Carr, Doncaster, South Yorkshire, 2002. Yorkshire Archaeol J 79:37-49
- Smith, D, Kenward H (2011) Roman grain pests in Britain: implications for grain supply and agricultural production. Britannia 42:243-262
- Smith D, Nayyar K, Schreve D, Thomas R, Whitehouse N (2014) Can dung beetles from the palaeoecological and archaeological record indicate herd concentration and the identity of herbivores? Quaternary Int 341:119-130
- Smith D, Tetlow E (2007) The insect remains. In: L. Jones, Archaeological excavation of a brickwork plan field system at Catesby Business Park, Balby Carr, Doncaster, South Yorkshire, 2002. Yorkshire Archaeol J 79:37-49
- Smith DN, Whitehouse NJ, Bunting MJ, Chapman H (2010) Can we characterise 'open-ness' in the Holocene palaeoecological record? Modern analogue studies from Dunham Massey deer park and Epping Forest, England. The Holocene 12:215-229
- Smith EG, Goossens RF (1973) Geology of the country around East Retford, Worksop and Gainsborough. Memoirs of the Geological Survey, U.K. London, HMSO
- Sopp EJB (1898) Habits of *Heptaulacus testudinarius*. Entomologist's Mon Mag 34:114-115
- Sutton G, Bennett J, Bateman M (2014) Effects of ivermectin residues on dung invertebrate communities in a UK farmland habitat. Insect Conservation and Diversity 7:64-72
- van de Noort R, Lillie M, Taylor D, Kirby J (1997) The Roman period landscape at Scaftworth. In: van de Noort R, Ellis S (eds) Wetland heritage of the Humberhead Levels. Hull, Humber Wetlands Project, pp 409-428.
- Wagner P (1999) The Skelfrey Beck section. In: Halkon P, Millett M (eds) Rural settlement and industry: Studies in the Iron Age and Roman archaeology of lowland East Yorkshire. Yorkshire Archaeology Report 4. Yorkshire Archaeological Society, Leeds, p 170
- Webb SC, Hedges REM, Robinson M (1998) The seaweed fly *Thoracochaeta zosterae* (Hal.) (Diptera: Sphaeroceridae) in inland archaeological contexts: $\delta^{13}C$ and $\delta^{15}N$ solves the puzzle. J Archaeol Sci 25:1253-1257
- Webster G, Booth N (1947) A Romano-British pottery kiln at Swanpool, near Lincoln. Antiquaries J 27:61-79
- Wilson DG (1968) Plant remains from a Roman well at Bunny, Nottinghamshire. Trans Thoroton Soc Nottinghamshire 72:42-50
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List of Figures

Figure 1. Location map and surface geology of the Wild Goose Cottage site, Lound, Nottinghamshire. (*redrawn from Garton & Salisbury 1995 © Thoroton Society of Nottinghamshire*)

Figure 2. Aerial photograph of Wild Goose Cottage. (*Photograph D Riley DNR 1013/19 - SK7087/13, © English Heritage*).

Figure 3. Wild Goose Cottage: site plan showing location of well. (*redrawn from Garton & Salisbury 1995 © Thoroton Society of Nottinghamshire*)

Figure 4. The excavated well at Wild Goose Cottage, with the oak plank lining and stratigraphic units labelled. (*Photograph D Garton ©*).

Figure 5. Two habitat reconstructions generated by the BugsCEP software (Buckland & Buckland 2006) for the Wild Goose Cottage sample. The horizontal axis of each chart element indicates the proportion of the sample fauna indicating that particular habitat. Any single taxon may be present in more than one habitat group. 5a shows numbers of species per habitat, scaled as percentage of total number of species in all habitats (a species may be present in more than one habitat); 5b shows the reconstruction weighted by individual based abundance data. The diagram serves as a tool to aid the interpretation of environmental implications of the fauna, and not a proportional landscape reconstruction. In 5b, for example, 25% of the environmental signal comes from Pasture/Dung favouring individuals, but this does not necessarily mean that the landscape around the well was 25% pasture in area. Habitats with less than 1% in each diagram have been excluded to improve clarity. See Buckland 2007 for the full list of habitats and notes on their interpretation.

Figure 6. A comparison of the environmental implications of habitat reconstructions from several Iron Age and Bronze Age wells and water holes; Wild Goose Cottage included. Reconstruction is based on species data only (i.e. *not* abundance weighted) using the same method as shown in figure 5A. Where *sum* follows the site name the data from several samples have been aggregated prior to calculation to provide a more robust reconstruction. Numbers of individuals of the species used in the reconstruction (abundance) and numbers of species (N. Species) are given to the right, and individual diagrams have been standardised with respect to the total number of environmental indications in each sample. In this respect the reconstructions for each site are comparable in that individual bars represent the proportional representation of each habitat class within the site with respect to the other classes.

Table 1

Taxon	WGC0012
Carabidae	
Indet.	2
<i>Carabus granulatus</i> L.	3
<i>Leistus ferrugineus</i> (L.)	2
<i>Nebria salina</i> Fairm. & Lab.	3
<i>Notiophilus biguttatus</i> (F.)	4
<i>Loricera pilicornis</i> (F.)	1
<i>Clivina collaris</i> (Hbst.)	2
<i>Dyschirius globosus</i> (Hbst.)	1
<i>Trechus obtusus</i> Er.	2
<i>T. obtusus</i> Er./ <i>quadristriatus</i> (Schr.)	4
<i>Bembidion lampros</i> (Hbst)	5
<i>B. properans</i> (Steph.)	5
<i>B. obtusum</i> Serv.	1
<i>B. mannerheimi</i> Sahl.	2
<i>Bembidion</i> sp.	1
<i>Asaphidion flavipes</i> (L.)	1
<i>Ophonus melleti</i> (Heer)	1
<i>Ophonus</i> spp.	5
<i>Pseudoophonus rufipes</i> (Deg.)	13
<i>Harpalus tardus</i> (Panz.)	1
<i>Acupalpus meridianus</i> (L.)	1
<i>A. exiguus</i> (Dej.)	1
<i>Poecilus cupreus</i> (L.)	1
<i>Pterostichus diligens</i> (Sturm)	1
<i>P. nigrita</i> (Payk.) / <i>rhaeticus</i> Heer	1
<i>P. niger</i> (Schall.)	2
<i>P. melanarius</i> (Ill.)	1
<i>Calathus fuscipes</i> (Goeze)	5
<i>C. cinctus</i> Mots.	10
<i>Agonum afrum</i> (Duft.)	1
<i>A. fuliginosum</i> (Panz.)	1
<i>Paranchus albipes</i> (F.)	3
<i>Oxypselaphus obscurus</i> (Hbst)	1
<i>Anchomenus dorsalis</i> (Pont.)	1
<i>Amara plebeja</i> (Gyll.)	1
<i>A. aenea</i> (Deg.)	2
<i>A. tibialis</i> (Payk.)	3
<i>A. bifrons</i> (Gyll.)	10
<i>A. aulica</i> (Panz.)	1
<i>Amara</i> spp.	8
<i>Syntomus obscuroguttatus</i> (Duft.)	1
Dytiscidae	
<i>Agabus bipustulatus</i> (L.)	1
<i>Ilybius ater</i> (Deg.)	1
Hydraenidae	
<i>Ochthebius</i> cf. <i>minimus</i> grp.	9
Hydrophilidae	
<i>Helophorus</i> (small) spp.	3

<i>Sphaeridium</i> sp.	1
<i>Cercyon obsoletus</i> (Gyll.)	2
<i>C. impressus</i> Sturm	1
<i>C. haemorrhoidalis</i> (F.)	10
<i>C. atricapillus</i> (Marsham)	2
<i>C. terminatus</i> (Marsham)	21
<i>C. pygmaeus</i> (Ill.)	2
<i>Cercyon</i> spp.	7
<i>Megasternum obscurum</i> (Marsham)/ <i>immaculatum</i> Steph.	34
<i>Cryptopleurum minutum</i> (F.)	3
<i>C. crenatum</i> (Panz.)	2
<i>Anacaena globulus</i> (Payk.)	1
Histeridae	
<i>Onthophilus striatus</i> (Müll.)	23
<i>Acritus nigricornis</i> (Hoff.)	1
<i>Kissister minimus</i> Laporte	1
<i>Margarinotus purpurascens</i> (Hbst.)	3
<i>Atholus duodecimstriatus</i> (Schrank)	1
Silphidae	
<i>Silpha obscura</i> L.	4
<i>S. tristis</i> Ill.	2
<i>Silpha</i> (s.l.) sp.	1
Catopidae	
<i>Catops</i> sp.	2
Scydmaenidae	
<i>Stenichnus collaris</i> (Müll. & Kunze)	1
Orthoperidae	
<i>Corylophus crassidoides</i> (Marsham)	2
<i>Orthoperus brunnipes</i> (Gyll.)	3
Ptiliidae	
<i>Acrotrichis</i> sp.	1
Staphylinidae	
<i>Micropeplus porcatus</i> (F.)	1
<i>Megarthus denticollis</i> (Beck)	1
<i>Phyllodrepa salicis</i> (Gyll.)	1
<i>Omalium rivulare</i> (Payk.)	3
<i>O. italicum</i> Bernh.	2
<i>Omalium</i> sp.	2
<i>Xylodromus concinnus</i> (Marsham)	5
<i>Olophrum piceum</i> (Gyll.)	1
<i>Lesteva longoelytrata</i> (Goeze)	1
Omalinae indet.	2
<i>Coprophilus striatulus</i> (F.)	2
<i>Carpelimus bilineatus</i> (Steph.) / <i>erichsoni</i> Sharp	6
<i>Aploderus caelatus</i> (Grav.)	7
<i>Oxytelus sculptus</i> Grav.	1
<i>Anotylus rugosus</i> (F.)	5
<i>A. sculpturatus</i> (Grav.) / <i>mutator</i> (Lohse)	6
<i>A. nitidulus</i> (Grav.)	2
<i>A. tetracarinatus</i> Block	2

<i>Platystethus arenarius</i> (Geoff.)	10
<i>P. cornutus</i> (Grav.) / <i>degener</i> Muls. & Rey	2
<i>Stenus</i> spp.	6
<i>Rugilus similis</i> Er.	2
<i>R. erichsoni</i> (Fauvel)	1
<i>Lathrobium</i> (s.l.) spp.	2
<i>Gauropterus fulgidus</i> (F.)	1
<i>Gyrophypnus fracticornis</i> (Müll.)	1
<i>G. angustatus</i> Steph.	12
<i>Xantholinus linearis</i> (Ol.)	2
<i>X. longiventris</i> Heer	2
<i>X. linearis</i> (Ol.) / <i>longiventris</i> Heer	6
<i>Philonthus intermedius</i> (Lac.)	1
<i>P. laminatus</i> (Creutz.)	2
<i>P. intermedius</i> (Lac.) / <i>laminatus</i> (Creutz.)	2
<i>Philonthus</i> spp.	14
<i>Creophilus maxillosus</i> (L.)	1
<i>Habrocerus capillaricornis</i> (Grav.)	1
<i>Mycetoporus lepidus</i> (Grav.)	1
<i>Tachyporus dispar</i> (Payk.)	1
<i>T. pusillus</i> Grav.	1
<i>Tachyporus</i> spp.	2
<i>Tachinus rufipes</i> (L.)	14
<i>T. laticollis</i> Grav.	34
<i>T. marginellus</i> (F.)	3
<i>Falagria caesa</i> Er.	1
<i>Aleochara</i> sp.	1
Aleocharinae indet.	9
Cantharidae	
<i>Rhagonycha fulva</i> (Scop.)	1
<i>R. testacea</i> (L.)	1
Elateridae	
<i>Agriotes obscurus</i> (L.)	2
<i>Agrypnus murina</i> (L.)	2
Bryrrhidae	
<i>Byrrhus pustulatus</i> (Forst.)	2
Brachypteridae	
<i>Brachypterus urticae</i> (F.)	13
<i>B. glaber</i> (Steph.)	1
Rhizophagidae	
<i>Rhizophagus parallellocollis</i> Gyll.	8
<i>R. perforatus</i> Er.	2
<i>Monotoma picipes</i> Hbst	5
<i>M. longicollis</i> (Gyll.)	1
Cryptophagidae	
<i>Cryptophagus scutellatus</i> Newman	4
<i>Cryptophagus</i> spp.	12
<i>Atomaria</i> spp.	5
Phalacridae	
<i>Stilbus testaceus</i> (Panz.)	1
Latridiidae	

<i>Stephostethus angusticollis</i> (Gyll.)	1
<i>Latridius minutus</i> (grp) (L.)	28
<i>Corticaria</i> sp.	1
<i>Corticaria gibbosa</i> (Hbst.)	1
<i>Corticaria/Corticarina</i> spp.	5
Mycetophagidae	
<i>Typhaea stercorea</i> (L.)	1
Anobiidae	
<i>Hedobia imperialis</i> (L.)	1
<i>Grynobius planus</i> (F.)	1
<i>Anobium punctatum</i> (DeG.) / <i>inexpectatum</i> Lohse	2
Ptinidae	
<i>Ptinus fur</i> (L.)	2
Anthicidae	
<i>Omonadus floralis</i> (L.)	1
Geotrupidae	
<i>Geotrupes mutator</i> (Marsham)	1
<i>G. spiniger</i> (Marsham)	1
<i>G. stercorarius</i> (L.)	2
Scarabaeidae	
<i>Onthophagus joannae</i> Goljan	1
<i>Oxyomus sylvestris</i> (Scop.)	48
<i>Aphodius rufipes</i> (L.)	1
<i>A. pusillus</i> (Hbst.)	1
<i>A. sticticus</i> (Panz.)	6
<i>A. obliteratus</i> Panz.	15
<i>A. sphacelatus</i> (Panz.)	1
<i>A. fimetarius</i> (grp) (L.)	2
<i>A. ictericus</i> (Laich.)	1
<i>A. rufus</i> (Moll)	1
<i>A. granarius</i> (L.)	12
<i>Aphodius</i> spp.	17
<i>Heptaulacus testudinarius</i> (F.)	3
<i>Phyllopertha horticola</i> (L.)	2
Chrysomelidae	
<i>Gastrophysa polygoni</i> (L.)	1
<i>Gastrophysa viridula</i> (Deg.)	1
<i>Prasocuris phellandrii</i> (L.)	1
<i>Phyllotreta</i> sp.	1
<i>Longitarsus</i> spp.	3
<i>Epitrix pubescens</i> (Koch)	3
<i>Chaetocnema concinna</i> (Marsham) / <i>picipes</i> (Steph.)	5
<i>Psylliodes cupreus</i> (Koch)	3
Scolytidae	
<i>Leperisinus fraxini</i> (Panz.)	1
Curculionidae	
<i>Apion haematodes</i> Kirby	1
<i>Aspidapion aeneum</i> (F.)	4
<i>Taeniapion urticarium</i> (Hbst)	1
<i>Oxystoma cerdo</i> (Gers.)	1
<i>O. pomonae</i> (F.)	1

<i>Apion</i> (s.l.) spp.	7
<i>Sitona cambricus</i> Steph.	1
<i>Sitona lineellus</i> (Bonsd.)	1
<i>Sitona</i> spp.	4
<i>Hypera nigrirostris</i> (F.)	1
<i>Hypera</i> sp.	1
<i>Procas armillatus</i> (F.)	1
<i>Rhinoncus pericarpus</i> (L.)	1
<i>Ceutorhynchus erysimi</i> (F.)	1
<i>C. floralis</i> (Payk.)	1
<i>Parethelcus pollinarius</i> (Forst.)	2
<i>Nedys quadrimaculatus</i> (L.)	18
<i>Sirocalodes mixtus</i> (Muls. & Rey)	2
<i>Ceutorhynchus</i> (s.l.) spp.	7
<i>Mecinus pyraister</i> (Hbst.)	1
Dermaptera	
Forficulidae	
<i>Forficula auricularia</i> L.	8
Hemiptera	
Lygaeidae	
<i>Peritrechus geniculatus</i> (Hahn)	4
<i>Scolopostethus affinis</i> (Schilling)	1
<i>Auchenorrhyncha</i> indet.	1
Delphacidae	
<i>Conomelus anceps</i> (Germ.)	1
Diptera	
Scatopsidae	
<i>Scatopse notata</i> (L.)	1
Phoridae	
Indet.	1
Anthomyiidae indet.	
Indet.	2
Fanniidae	
<i>Fannia scalaris</i> (F.)	2
<i>Fannia</i> sp.	1
Muscidae	
<i>Hydrotaea dentipes</i> (F.)	1
<i>Hydrotaea</i> sp.	1
<i>Stomoxys calcitrans</i> (L.)	2
Scathophagidae	
<i>Scathophaga</i> sp.	1
Sepsidae	
Indet.	3
Heleomyzidae	
<i>Heleomyza serrata</i> (L.)	1
Sphaeroceridae	
<i>Telomerina flavipes</i> Meig.	3
<i>Thoracochaeta zosteræ</i> (Hal.)	2
Ephydridae	
Indet.	1
Hymenoptera	





Formicidae	
<i>Myrmica</i> sp.	3
<i>Lasius</i> sp.	13

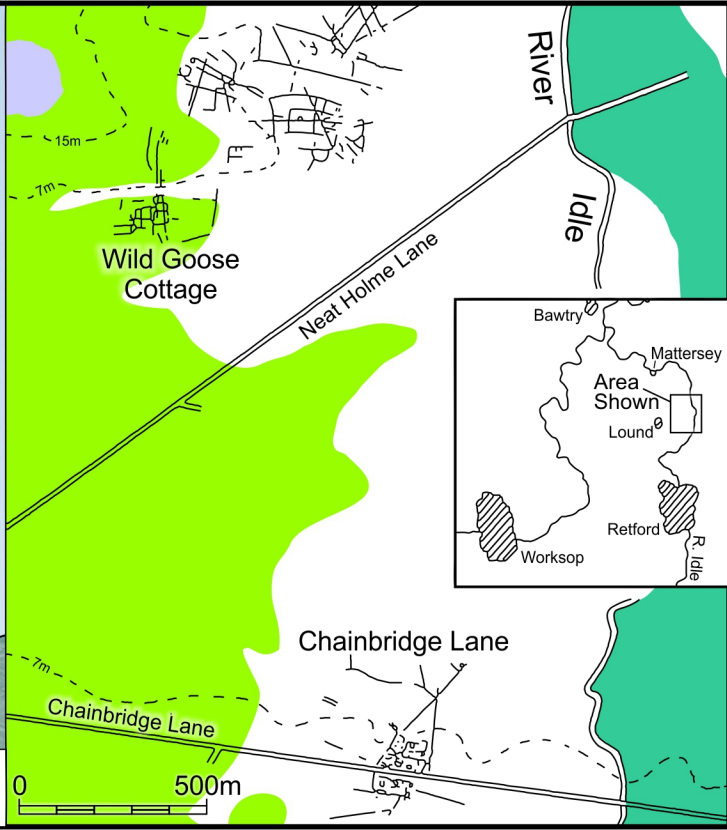
Insect remains from the Wild Goose Cottage well. Taxonomy after Duff (2012) and Chandler (1998)

Taxon	Host plant
<i>Parethelcus pollinarius</i>	<i>Urtica dioica</i>
<i>Nedyus quadrimaculatus</i>	" "
<i>Taeniapion urticarium</i>	
<i>Brachypterus urticae</i>	<i>Urtica</i> spp.
<i>B. glaber</i>	" "
<i>Apion haematodes</i>	<i>Rumex acetosella</i>
<i>Gastrophysa viridula</i>	<i>Rumex</i> spp.
<i>Rhinoncus pericarpus</i>	" "
<i>Gastrophysa polygoni</i>	Polygonaceae
<i>Chaetocnema concinna/picipes</i>	" " "
<i>Prasocuris phellandrii</i>	<i>Caltha palustris</i>
<i>Ceutorhynchus erysimi</i>	<i>Capsella bursa-pastoris</i>
<i>C. floralis</i>	Brassicaceae
<i>Phyllotreta</i> sp.	" " "
<i>Psylliodes cuprea</i>	" "
<i>Epitrix pubescens</i>	<i>Solanum dulcamara</i>
<i>Aspidapion aeneum</i>	Malvaceae
<i>Oxystoma cerdo</i>	<i>Vicia</i> spp.
<i>O. pomonae</i>	<i>Vicia</i> & <i>Lathyrus</i> spp.
<i>Sitona cambricus</i>	<i>Lotus uliginosus</i>
<i>Hypera nigrirostris</i>	<i>Trifolium pratense</i>
<i>Sitona lineellus</i>	Leguminosae
<i>Mecinus pyraister</i>	<i>Plantago lanceolata</i>
<i>Sirocalodes nigrinus</i>	<i>Fumaria officinalis</i>
<i>Procas armillatus</i>	<i>Fumaria</i> spp.
<i>Leperisinus fraxini</i>	<i>Fraxinus excelsior</i>
<i>Conomelus anceps</i>	<i>Juncus effusus</i>

Table 2: Plants indicated by their phytophages



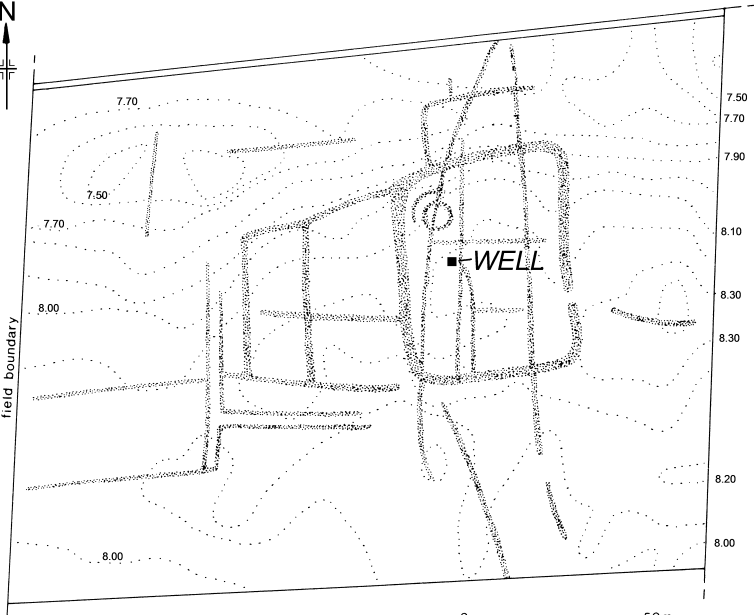
- | | |
|--|--|
|  Sandy boulder clay |  Alluvium |
|  1st terrace |  Peat |

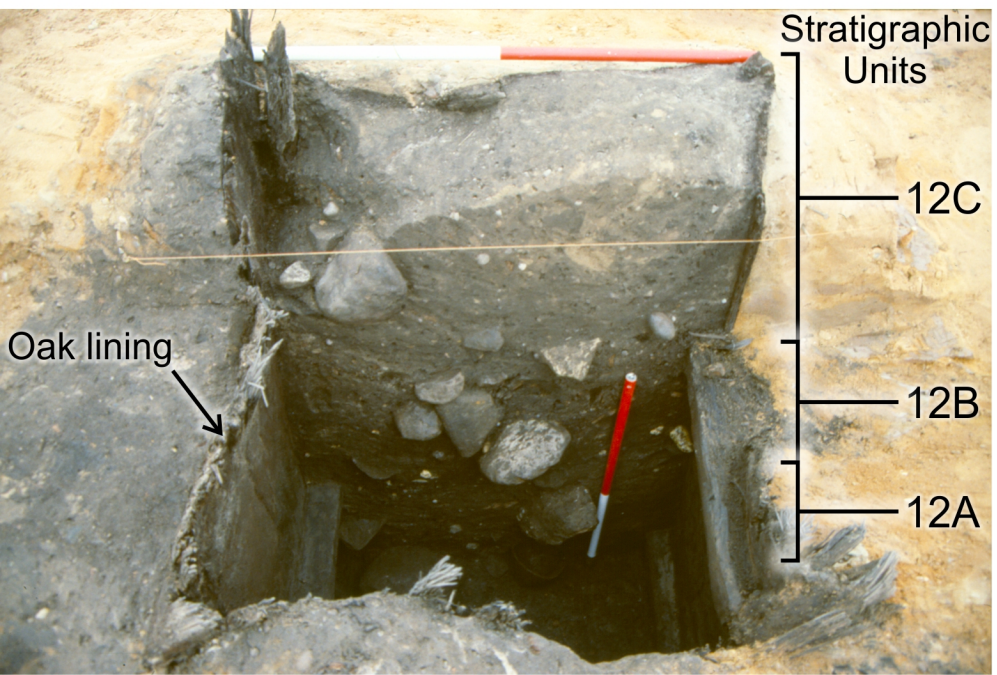






field boundary





A

Aquatics

Pasture
/dung

Meadowland

Wood & trees

Indicators:
deciduous
Wetlands/
marshesDisturbed
/arableSandy/dry
disturbed/arableDung/foul
habitats

Carrion

Indicators:
dung

Mould beetles

General
synanthropicHeathland
& moorland

Halotolerant

B

