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Technical report: Insect remains from a Roman well at Hayton, East Yorkshire

by

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Summary

Following assessment, one of a group of five subsamples from the fills of a Roman timber-lined well was selected for detailed analysis for insect and other macro-invertebrate remains. Insects were abundant and generally excellently preserved. It was argued that they represented both local and more distant habitats. The immediate surroundings seem to have been intensively used, with a limited fauna, and the wider landscape may have been used primarily for arable farming, as the evidence for grazing land was slight. There was little evidence of foul matter such as litter in livestock pens, almost no grain pests, and a limited fauna from buildings. Wood- or tree-associated species (other than the ubiquitous woodworm beetle) were very rare. Two bugs gave indications of temperatures above those of the mid 20th century.

Keywords: HAYTON; EAST RIDING OF YORKSHIRE; ROMAN; INSECT REMAINS; INVERTEBRATES

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Introduction

Following a field visit, five subsamples from the fill (Context 1177) of this wooden tank-like feature were assessed by Jaques *et al.* (2000) using the 'test' methodology of (Kenward *et al.* 1986a). All five flots were quite rich in insect remains, and preservation was generally superb; the five assemblages were essentially similar. Further, detailed, investigation was recommended.

Methods

A 4 kg subsample from one of the subsamples, numbered 3, was fully processed (three cycles of admixture of paraffin, 3-4 floatations of each). Identification was by comparison with material in the collection in the former EAU, University of York. Data processing and interpretative methods were as described, for example, by Kenward 2005.

Results

A complete list of the taxa recorded is given in Table 1, and detailed species list in Table 4. Main statistics for the assemblage of adult beetles and bugs are summarised in Table 2. Abbreviations used in the tables are explained in Table 5.

The deposits were fairly homogenous and appeared to have formed by slow accretion over a moderately long period (subjectively a at least decade or so, but the lifetime of the feature can only be estimated on other evidence). Preservation of insect remains was often superb, though it varied a little and the few lice were in poor condition. The assemblage of adult beetles and bugs recovered was large (654 individuals of 246 taxa), very species-rich (index of diversity, alpha = 143, SE = 9), and a represented wide range of habitats.

Aquatic invertebrates were present in moderate numbers, and included numerous *Daphnia* (water fleas) and Chironomidae (midge) larvae, some Ostracoda, and appreciable numbers of water beetles. These included at least 20 individuals of *Ochthebius minimus*. While it is quite likely that such insects lived in the well, all the aquatic beetles may have simply been attracted to the water surface and not necessarily have bred *in situ*. Aquatic *Helophorus* water beetles, normally the most abundant in water bodies of this kind, were rare: all but four of the *Helophorus* were *H. nubilus* or *H. rufipes*, beetles of well-drained soils in open landscapes, such as arable fields. The crustaceans (*Daphnia* and ostracods) and chironomids seem likely to have lived in the well, unless it was used as a receptacle for imported or waste water. There were appreciable numbers of individuals of waterside taxa, notably *Carpelimus elongatulus* (32) and *Lesteva longoelytrata* (7). These too may have lived in the well (it was argued by Hall *et al.* 1980 that *L. longoelytrata* lived in a much deeper well in Roman York), but again are as likely to have arrived in considerable numbers in flight or imported water.

There were significant numbers of synanthropes (here defined as species associated with human occupation; just over a fifth of the assemblage), presumably representing the fauna of the adjacent buildings. *Ptinus ?fur* (3 individuals, the commonest of the native spider beetles)

and the *Cryptophagus* spp. (a total of 16, 13 of them from the *C. dentatus* group) probably both fall in this category, though they may have lived in habitats such as birds' nests. The spider beetle *Tipnus unicolor* (2) appears to be typical of older buildings and is often abundant in Roman occupation deposits (Kenward in press). However, the synanthropic component from the well fill consisted mainly of facultative forms, those which are just as often found in nature as in artificial habitats (17 of 21 individuals). 'Typical' synanthropes (i.e. those mostly found in artificial habitats but well able to survive in nature) contributed only 3% of the assemblage (21 individuals), and there was only a single strong synanthrope. Unusually for any Roman site, grain pests were conspicuously rare, restricted to a single saw-toothed grain beetle, *Oryzaephilus surinamensis* (there was also a *Cryptolestes* from one of the assessment samples, though it cannot be confirmed as the common grain pest *C. ferrugineus*). The relative paucity of synanthropes other than facultative forms perhaps reflects the way the fauna accumulated rather than their rarity in the surroundings, for there is no evidence of dumped material or waste, which would have introduced or supported such species, within the structure. It appears likely that the *immediate* surroundings of the well were reasonably clean while this deposit accumulated.

A third ecological group was a range of decomposers typically associated with fairly foul conditions, together probably indicative of dung, including four *Aphodius* species (totalling 10 individuals), the dor beetle *Geotrupes spiniger* (2), and single individuals of a few others. This component was limited, however (only 2% of the fauna). Some other taxa coded 'rt', notably *Megasternum obscurum* (21), *Anotylus sculpturatus* (13), *A. rugosus* (12), *Tachinus laticollis* (11), *T. signatus* (5), and *Omalium rivulare* (3), are commonly found in dung. This component probably reflects livestock in the wider surroundings though, since all the species are migratory, there is no clear evidence for livestock immediately adjacent to the well. There was no 'stable manure' component of the kind recognised by Kenward and Hall (1997). Remains of what *may* have been *Damalinia* lice offer a hint that this well was drunk from by livestock, but unfortunately the specimens were rather decayed and lacked good identification characters even at the generic level; they may have come from wild mammals or birds. The evidence for grazing land is limited, apart from the dung beetles, which were not especially abundant. Comparison may be made with the large numbers of dung beetles found at some other sites, for example the Late Bronze Age well at Wilsford, Wiltshire (Osborne 1969; 1989); the Iron Age ditch fills at Bolton Hall, Bolton, NE of Pocklington, not far from Hayton (Jaques *et al.* 2002); the large cut of 15th/16th century date at North Bridge, Doncaster (Carrott *et al.* 1997; Kenward *et al.* 2004); the Flodden Hill rectilinear enclosure, Northumberland (Kenward 2001); or in a ditch fill at Haughey's Fort, County Armagh, Northern Ireland (Anderson 1989).

There were only a few typical grassland species (e.g. two chafers, *Phyllopertha horticola*, and two click beetles, *Adrastus pallens*, with three individuals, and *Agriotes lineatus*, with two); this is emphasised by comparison with the abundance of grassland species at nearby Bolton Hall, mentioned above. There were some species often associated with litter in open ground, e.g. *M. obscurum* (though see above), *Enicmus* sp. (15), and *Tachyporus hypnorum* (6), but no more than could survive in an intensively disturbed area with a few weeds, or might arrive in flight from an open agricultural landscape.

Plant feeders were abundant, and suggested a landscape with varied herbaceous vegetation. The most abundant phytophage was a flea beetle, *Longitarsus* sp. (14), which cannot be

assigned to a host plant. Similarly, a second *Longitarsus* sp. (6), the 'froghoppers *Aphrodes bicinctus* (8), *Aphrodes* sp. (6), Cicadellidae sp. (6, 3), *Philaenus spumarius* (3), and many others, can only be taken as indicative of herbaceous vegetation such as hay meadows, rough grassland, weedy fields or road margins. Some of the plant-feeders have more clearly defined hosts (Table 3). Two species associated with dead wood were recognised, but the woodworm beetle *Anobium punctatum* provided 30 of the 31 individuals, and were most probably derived from local structural timber, whether in buildings or just in fences or a well surround. Larvae of the second species, the bright red 'cardinal beetle' *Pyrochroa serraticornis*, typically develop under bark in rotten tree stumps, but the adults fly readily and are often found away from the larval habitat (and indeed the author has seen them drowned in an open cistern outdoors). A third beetle, the chafer *Cetonia aurata* (provisionally identified), can exploit wood mould, but also humus. There were no insects exclusively associated with living trees. Most tree-associated species, especially those exploiting dead wood, may have poor dispersal ability, however, leading to under-representation (tested for modern deposits by Kenward 2006), and examination of nearby contemporaneous natural deposits would be very desirable, should they contain useful quantities of insects.

There were rather few ground beetles (Carabidae) or other ground-living insects (only a single *Staphylinus* sp. for example), strongly suggesting that this structure did not act as a pitfall trap, and those ground-dwellers which had entered probably did so by climbing or in flight.

The nettlebug *Heterogaster urticae* is probably indicative of temperatures above those of the present day. *Eurydema oleracea* (a single individual from the well) occurred 'sparingly throughout southern England up to Cambs. and Glos. but [was] absent from East Anglia' in the middle of the 20th century according to Southwood and Leston (1959). It was thus well outside its known range in Yorkshire, hinting at substantially elevated temperatures (perhaps more like those of the early 21st century). These records may be related to those of southerly bugs from the Roman well at The Bedern, York (Kenward *et al.* 1986b): the latter were quite possibly imported in hay, but whether from a warmer Yorkshire or from the south of England (or even further afield) is uncertain. Importation of hay to the Hayton site over a distance of hundreds of kilometres seems much less likely than to the military establishment in the major centre at York, although of course Hayton lay close to an important road. The possible climatic significance of records of beetles and bugs from occupation sites in Northern England is discussed by Kenward (2004).

Discussion

The well fill deposit is of particular value in that it can reasonably be argued to be contemporaneous with the main phase of occupation at the site, rather than a period of degeneration or abandonment with infilling by natural sedimentation or deliberate dumping, as appears to be the case for the assemblages recovered from most Roman deep wells such as those in Skeldergate and Bedern in York (Hall *et al.* 1980; Kenward *et al.* 1986b) (it may be suggested that most other well fills which have been used to reconstruct conditions on sites have almost certainly in fact in-filled after abandonment or during low-grade occupation). In addition, most of the fauna probably arrived in flight, which means that it probably reflects a fairly wide area, albeit with a bias between habitats. It is thus of substantial value in reconstructing a picture of land use and natural environment (if such, in a strict sense, still

existed!) in the surroundings of the settlement. The immediate surroundings of the well were probably largely sterilised by intensive use, with at most a few weeds and accumulations of litter. The lack of evidence for stable manure or other foul matter produced by keeping livestock is notable, as is the rarity of species typical of stored hay. The typically very migratory insects from these habitats would surely have been more abundant had they existed in significant populations nearby. There was dead wood, but this was almost certainly structural, supporting only woodworm beetles. Insects from within buildings were rare and there were no ectoparasites of humans. Grain pests were exceptionally rare for a Roman occupation site.

Beyond the immediate area of occupation, it seems that the landscape had been greatly altered by human activity, and was probably very much as it was at the time the site was excavated: intensively exploited for arable farming, probably with some livestock, but not predominantly used for grazing. There is a little evidence from southerly bugs for temperatures somewhat above those of the mid 20th century.

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*Table 1. Complete list of invertebrate remains recorded from the 'detail' recorded subsample from the Roman well at Hayton. Order and nomenclature follow Kloet and Hincks (1964-77) for insects. Where both secure and tentative identifications for a given taxon were recorded, only the former are listed here. Ecological codes used in calculating statistics (Table 2) are given (they are explained in Table 5) together with the number of samples in which each taxon was recorded. * = not used in calculating assemblage statistics. The remains were of adults unless stated. 'Sp.' indicates that record was probably an additional taxon, 'sp. indet.' that the material may have been of a taxon listed above it.*

Crustacea	
**Daphnia* sp. (ephippium)	oa-w
*Ostracoda sp.	u
Myriapoda	
*Diplopoda sp.	u
*Chilopoda sp.	u
Insecta	
Trichoptera	
*Trichoptera sp.	oa-w
Dermaptera	
**Forficula auricularia* Linnaeus	u
Mallophaga	
**?Damalinia* sp.	u
Hemiptera	
Dolycoris baccarum (Linnaeus)	oa-p
Eurydema oleracea (Linnaeus)	oa-p
*Pentatomidae sp. (nymph)	oa-p
Heterogaster urticae (Fabricius)	oa-p
Stygnocoris pedestris (Fallen)	oa
Drymus sp.	oa-p
Scolopostethus sp.	oa-p
Lygaeidae sp.	oa-p
Dictyla convergens (Herrich-Schaffer)	oa-p
Anthocoris sp.	oa-p
Orius sp.	oa-p
?Psallus sp.	oa-p
Lyctocoris campestris (Fabricius)	rd-st
Lygus ?wagneri Remane	oa-p
Liocoris tripustulatus (Fabricius)	oa-p
Miridae spp.	oa-p
Saldula sp.	oa-d
Aphrophora alni (Fallen)	oa-p
Philaenus spumarius (Linnaeus)	oa-p

Macropsis sp.	oa-p
Aphrodes bicinctus (Schrank)	oa-p
Aphrodes sp.	oa-p
Conosanus obsoletus (Kirschbaum)	oa-p
Cicadellidae spp.	oa-p
Cicadomorpha sp.	oa-p
Delphacidae spp.	oa-p
*Aphidoidea sp.	u

Diptera

*Bibionidae sp.	u
*Chironomidae sp. (larva)	w
*Diptera sp. (adult)	u
*Diptera sp. (pupa)	u

Coleoptera

Nebria brevicollis (Fabricius)	oa
Notiophilus ?palustris (Duftschmid)	oa
Loricera pilicornis (Fabricius)	oa
Dyschirius globosus (Herbst)	oa
Clivina fossor (Linnaeus)	oa
Patrobus ?atrorufus (Strom)	oa
Bembidion properans Stephens	oa
Bembidion (*Peryphus*) sp.	oa
Bembidion quadrimaculatum (Linnaeus)	oa
Bembidion guttula or *mannerheimi*	oa
Pterostichus cupreus (Linnaeus)	oa
Pterostichus gracilis (Dejean)	oa-d
Pterostichus melanarius (Illiger)	ob
Pterostichus ?strenuus (Panzer)	oa
?Pterostichus sp. indet.	ob
Calathus fuscipes (Goeze)	oa
Laemostenus terricola (Herbst)	ss
Amara lunicollis Schiodte	oa
Amara ?familiaris (Duftschmid)	oa
Amara ?plebeja (Gyllenhal)	oa
Amara sp.	oa
Harpalus rufipes (Degeer)	oa
Harpalus rufibarbis (Fabricius)	oa
Harpalus affinis (Schrank)	oa
*Carabidae sp. indet. (larva)	ob
Hydroporinae sp.	oa-w
Agabus bipustulatus (Linnaeus)	oa-w
Helophorus ?aquaticus (Linnaeus)	oa-w
Helophorus nubilus Fabricius	oa
Helophorus rufipes (d'Antic)	oa
Helophorus sp.	oa-w
Cercyon analis (Paykull)	rt-sf

Cercyon atricapillus (Marsham)	rf-st
Cercyon ?haemorrhoidalis (Fabricius)	rf-sf
Cercyon tristis (Illiger)	oa-d
Megasternum obscurum (Marsham)	rt
Hydrobius fuscipes (Linnaeus)	oa-w
Anacaena sp.	oa-w
Acritus nigricornis (Hoffmann)	rt-st
Hister impressus Fabricius	rt-sf
Ochthebius bicolon Germar	oa-w
Ochthebius minimus (Fabricius)	oa-w
Hydraena sp.	oa-w
Limnebius truncatellus (Thunberg)	oa-w
Ptenidium sp.	rt
Acrotrichis spp.	rt
Catops sp.	u
Scydmaenidae sp.	u
Micropeplus porcatus (Paykull)	rt
Megarthrus denticollis (Beck)	rt-sf
Proteinus sp.	rt
Acidota cruentata Mannerheim	oa
Lesteva longoelytrata (Goeze)	oa-d
Omalium caesum Gravenhorst	rt-sf
Omalium rivulare (Paykull)	rt-sf
Xylodromus concinnus (Marsham)	rt-st
Coprophilus striatulus (Fabricius)	rt-st
Syntomium aeneum (Muller)	oa
Carpelimus bilineatus Stephens	rt-sf
Carpelimus elongatulus (Erichson)	oa-d
Aploderus caelatus (Gravenhorst)	rt
Platystethus arenarius (Fourcroy)	rf
Platystethus degener Mulsant & Rey	oa-d
Platystethus nitens (Sahlberg)	oa-d
Anotylus complanatus (Erichson)	rt-sf
Anotylus inustus (Gravenhorst)	rt
Anotylus nitidulus (Gravenhorst)	rt
Anotylus rugosus (Fabricius)	rt
Anotylus ?sculpturatus (Gravenhorst)	rt
Anotylus tetracarinatus (Block)	rt
Oxyporus rufus (Linnaeus)	u
Stenus clavicornis (Scopoli)	u
Stenus fulvicornis Stephens	rt
Stenus spp.	u
Lathrobium multipunctatum Gravenhorst	u
Lathrobium spp.	u
Medon sp.	u
Rugilus rufipes Germar	rt-st
Othius sp.	rt
Gyrohypnus fracticornis (Muller)	rt-st

Xantholinus linearis (Olivier)	rt-sf
Xantholinus longiventris Heer	rt-sf
Philonthus laminatus (Creutzer)	rf-st
Philonthus spp.	u
Staphylinus aeneocephalus Degeer	u
Quedius cinctus (Paykull)	rt
Tachyporus hypnorum (Fabricius)	u
Tachyporus nitidulus (Fabricius)	u
Tachyporus obtusus (Linnaeus)	u
Tachyporus pusillus Gravenhorst	u
Tachyporus sp. indet.	u
Tachinus corticinus Gravenhorst	u
Tachinus humeralis Gravenhorst	u
Tachinus laticollis Gravenhorst	u
Tachinus signatus Gravenhorst	u
Cordalia obscura (Gravenhorst)	rt-sf
Drusilla canaliculata (Fabricius)	u
Aleochara sp.	u
Aleocharinae spp.	u
Amauronyx maerkeli (Aube)	u
Bryaxis sp.	u
Geotrupes spiniger (Marsham)	oa-rf
Aphodius ater (Degeer)	oa-rf
Aphodius contaminatus (Herbst)	oa-rf
Aphodius prodromus (Brahm)	ob-rf
Aphodius rufipes (Linnaeus)	oa-rf
Oxyomus sylvestris (Scopoli)	rt-sf
Serica brunnea (Linnaeus)	oa-p
Phyllopertha horticola (Linnaeus)	oa-p
Cetonia ?aurata (Linnaeus)	oa
Clambus pubescens Redtenbacher	rt-sf
Cyphon sp.	oa-d
Byrrhidae sp.	oa-p
Dryops ernesti des Gozis	oa-d
Athous haemorrhoidalis (Fabricius)	oa-p
Agriotes lineatus (Linnaeus)	oa-p
Agriotes obscurus (Linnaeus)	oa-p
Adrastus pallens (Fabricius)	oa-p
Cantharis rufa Linnaeus	ob
Cantharis rustica Fallen	ob
Rhagonycha fulva (Scopoli)	ob
Anobium punctatum (Degeer)	l-sf
Tipnus unicolor (Piller & Mitterpacher)	rt-ss
Ptinus fur (Linnaeus)	rd-sf
Kateretes rufilabris (Latreille)	oa-p-d
Brachypterus urticae (Fabricius)	oa-p
Meligethes sp.	oa-p
Monotoma bicolor Villa	rt-st

Monotoma sp.	rt-sf
Oryzaephilus ?surinamensis (Linnaeus)	g-ss
Cryptophagus dentatus group	rd-sf
Cryptophagus schmidti Sturm	rt
Cryptophagus spp.	rd-sf
Atomaria spp.	rd
Ephistemus globulus (Paykull)	rd-sf
Olibrus aeneus (Fabricius)	oa-p
Stilbus testaceus (Panzer)	oa-p
Rhyzobius litura (Fabricius)	oa-p
Mycetaea hirta (Marsham)	rd-ss
Lathridius minutus group	rd-st
Enicmus histrio or *transversus*	rt-sf
Corticaria elongata (Gyllenhal)	rt-sf
Corticaria spp.	rt-sf
Corticarina sp.	rt
Cortinicara gibbosa (Herbst)	rt
Typhaea stercorea (Linnaeus)	rd-ss
Pyrochroa serraticornis (Scopoli)	oa-l
Anthicus floralis (Linnaeus)	rt-st
Chrysolina oricalcia (Muller)	oa-p
Chrysolina ?staphylaea (Linnaeus)	oa-p
Gastrophysa viridula (Degeer)	oa-p
Phaedon tumidulus (Germar)	oa-p
Hydrothassa marginella (Linnaeus)	oa-d-p
Phyllotreta ?nemorum (Linnaeus)	oa-p
Phyllotreta undulata Kutschera	oa-p
Phyllotreta sp.	oa-p
Longitarsus spp.	oa-p
Chaetocnema arida group	oa-p
Chaetocnema concinna (Marsham)	oa-p
Psylliodes chrysocephala (Linnaeus)	oa-p
Psylliodes spp.	oa-p
Apion (*Aspidapion*) *aeneum* (Fabricius)	oa-p
Apion (*Aspidapion*) *radiolus* (Marsham)	oa-p
Apion (*Ceratapion*) *onopordi* Kirby	oa-p
Apion (*Eutrichapion*) *ervi* Kirby	oa-p
Apion (*Eutrichapion*) *?virens* Herbst	oa-p
Apion (*Oxystoma*) *craccae* (Linnaeus)	oa-p
Apion (*Protapion*) spp.	oa-p
Apion spp. and spp. indet.	oa-p
Sitona hispidulus (Fabricius)	oa-p
Sitona lepidus Gyllenhal	oa-p
Sitona ?lineatus (Linnaeus)	oa-p
Hypera nigrirostris (Fabricius)	oa-p
Leiosoma ?deflexum (Panzer)	oa-p
Ceutorhynchus contractus (Marsham)	oa-p
Ceutorhynchus pollinarius (Forster)	oa-p

Ceutorhynchus spp.	oa-p
Rhinoncus pericarpius (Linnaeus)	oa-p
Phytobius quadrituberculatus (Fabricius)	oa-p-d
Ceuthorhynchinae sp.	oa-p
?Curculionidae sp.	oa
*Coleoptera sp. (larva)	u

Hymenoptera

**Myrmica* sp.	u
**?Lasius* sp.	u
*Formicidae sp. A	u
*Chalcidoidea sp.	u
*Proctotrupoidea sp.	u
*Hymenoptera Parasitica sp.	u
*Hymenoptera sp.	u

Arachnida

*Aranae sp.	u
*Acarina sp.	u

Table 2. Main statistics for assemblages of adult beetles and bugs (excluding aphids and scale insects) from the quantified assemblage from the well at Hayton. For explanation of abbreviations, see Table 5.

Context	1177	SM	0	PSSA	17
Sample	3	PSM	0	NSA	140
Ext	/2	NM	0	PNSA	21
S	246	PNM	0	ALPHASA	20
N	654	ALPHAM	0	SEALPHASA	3
ALPHA	143	SEALPHAM	0	SSF	25
SEALPHA	9	SL	2	PSSF	10
SOB	140	PSL	1	NSF	113
PSOB	57	NL	31	PNSF	17
NOB	320	PNL	5	ALPHASF	10
PNOB	49	ALPHAL	1	SEALPHASF	2
ALPHAOB	95	SEALPHAL	0	SST	11
SEALPHAOB	9	SRT	66	PSST	4
SW	11	PSRT	27	NST	21
PSW	4	NRT	218	PNST	3
NW	36	PNRT	33	ALPHAST	10
PNW	6	ALPHART	32	SEALPHAST	4
ALPHAW	6	SEALPHART	4	SSS	5
SEALPHAW	2	SRD	12	PSSS	2
SD	12	PSRD	5	NSS	6
PSD	5	NRD	65	PNSS	1
ND	56	PNRD	10	ALPHASS	0
PND	9	ALPHARD	4	SEALPHASS	0
ALPHAD	5	SEALPHARD	1	SG	1
SEALPHAD	1	SRF	9	PSG	0
SP	81	PSRF	4	NG	1
PSP	33	NRF	16	PNG	0
NP	163	PNRF	2	ALPHAG	0
PNP	25	ALPHARF	0	SEALPHAG	0
ALPHAP	64	SEALPHARF	0		
SEALPHAP	8	SSA	41		

Table 3. Phytophages from the well fill 1177, Hayton, with constrained host ranges; eurytopic forms have been omitted. Principal sources: Bullock (1993), Philp (2006), Southwood and Leston (1959).

Taxon	Hosts
Eurydema oleracea	Various crucifers
Heterogaster urticae	Almost exclusively nettles, *Urtica*, and usually stinging nettle, *U. dioica* L.
Dictyla convergens (*Monanthia humuli*)	Water forget-me-not, *Myosotis scorpioides* L.
Liocoris tripustulatus	*Urtica dioica*
Conosanus obsoletus	Rushes, *Juncus*, and grasses, Poaceae
Kateretes rufilabris	*Juncus* spp.
Brachypterus urticae	*Urtica*, especially *U. dioica*
Chrysolina oricalcia	Cow parsley, *Anthriscus sylvestris (L.) Hoffm.*
Gastrophysa viridula	*Rumex* spp.
Phaedon tumidulus	Hogweed, *Heracleum sphondylium* L.
Hydrothassa marginella	Buttercups and their allies, *Ranunculus* spp.
Phyllotreta nemorum (?)	*Brassica* spp. and other crucifers
P. undulata	*Brassica* spp. and other crucifers
Chaetocnema arida group	Mostly grasses and *Juncus*
C. concinna	Knotgrasses, docks and their relatives, *Persicaria* and *Rumex* spp.
Psylliodes chrysocephala	*Brassica* spp. and other crucifers
Apion aeneum	Common mallow, *Malva sylvestris* L.
A. radiolus	*Malva sylvestris* and other Malvaceae

A. onorpordi	Thistles, burdocks, knapweeds, *Carduus*, *Cirsium*, *Arctium*, *Centaurea* spp.
A. ervi	Meadow vetchling, *Lathyrus pratensis* L.
A. virens (?)	Clovers, *Trifolium* spp.
A. craccae	Vetches, *Vicia* spp.
Sitona hispidulus	Lucerne, medicks, clovers, trefoils, *Medicago* and *Trifolium* spp.
S. lepidus	Clovers, trefoils, *Trifolium* spp.
S. lineatus (?)	Various Fabaceae
Hypera nigrirostris	Red clover, *Trifolium pratense* L.
Leiosoma deflexum (?)	Wood anemone, creeping buttercup, *Anemone nemorosa* L., *Ranunculus repens* L.
Ceutorhynchus contractus	Various Brassicaceae
C. pollinarius	*Urtica dioica*
Rhinoncus pericarpius	Docks, *Rumex* spp.
Phytobius quadrituberculatus	*Rumex crispus*, *Persicaria* spp.

Table 4. Species list in rank order for invertebrate macrofossils from the detail-recorded sample from the well at Hayton. The adult Hemiptera (bugs) and Coleoptera (beetles) are listed first, followed by the remaining invertebrates. Headers: ec - ecological codes; n = minimum number of individuals. For translation of ecological codes, see Table 5. Note: it has not been practical to italicise specific epithets in this table.

Taxon	**n**	**ec**
Carpelimus elongatulus	32	oa-d
Anobium punctatum	30	l-sf
Megasternum obscurum	21	rt
Ochthebius minimus	20	oa-w
Enicmus histrio or transversus	15	rt-sf
Stenus sp. A	14	u
Longitarsus sp. C	14	oa-p
Anotylus ?sculpturatus	13	rt
Cryptophagus dentatus group	13	rd-sf
Anotylus rugosus	12	rt
Tachinus laticollis	11	u
Atomaria sp. B	10	rd
Lathridius minutus group	10	rd-st
Aphrodes bicinctus	8	oa-p
Aleocharinae sp. F	8	u
Atomaria sp. B	8	rd
Ephistemus globulus	8	rd-sf
Lesteva longoelytrata	7	oa-d
Aphrodes sp.	6	oa-p
Cicadellidae sp. B	6	oa-p
Acrotrichis sp. C	6	rt
Tachyporus hypnorum	6	u
Aleocharinae sp. C	6	u
Gastrophysa viridula	6	oa-p
Longitarsus sp. B	6	oa-p
Amara sp.	5	oa
Helophorus nubilus	5	oa
Anotylus nitidulus	5	rt
Xantholinus longiventris	5	rt-sf
Tachinus signatus	5	u
Aphodius prodromus	5	ob-rf
Conosanus obsoletus	4	oa-p
Dyschirius globosus	4	oa
Omalium caesum	4	rt-sf
Syntomium aeneum	4	oa
Dryops ernesti	4	oa-d
Agriotes obscurus	4	oa-p
Cryptophagus sp. B	4	rd-sf
Phyllotreta undulata	4	oa-p
Longitarsus sp. A	4	oa-p

Ceutorhynchus contractus	4	oa-p
Lygus ?wagneri	3	oa-p
Philaenus spumarius	3	oa-p
Cicadellidae sp. C	3	oa-p
Nebria brevicollis	3	oa
Harpalus rufibarbis	3	oa
Helophorus sp.	3	oa-w
Limnebius truncatellus	3	oa-w
Micropeplus porcatus	3	rt
Omalium rivulare	3	rt-sf
Platystethus nitens	3	oa-d
Stenus sp. B	3	u
Medon sp.	3	u
Xantholinus linearis	3	rt-sf
Aphodius contaminatus	3	oa-rf
Adrastus pallens	3	oa-p
Ptinus fur	3	rd-sf
Atomaria sp. A	3	rd
Corticaria elongata	3	rt-sf
Corticaria sp. C	3	rt-sf
Heterogaster urticae	2	oa-p
Lyctocoris campestris	2	rd-st
Liocoris tripustulatus	2	oa-p
Miridae sp. B	2	oa-p
Aphrophora alni	2	oa-p
Delphacidae sp. A	2	oa-p
Delphacidae sp. B	2	oa-p
Bembidion quadrimaculatum	2	oa
Pterostichus melanarius	2	ob
Amara ?familiaris	2	oa
Amara ?plebeja	2	oa
Harpalus rufipes	2	oa
Cercyon analis	2	rt-sf
Ochthebius bicolon	2	oa-w
Hydraena sp.	2	oa-w
Acrotrichis sp. A	2	rt
Carpelimus bilineatus	2	rt-sf
Platystethus degener	2	oa-d
Anotylus complanatus	2	rt-sf
Stenus clavicornis	2	u
Stenus sp. F	2	u
Lathrobium multipunctatum	2	u
Lathrobium sp. A	2	u
Philonthus sp. C	2	u
Quedius cinctus	2	rt
Tachyporus nitidulus	2	u
Geotrupes spiniger	2	oa-rf
Phyllopertha horticola	2	oa-p

Agriotes lineatus	2	oa-p
Tipnus unicolor	2	rt-ss
Meligethes sp.	2	oa-p
Cryptophagus sp. A	2	rd-sf
Rhyzobius litura	2	oa-p
Corticaria sp. A	2	rt-sf
Corticaria sp. B	2	rt-sf
Cortinicara gibbosa	2	rt
Phaedon tumidulus	2	oa-p
Hydrothassa marginella	2	oa-d-p
Chaetocnema arida group	2	oa-p
Chaetocnema concinna	2	oa-p
Psylliodes sp. A	2	oa-p
Apion (Ceratapion) onopordi	2	oa-p
Apion (Oxystoma) craccae	2	oa-p
Apion (Protapion) sp. B	2	oa-p
Sitona hispidulus	2	oa-p
?Psallus sp.	1	oa-p
Dolycoris baccarum	1	oa-p
Eurydema oleracea	1	oa-p
Stygnocoris pedestris	1	oa
Drymus sp.	1	oa-p
Scolopostethus sp.	1	oa-p
Lygaeidae sp.	1	oa-p
Dictyla convergens	1	oa-p
Anthocoris sp.	1	oa-p
Orius sp.	1	oa-p
Miridae sp.	1	oa-p
Miridae sp. A	1	oa-p
Saldula sp.	1	oa-d
Macropsis sp.	1	oa-p
Cicadellidae sp. A	1	oa-p
Cicadomorpha sp.	1	oa-p
Notiophilus ?palustris	1	oa
Loricera pilicornis	1	oa
Clivina fossor	1	oa
Patrobus ?atrorufus	1	oa
Bembidion properans	1	oa
Bembidion (Peryphus) sp.	1	oa
Bembidion guttula or mannerheimi	1	oa
Pterostichus cupreus	1	oa
Pterostichus gracilis	1	oa-d
Pterostichus ?strenuus	1	oa
?Pterostichus sp.	1	ob
Calathus fuscipes	1	oa
Laemostenus terricola	1	ss
Amara lunicollis	1	oa
Amara sp. A	1	oa

Harpalus affinis	1	oa
Hydroporinae sp.	1	oa-w
Agabus bipustulatus	1	oa-w
Helophorus ?aquaticus	1	oa-w
Helophorus rufipes	1	oa
Cercyon atricapillus	1	rf-st
Cercyon ?haemorrhoidalis	1	rf-sf
Cercyon tristis	1	oa-d
Hydrobius fuscipes	1	oa-w
Anacaena sp.	1	oa-w
Acritus nigricornis	1	rt-st
Hister impressus	1	rt-sf
Ptenidium sp.	1	rt
Acrotrichis sp. B	1	rt
Catops sp.	1	u
Scydmaenidae sp.	1	u
Megarthrus denticollis	1	rt-sf
Proteinus sp.	1	rt
Acidota cruentata	1	oa
Xylodromus concinnus	1	rt-st
Coprophilus striatulus	1	rt-st
Aploderus caelatus	1	rt
Platystethus arenarius	1	rf
Anotylus inustus	1	rt
Anotylus tetracarinatus	1	rt
Oxyporus rufus	1	u
Stenus fulvicornis	1	rt
Stenus sp. C	1	u
Stenus sp. D	1	u
Stenus sp. E	1	u
Lathrobium sp. B	1	u
Rugilus rufipes	1	rt-st
Othius sp.	1	rt
Gyrohypnus fracticornis	1	rt-st
Philonthus laminatus	1	rf-st
Philonthus sp. A	1	u
Philonthus sp. B	1	u
Philonthus sp. D	1	u
Staphylinus aeneocephalus	1	u
Tachyporus obtusus	1	u
Tachyporus pusillus	1	u
Tachyporus sp.	1	u
Tachinus corticinus	1	u
Tachinus humeralis	1	u
Cordalia obscura	1	rt-sf
Drusilla canaliculata	1	u
Aleochara sp.	1	u
Aleocharinae sp. A	1	u

Aleocharinae sp. B	1	u
Aleocharinae sp. D	1	u
Aleocharinae sp. E	1	u
Aleocharinae sp. G	1	u
Aleocharinae sp. H	1	u
Aleocharinae sp. I	1	u
Aleocharinae sp. J	1	u
Amauronyx maerkeli	1	u
Bryaxis sp.	1	u
Aphodius ater	1	oa-rf
Aphodius rufipes	1	oa-rf
Oxyomus sylvestris	1	rt-sf
Serica brunnea	1	oa-p
Cetonia ?aurata	1	oa
Clambus pubescens	1	rt-sf
Cyphon sp.	1	oa-d
Byrrhidae sp.	1	oa-p
Athous haemorrhoidalis	1	oa-p
Cantharis rufa	1	ob
Cantharis rustica	1	ob
Rhagonycha fulva	1	ob
Kateretes rufilabris	1	oa-p-d
Brachypterus urticae	1	oa-p
Monotoma bicolor	1	rt-st
Monotoma sp.	1	rt-sf
Oryzaephilus ?surinamensis	1	g-ss
Cryptophagus schmidti	1	rt
Olibrus aeneus	1	oa-p
Stilbus testaceus	1	oa-p
Mycetaea hirta	1	rd-ss
Corticarina sp.	1	rt
Typhaea stercorea	1	rd-ss
Pyrochroa serraticornis	1	oa-l
Anthicus floralis	1	rt-st
Chrysolina oricalcia	1	oa-p
Chrysolina ?staphylaea	1	oa-p
Phyllotreta ?nemorum	1	oa-p
Phyllotreta sp. A	1	oa-p
Phyllotreta sp. B	1	oa-p
Psylliodes chrysocephala	1	oa-p
Psylliodes sp. B	1	oa-p
Apion (Aspidapion) aeneum	1	oa-p
Apion (Aspidapion) radiolus	1	oa-p
Apion (Eutrichapion) ervi	1	oa-p
Apion (Eutrichapion) ?virens	1	oa-p
Apion (Protapion) sp. A	1	oa-p
Apion sp. A	1	oa-p
Apion sp. B	1	oa-p

Apion sp. C	1	oa-p
Apion sp. D	1	oa-p
Sitona lepidus	1	oa-p
Sitona ?lineatus	1	oa-p
Hypera nigrirostris	1	oa-p
Leiosoma ?deflexum	1	oa-p
Ceutorhynchus pollinarius	1	oa-p
Ceutorhynchus sp. A	1	oa-p
Ceutorhynchus sp. B	1	oa-p
Rhinoncus pericarpius	1	oa-p
Phytobius quadrituberculatus	1	oa-p-d
Ceuthorhynchinae sp.	1	oa-p
?Curculionidae sp.	1	oa
*Diptera sp. (adult)	100	u
*Acarina sp.	100	u
*Daphnia sp. (ephippium)	15	oa-w
*Chironomidae sp. (larva)	15	w
*Formicidae sp. A	15	u
*Myrmica sp.	15	u
*Aranae sp.	15	u
*Forficula auricularia	6	u
*Bibionidae sp.	6	u
*Coleoptera sp. (larva)	6	u
*Hymenoptera Parasitica sp.	6	u
*Ostracoda sp.	5	u
*Carabidae sp. (larva)	4	ob
*?Damalinia sp.	3	u
*Chalcidoidea sp.	3	u
*Trichoptera sp.	2	oa-w
*Diplopoda sp.	2	u
*Aphidoidea sp.	2	u
*Diptera sp. (pupa)	2	u
*Proctotrupoidea sp.	2	u
*Chilopoda sp.	1	u
*Pentatomidae sp. (nymph)	1	oa-p
*?Heterogaster urticae (nymph)	1	oa-p
*?Lasius sp.	1	u
*Hymenoptera sp.	1	u

Table 5. Abbreviations for ecological codes and statistics used for interpretation of insect remains in text and tables. Lower case codes in parentheses are those assigned to taxa and used to calculate the group values (the codes in capitals). See Table 2 for codes assigned to taxa from Hayton. Indivs - individuals (based on MNI); No - number.

No taxa	S	Percentage of RT taxa	PSRT
Estimated number of indivs	N	No RT indivs	NRT
Index of diversity (α)	alpha	Percentage of RT indivs	PNRT
Standard error of alpha	SE alpha	Index of diversity of RT component	alpha RT
No 'certain' outdoor taxa (oa)	SOA	Standard error	SEalphaRT
Percentage of 'certain' outdoor taxa	PSOA	No 'dry' decomposer taxa (rd)	SRD
No 'certain' outdoor indivs	NOA	Percentage of RD taxa	PSRD
Percentage of 'certain' outdoor indivs	PNOA	No RD indivs	NRD
No OA and probable outdoor taxa (oa + ob)	SOB	Percentage of RD indivs	PNRD
Percentage of OB taxa	PSOB	Index of diversity of the RD component	alphaRD
No OB indivs	NOB	Standard error	SEalphaRD
Percentage OB indivs	PNOB	No 'foul' decomposer taxa (rf)	SRF
Index of diversity of the OB component	alphaOB	Percentage of RF taxa	PSRF
Standard error	SEalphaOB	No RF indivs	NRF
No aquatic taxa (w)	SW	Percentage of RF indivs	PNRF
Percentage of aquatic taxa	PSW	Index of diversity of the RF component	alphaRF
No aquatic indivs	NW	Standard error	SEalphaRF
Percentage of W indivs	PNW	No synanthropic taxa (sf + st + ss)	SSA
Index of diversity of the W component	alphaW	Percentage of synanthropic taxa	PSSA
Standard error	SEalphaW	No synanthropic indivs	NSA
No damp ground/waterside taxa (d)	SD	Percentage of SA indivs	PNSA
Percentage D taxa	PSD	Index of diversity of SA component	ALPHASA
No damp D indivs	ND	Standard error	SEALPHASA
Percentage of D indivs	PND	No facultatively synanthropic taxa	SSF
Index of diversity of the D component	alphaD	Percentage of SF taxa	PSSF
Standard error	SEalphaD	No SF indivs	NSF
No strongly plant-associated taxa (p)	SP	Percentage of SF indivs	PNSF
Percentage of P taxa	PSP	Index of diversity of SF component	ALPHASF
No strongly P indivs	NP	Standard error	SEALPHASF
Percentage of P indivs	PNP	No typical synanthropic taxa	SST
Index of diversity of the P component	alphaP	Percentage of ST taxa	PSST
Standard error	SEalphaP	No ST indivs	NST
No heathland/moorland taxa (m)	SM	Percentage of ST indivs	PNST
Percentage of M taxa	PSM	Index of diversity of ST component	ALPHAST
No M indivs	NM	Standard error	SEALPHAST
Percentage of M indivs	PNM	No strongly synanthropic taxa	SSS
Index of diversity of the M component	alphaM	Percentage of SS taxa	PSSS
Standard error	SEalphaM	No SS indivs	NSS
No wood-associated taxa (l)	SL	Percentage of SS indivs	PNSS
Percentage of L taxa	PSL	Index of diversity of SS component	ALPHASS
No L indivs	NL	Standard error	SEALPHASS
Percentage of L indivs	PNL	No uncoded taxa (u)	SU
Index of diversity of the L component	alphaL	Percentage of uncoded indivs	PNU
Standard error	SEalphaL	No indivs of grain pests (g)	NG
No decomposer taxa (rt + rd + rf)	SRT	Percentage of indivs of grain pests	PNG