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Defining an indicator package to allow identification of 'cesspits' in the archaeological record

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ABSTRACT

This paper summarises the insect, plant macrofossil and other environmental evidence from a large number of deposits, thought to be cesspits, at a range of archaeological sites. A potential 'indicator package' (*sensu* Kenward and Hall, 1997), consisting of a range of biological materials and archaeological artefacts, is outlined which should allow a more accurate identification of cesspits in the archaeological record enhancing further studies of the rich evidence often preserved in them.

1. Introduction

Cess/rubbish pits are probably one of most common features encountered on medieval archaeological sites (usually 9th–15th century in Britain) (Greig, 1982a; Sabine, 1934). The contents of these features, technically best described as *ordure*, are commonly called 'cess' by most field archaeologists (although strictly speaking 'cess' is an ancient land tax) and the term 'cess' will be maintained throughout this paper.

Cess/rubbish pits are a type of archaeological feature which is routinely ignored both during excavation and publication. This is in part due to their perceived 'mundane nature' and their 'obvious function'. However, previous studies have clearly shown that they contain a wealth of information on past diet, waste disposal, health and hygiene, and settlement history (e.g. Greig, 1982a, 1994; Hall, 2000; Moffett, 1992). One persistent problem is how the archaeologist defines a cesspit from any other pit or archaeological feature, particularly on deeply stratified urban sites? Moreover, how can we effectively identify the presence of cess in the archaeological record within features where it should not normally be present?

One answer to these questions is to propose an 'indicator package' for both cesspits and cess in the archaeological record. Defining indicator packages for the identification of specific archaeological materials or contexts has become *de rigueur* (i.e. Kenward and Hall, 1997; Hall and Kenward, 2003; Moffett and Smith, 1997; Smith et al., 1999, 2005). The aim is to take individual 'indicators' for a specific archaeological behaviour, derived either from the archaeological record itself or the biological record, and combine these to form a larger diagnostic 'package'. The development of these larger indicator packages has been shown to be a very strong interpretative tool allowing a number of archaeological materials and features to be firmly identified (Kenward and Hall, 1997; Hall and Kenward, 2003). Much of the strength of this interpretive tool comes from the fact that the 'package' is primarily based on information derived from the existing archaeological record rather than any reliance on modern behaviour.

This paper will attempt to establish an indicator package for cess and cesspits in the archaeological record.

2. Methods and data

A survey of 49 cesspit features from eleven archaeological sites was undertaken for this proposed indicator package for cesspits. The locations of these sites are plotted in Fig. 1. The features discussed date from the late 11th century AD to the late 16th century AD, with the majority dating between the 12th and 15th centuries. In terms of the biological contents of the cesspits, this consists of a survey of 56 individual fills.

The construction and nature of fills of the cesspits from these sites are outlined in Table 1. A detailed discussion of the archaeology of these features, and its implications for archaeological

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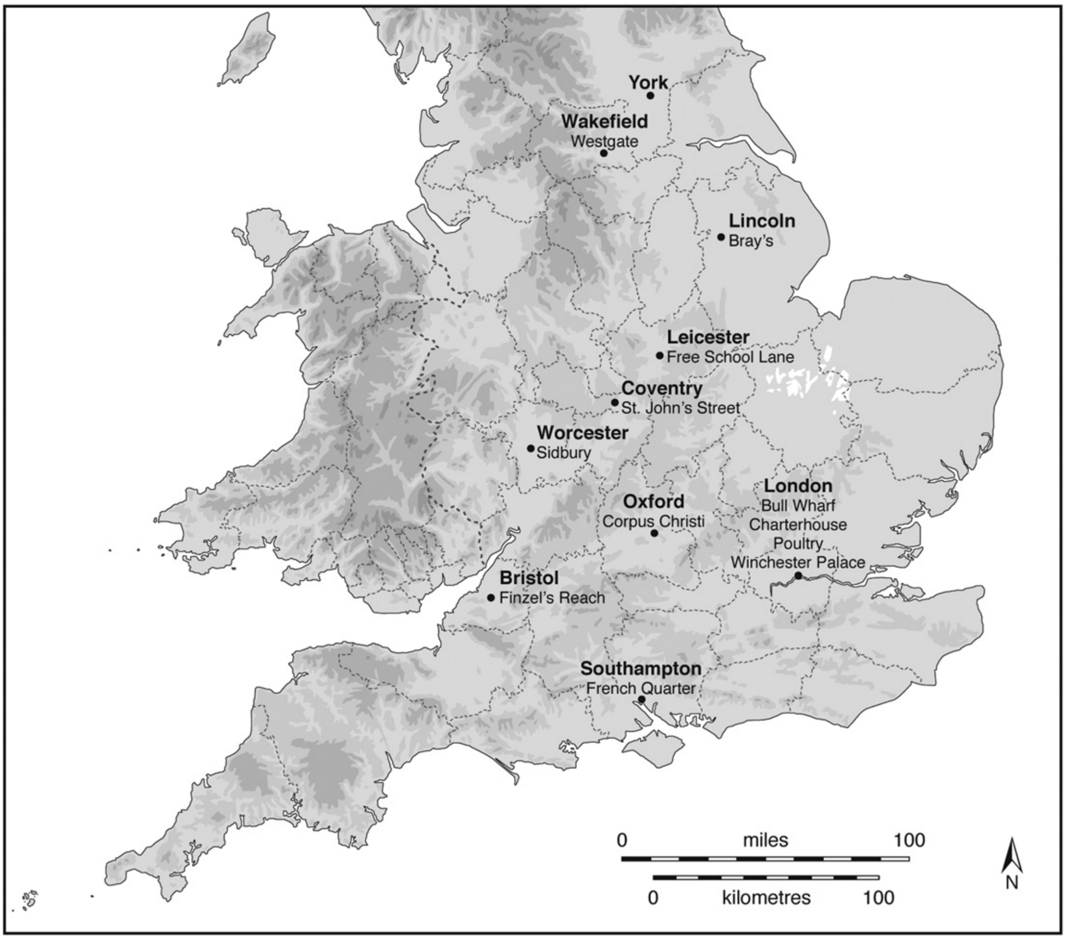

Fig. 1. Location of sites mentioned in text.

recording and interpretation will be presented in a companion paper to this.

The nature of the animal bone, fish bone and parasite ova recovered (where available) is also listed in Table 1. One problem that was encountered in this survey was that the larger mammal bone often is reported as part of the general phase assemblage for the archaeological site rather than on a context or feature basis. It is likely that large animal bone probably was recorded at the context level during zooarchaeological analysis, but without access to this detailed data it is difficult to relate specific examples or 'associated bone groups' to individual features or pits (*sensu* Hill, 1995). This has been a major limitation for the present survey and has effectively excluded this important source of information from this review and any proposed indicator package. However, the insect and plant macrofossil remains are reported by individual context and have received more detailed attention below.

2.1. Insect remains

Insect remains recovered from cesspits can be preserved in two ways. The majority of the remains are preserved by waterlogging and are recovered from whole earth samples using paraffin flotation (Kenward et al., 1980). However, at Free School Lane, Leicester (Smith, 2008) and at the French Quarter, Southampton (Smith, 2009) mineralised remains were present and were only recovered from the plant macrofossil fractions and residues.

The insect faunas from these features have been analysed in two ways:

1) A detrended correspondence analysis (hereafter DCA) using the CANOCO 4.5 programme (ter Braak and Smilauer, 2002) was carried out on a total of 131 insect faunas from a wide range of Roman to Late medieval features in order to clarify whether insects faunas from cesspit type deposits were distinct from any other insects faunas encountered from a wide range of other feature types. The full data set consists of 17,476 individuals from 394 taxa. This data set includes both adult beetles (Coleoptera) and the puparia of the flies (Diptera). An initial run of the DCA across the whole data set indicated that standard reciprocal averaging gave an undue importance to both rare individuals and individual taxa where sample counts were low. This is a common problem encountered with reciprocal averaging (Gauch, 1982) and, as a result, it was decided to restrict the data by removing faunas where less than 50 individuals were recovered and removing taxa which accounted for less than 10% of the total fauna (in essence this meant the removal of faunas that would not normally be considered as interpretable and taxa that occurred less than 13 times in the whole data set). This reduced the data set to 16,115 individuals of 123 taxa from 96 faunas. The option to 'down weight' species occurring infrequently was selected for the DCA.
2) Rank orders of insect taxa have been calculated for all 49 cesspit features from 11 archaeological sites and including four of the London sites used in the DCA discussed above. The first step in this analysis was combining the individual scores for each taxon from all 'cesspit' deposits from an individual site to give a combined value for that site. One disadvantage of

Table 1
Summary of the archaeology of the 'cesspits' from the sites discussed.

	St. John's Street, Coventry	Freeschool Lane, Leicester	Bull Wharf, London[a]	Charterhouse, London	Poultry, London	Winchester Palace, London	Bray's Lincoln	Corpus Christi, Oxford	French Quarter, Southampton	Westgate, Wakefield[a]	Worcester, Barrel
Date (AD)	1200–1550+	1300–1500	1050–1300	12–1370, 1400–1538	1100–1300	1100–1200, 1400–1500	1000–1200	1500–1700	1066–1500	1450+	1450+
Nature of structure	Sequence of latrine pits associated with building range. D is stone lined.	Two stone lined latrines	Number of 'well-like' latrines	Earth cut rectangular pits in Charterhouse yard.	Earth cut rectangular pits, some with wicker lining.	Stone lined garderobe between east and south ranges.	Series of cesspits	Cellar fill and stone lined cesspit.	Sub-rectangular pits from all periods. One timber lined shaft. One from limestone lined garderobe.	Stone lined latrine or 'privy' pit in building range	Barrel lined cesspit at base of long shaft
Fills	D and E show distinct layering.	Fills are, to some extent, layered	No information available	Mineralised concretions with straw. Pit 37.124 sealed by compressed vegetable matter.	Sandy organic fills with charcoal and ash	Dark brown organic silts interleaved with layers of white lime and ash. Bird and fish bone. Mineralised fly puparia and seeds.	No information available	One is fill of cellar which is cess the second is from a stone lined cesspit	Range of organic silts containing domestic waste. Some indications for liming and mineralised concretions.	Distinct layers of deposit	Layer 4 (basal) is full of ash. Layer 3 yellow grassy material. Layer 2 cohesive mass with plant material, cloth and animal bone. Layer 1 soft black material.
Material culture	Button, wire, leather and millstone working waste. Whole pottery beakers, vessels, Pewter plates, spoons (pit D) whole shoes (pit E) and pewter spoons.	Slates, textiles, burnt bone and metal working waste	No information available	Residual pottery, shoes, textiles. moss pollsters.	Fragmented pottery, whole vessels, bone and metal working waste. bone skates.	Whole pots. Urinals and quality glass goblets. Gold finger ring with pear shaped ruby	No information available	No information available	Fragmented pottery, oyster and shell fish. Bone and settlement waste in most pits. Garderobe contains scissor snuffers, clay pipes and tokens.	No information available	Fragments of cloth
Plant	Pits E and D dominated by cereal bran and fruit seeds.	Dominated by fruit stones, a few charred cereals and some grass seeds	No information available	Dominated by small-seeded fruits and cereal bran	Fruit stones and pits and hazelnut shell. Cereal bran and fragmented corncockle seeds.	Small-seeded fruits, herbs and weeds. Cereal bran.	No information available	Small-seeded fruits. Limited cereal bran.	Small-seeded fruits, hazel nuts.	No information available	Small-seeded fruits. Some spices and flavourings. Weeds of cultivated land.
Bone	Partial dog skeleton in D	Burnt bone from domesticated species. Eels, perch, cyprinids, herring, haddock, small ray, flatfish including plaice	No information available	Oyster shell. Sheep, pig, cattle, chicken. Cod and gurnard ray, eel, Conger, herring, carp, cod. Wood pigeon.	Small numbers of larger domesticates, smaller game species, egg shells, herring/sprat, eel and Gadidae.	Small numbers sheep, cattle, pig and poultry. Smelt, sprat, eel. Two whole cats.	No information available	Many small fish and animal bones	Small numbers of domesticates in pits. Herring, eel, sprats, pilchards, whiting, rays, cod	No information available	Chicken and eel bone. *Sepsis* and Scatopsidae fly puparia. Garderobe contains large assemblage of table waste.

Parasite ova	Not investigated	Not investigated	No information available	*Trichuris* and ? *Ascaris* in two pits	Not investigated	Not investigated	No information available	Not investigated	*Trichuris* recovered in numbers from two of the cesspits	No information available	*Ascaris* and *Trichuris* ova in large numbers
Pollen	Not investigated	Not investigated	No information available	Not investigated	Not investigated	Not investigated	No information available	Not investigated	Not investigated	No information available	Mainly grass and cereal pollen

[a] Information from these sites is often 'buried' in a variety of unpublished site archives and is difficult to obtain. As a result some site/find information is incomplete or absent.

combining the individual counts in this way is that it is likely to somewhat 'average' the data. However, given the apparent consistency of the insect faunas recovered from these pits this effect is probably minimal. The top 15 most abundant taxa for each site have then been ranked using the dense ranking '1223' system (see Wikipedia, 2011) and this data are presented in Table 2. One small problem encountered was that at two of the sites (Free School Lane, Leicester and the French Quarter, Southampton) the taxon counts were not minimum number of individual (MNI) but rather were estimates of abundance plotted using the 'semi-quantitative system' proposed by Kenward et al. (1985) and Kenward (1992). The ranges of the 'star system' used are outlined at the base of Table 2. As a result, the taxa from these two sites have been ranked using the maximum number in each of the star systems bands.

2.2. Plant remains

Plant remains are preserved in three ways in these pit features. Carbonised, waterlogged and mineralised remains are encountered. On large urban sites such as these waterlogged plant remains are usually not counted (MNI) but rather estimated using a similar star system to that described above for the insect remains. Charred and mineralised plant remains are usually fully quantified, unless occurring in small numbers in an assemblage which is otherwise primarily preserved by waterlogging. However, mineralised plant remains often can be preserved as amorphous nodules and these are frequently not fully quantified. The numerical value for each category can therefore differ between workers and there are no 'exact numbers' to work with.

As a result two decisions were made in terms of the plant macrofossil data. First, semi-quantified data (scored on a star system) would be maintained when comparing between sites, rather than attempt to rank the taxon as had been done for the insects. Second, because the data were generally consistent, there has been an attempt to 'average' the scores for each plant taxa on a site level. This was done by estimating the 'average' scores across the range of samples for each site (in effect 'there are mainly between 10 and 20 individuals of this taxon in most of the samples from that site'). This has undoubtedly led to the data being 'smoothed' and also may overemphasise certain taxa. However, given the apparent ubiquity of the plant remains from these features this effect may be minimal.

3. Results

The results of the DCA for the insect faunas from London are plotted by sample type in Fig. 2. The individual taxa have been coded using the various ecological categories proposed by Kenward (Kenward, 1978; Hall and Kenward, 1990; Kenward and Hall, 1995). A key to this coding is displayed at the bottom of Fig. 2. Taxon abbreviations are included in the appendix in Smith (2012).

Table 2 presents the rank order for the taxa recovered from the various cesspit features examined the nomenclature used follows that of Lucht (1987).

The data from the survey of the plant material recovered from the cesspits studied are outlined in Table 3. The star system used is presented at the base of Table 3. The nomenclature used follows that of Stace (2010).

4. Discussion: building the indicator package of cesspits

There seem to be at least five classes of archaeological material that might be considered to be particularly indicative of the

Table 2
Combined rank order scores for the insect remains from a range of archaeological cesspits N (N) = rank order score (total number of individuals identified).

	Ecological	Syn-anthropic	All sites	St. John's Street, Coventry	Freeschool Lane, Leicester	Bull Wharf, London	Charterhouse, London	Poultry, London	Winchester Palace, London	Bray's Lincoln	Corpus Christi, Oxford	French Quarter, Southampton	Westgate, Wakefield	Worcester, Barrel
Date				1200–1550+	1300–1500	1050–1300	12–1370, 1400–1538	1100–1300	1100–1200, 1400–1500	1000–1200		1066–1500	1450+	1450+
Preservation (M = mineralisation; WL = waterlogged)				WL	M	WL	WL	WL	WL	WL	WL	M	WL	WL
COLEOPTERA														
Carabidae														
Nebria salina Fairm. Lab.	oa		–	–	–	–	–	–	–	–	10 (1)	–	–	–
Trechoblemus micros (Hbst.)	oa		–	–	–	–	–	–	–	–	–	–	–	9 (4)
Bembidion spp.	oa		–	–	–	–	–	–	–	–	10 (1)	–	–	–
Pterostichus niger (Schall.)	oa		–	–	–	–	–	–	–	–	–	–	15 (3)	–
Pterostichus melanarius (Ill.)	oa		–	–	–	–	–	–	–	–	–	–	–	12 (1)
Pristonychus terricola (Hbst.)	u	ss	–	–	–	–	–	–	–	–	–	–	12 (7)	12 (1)
Agonum spp.	oa		–	–	–	–	–	–	–	–	10 (1)	–	–	–
Hydraenidae														
Helophorus spp.	oa-w		–	–	–	–	–	–	–	–	10 (1)	–	–	–
Hydrophilidae														
Cercyon impressus (Sturm)	rf	sf	42 (23)	–	–	–	–	–	–	8 (19)	–	–	15 (3)	–
Cercyon haemorrhoidalis (F.)	rf	sf	49 (15)	–	–	–	–	–	–	–	–	–	–	–
Cercyon unipunctatus (L.)	rf	st	49 (15)	–	–	–	–	–	–	–	–	–	–	–
Cercyon atricapillus (Marsh.)	rf	st	41 (24)	–	–	–	12 (7)	–	–	12 (10)	–	–	–	–
Cercyon analis (Payk.)	rt	sf	17 (112)	13 (9)	–	–	14 (6)	–	–	5 (50)	–	–	13 (5)	–
Cercyon spp.			20 (64)	–	–	–	–	–	–	6 (28)	–	–	–	8 (6)
Cryptopleurum minutum (F.)	rf	st	–	–	–	–	–	–	–	–	–	–	–	12 (1)
Histeridae														
Acritus nigricornis (Hoffm.)	rt	st	47 (17)	–	–	–	–	–	–	–	–	–	–	–
Gnathoncus spp.	rt	sf	31 (44)	–	–	–	–	–	13 (25)	–	–	–	–	–
Hister cadaverinus Hoffm.			44 (20)	–	–	–	12 (7)	–	–	12 (10)	10 (1)	–	–	–
Hister striola Sahlb.	rt	sf	18 (93)	–	–	–	–	–	5 (83)	–	10 (1)	–	–	–
Hister spp.			–	–	–	–	–	–	–	–	–	–	–	12 (1)
Catopidae														
Catops spp.	oa		31 (44)	–	–	–	–	–	–	–	–	–	7 (18)	6 (8)
Orthoperidae														
Corylophus cassidoides (Marsh.)	rt		–	15 (5)	–	–	–	–	–	–	–	–	–	–
Staphylinidae														
Phyllodrepa floralis (Payk.)	rt		19 (84)	–	–	–	–	–	76 (6)	–	10 (1)	–	15 (3)	–
Omalium rivulare (Payk.)	rt	sf	11 (150)	–	–	7 (36)	–	6 (36)	4 (94)	–	–	–	–	–
Omalium spp.	rt		16 (124)	–	–	13 (16)	9 (11)	12 (16)	7 (59)	–	10 (1)	–	11 (8)	10 (3)
Xylodromus concinnus (Marsh.)	rt-h		26 (56)	–	–	–	11 (8)	–	–	–	–	–	13 (5)	8 (6)
Coprophilus striatulus (F.)	rt	st	33 (42)	7 (18)	–	–	10 (9)	–	–	–	7 (4)	–	15 (3)	11 (2)
Trogophloeus bilineatus (Steph.)	rt	sf	45 (19)	–	–	–	–	–	–	–	–	–	–	–
Trogophloeus spp.	u		41 (24)	–	–	–	–	–	–	–	–	–	–	–
Oxytelus sculptus Grav.	rt		29 (48)	–	–	–	10 (9)	–	–	9 (15)	10 (1)	–	15 (3)	12 (1)
Oxytelus rugosus (F.)	rt		23 (61)	3 (31)	–	–	12 (7)	–	–	14 (7)	10 (1)	–	–	–
Oxytelus sculpturatus Grav.	rt	sf	42 (23)	–	–	–	–	–	–	–	–	–	–	–
O. nitidulus Grav.	rt-d		39 (26)	–	–	–	–	–	–	–	–	–	–	–
Platystethus arenarius (Fourc.)	rf		38 (28)	–	–	–	–	–	–	11 (12)	–	–	–	–
Stenus spp.			43 (21)	–	–	–	–	–	–	–	–	–	–	12 (1)
Lithocharis ochraceus (Grav.)	rt	st	40 (25)	–	–	–	–	–	14 (23)	–	–	–	–	–
Leptracinus intermedius Donisth.	rt	st	46 (18)	–	–	–	–	–	15 (15)	–	–	–	–	–
Gyrohypnus fracticornis (Müll.)	rt	st	48 (16)	–	–	–	–	–	–	–	–	–	–	12 (1)
Xantholinus spp.				–	–	–	–	–	–	–	–	–	15 (3)	–
Neobisnius spp.	rt		33 (42)	14 (8)	–	–	–	–	–	10 (13)	–	–	–	–
Philonthus spp.			5 (264)	11 (11)	–	–	6 (16)	15 (13)	3 (119)	2 (83)	6 (5)	–	12 (7)	9 (4)
Gabrius spp.			–	–	–	–	–	–	–	–	–	–	–	12 (1)

Quedius spp.			9 (181)	–	–	2 (92)	–	2 (92)	12 (27)	–	8 (3)	–	10 (14)	11 (2)
Staphylinus spp.			–	–	–	–	–	–	–	–	–	–	15 (3)	12 (1)
Tachinus subterraneus (L.)			–	–	–	–	–	–	–	–	–	–	11 (8)	–
Aleocharinidae genus & spp. Indet.			15 (133)	8 (18)	–	9 (30)	10 (9)	8 (30)	10 (32)	–	–	–	17 (8)	7 (7)
Rhizophagidae														
Rhizophagus parallelocollis Gyll.	rt	sf	37 (32)	4 (30)	–	–	–	–	–	–	–	–	–	–
Dermestidae														
Attagenus pellio (L.)	rd-h	ss	–	–	–	–	–	–	–	–	–	–	–	12 (1)
Cucujidae														
Monotoma spp.	rt	sf	43 (21)	–	–	–	–	–	–	–	–	–	–	–
Oryzaephilus surinamensis (L.)	g	ss	36 (35)	–	–	–	8 (14)	–	–	–	–	5 (++)	–	9 (4)
Laemophloeus ferrugineus (Steph.)	g	ss	–	–	–	–	15 (4)	–	–	–	–	–	–	–
Cryptophagidae														
C. distinguedus Sturm	rd-h	st	48 (16)	–	–	–	–	15 (13)	–	–	–	–	–	–
Cryptophagus ?scanicus (L.)	rd-h	st	36 (35)	–	–	14 (15)	–	13 (15)	–	–	–	–	10 (14)	–
C. ?scutellatus Newm.	rd-h	st	27 (54)	–	–	3 (54)	–	3 (54)	–	–	–	–	–	–
Cryptophagus spp.	rd-h	sf	17 (112)	5 (22)	–	–	5 (19)	–	–	–	–	–	5 (24)	5 (10)
Atomaria spp.	rd-h	st	18 (93)	–	–	–	–	15 (13)	–	–	–	–	15 (3)	6 (8)
Lathridiidae														
Enicmus minutus (Group)	rd-h	st	8 (200)	13 (9)	–	6 (45)	5 (19)	5 (45)	–	–	10 (1)	8 (+)	9 (16)	4 (13)
Corticaria/corticarina spp.	rt	sf	25 (58)	–	–	15 (14)	–	14 (14)	–	15 (6)	10 (1)	–	14 (3)	–
Colydiidae														
Aglenus brunneus (Gyll.)	rt-h	ss	26 (56)	–	–	8 (31)	–	7 (31)	–	–	–	–	–	9 (4)
Endomychidae														
Mycetaea hirta (Marsh.)	rd-h	ss	6 (220)	13 (8)	–	4 (48)	3 (30)	4 (48)	–	–	4 (10)	–	6 (19)	2 (70)
Lyctidae														
Lyctus linearis (Goeze)	l-h	sf	–	–	–	–	–	–	–	–	–	–	–	12 (1)
Anobiidae														
Xestobium rufovillosum (Geer)	l	sf	32 (43)	–	–	–	–	–	9 (34)	–	–	8 (+)	–	–
Anobium punctatum (Geer)	l-h		13 (139)	12 (10)	–	11 (23)	11 (8)	10 (23)	13 (25)	9 (15)	10 (1)	–	13 (5)	3 (20)
Ptilnus pectinicornis (L.)	l	sf												
Ptinidae														
Tipnus unicolor (Pill. Mitt.)	rd-h	st	2 (823)	–	–	4 (48)	7 (15)	4 (48)	2 (177)	–	6 (5)	–	1 (443)	1 (131)
Ptinus fur (L.)	rd-h	sf	10 (163)	–	–	10 (25)	12 (7)	9 (25)	8 (56)	15 (6)	10 (1)	8 (+)	4 (58)	–
Tenebionidae														
Blaps mucronata Latr.	rt	ss	–	–	–	–	–	–	–	–	–	–	–	12 (1)
Tenebrio obscurus F.	rf	ss	–	–	–	–	–	–	–	–	–	–	15 (3)	–
Scarabaeidae														
Trox scaber (L.)	rt	sf	41 (24)	–	–	–	–	–	–	–	–	–	–	–
Geotrupes spp.	oa-rf		–	–	–	–	–	–	–	–	–	–	–	12 (1)
Aphodius sphacelatus (Panz.) or *A. prodromus* (Brahm)	oa-rf		–	–	–	–	–	–	–	4 (52)	–	–	–	–
A. granarius (L.)	oa-rf		30 (47)	–	–	–	–	–	–	7 (26)	–	–	–	–
Aphodius spp.	oa-rf		–	–	–	–	–	–	–	–	9 (2)	–	–	–
Chyrsomelidae														
Plateumaris sericea (L.)	oa-d		50 (14)	–	–	–	–	15 (13)	–	–	–	–	–	–
Phyllotreta spp.	oa		47 (17)	–	–	–	–	–	–	–	–	–	–	12 (1)
Longitarsus spp.	oa		–	–	–	–	–	–	–	–	10 (1)	–	–	–
Bruchidae														
Bruchus pisorum (L.)	oa-pu		7 (206)	–	–	–	–	–	–	11 (12)	–	–	–	–
Bruchus spp.	oa-pu		44 (20)	–	–	–	–	–	–	15 (6)	–	–	–	8 (6)
Curculionidae														
Apion spp.	oa-p		45 (19)	–	–	–	–	–	–	–	–	–	–	12 (1)
Sitona spp.	oa		–	–	–	–	–	–	–	–	–	–	–	12 (1)
Notaris acridulus (L.)	oa-d		–	–	–	–	–	–	–	13 (9)	–	–	–	–
Sitophilus granarius (L.)	g	ss	21 (63)	10 (14)	–	–	12 (7)	–	–	–	–	2 (+++)	–	5 (10)
DIPTERA														
Psychodinae														
Psychoda spp.			–	–	–	–	–	–	–	–	3 (12)	–	–	–

(*continued on next page*)

Table 2 (*continued*)

	Ecological	Syn-anthropic	All sites	St. John's Street, Coventry	Freeschool Lane, Leicester	Bull Wharf, London	Charterhouse, London	Poultry, London	Winchester Palace, London	Bray's Lincoln	Corpus Christi, Oxford	French Quarter, Southampton	Westgate, Wakefield	Worcester, Barrel
Scatopsidae														
Scatopse notata L.			4 (316)	9 (15)	–	–	–	–	–	–	10 (1)	2 (+++)	2 (300)	–
Syrphidae														
Eristalis ?tenax (L.)			22 (62)	–	–	–	2 (42)	–	–	–	–	4 (++)	–	–
Helomyzidae														
Heleomyza serrata (L.)			34 (38)	–	–	–	–	–	11 (30)	–	6 (5)	8 (+)	–	–
Sepsidae														
Sepsis spp.			12 (143)	6 (19)	–	–	13 (6)	–	–	1 (114)	–	–	–	–
Sphaeroceridae														
Sphaerocera curvipes Lat.			–	–	–	–	11 (8)	–	–	–	–	–	–	–
cf. *Telomerina flavipes* (Meigen)			3 (501)	1 (58)	–	12 (18)	4 (26)	11 (18)	9 (34)	–	–	6 (++)	–	–
Thoracochaeta zosterae (Hal.)			1 (2709)	2 (38)	1 (++++++)	1 (560)	1 (282)	1 (560)	1 (178)	3 (67)	1 (860)	1 (++++++)	3 (67)	–
Drosophilidae														
Drosophila spp.			43 (21)	–	3 (+++)	–	–	–	–	–	–	2 (+++)	–	–
Fanniinae														
Fannia scalaris (Fab.)			14 (135)	–	2 (+++++)	–	–	–	–	–	2 (14)	7 (++)	–	–
Calliphoridae														
Calliphora vicina Rob.-Des.			–	–	–	–	–	–	–	–	5 (8)	–	–	–
Calliphora spp.			–	–	–	–	–	–	–	14 (7)	–	–	–	–
Muscinae														
Musca domestica L.			35 (36)	–	–	–	–	–	10 (32)	–	–	–	–	–
Hydrotaea ?dentipes (F.)			47 (17)	–	–	–	–	–	–	–	–	–	14 (4)	–
Muscina stabulans (Fall.)			28 (52)	–	–	13 (16)	–	12 (16)	–	14 (7)	–	–	8 (17)	–
Stomoxys calcitrans (L.)			39 (26)	–	–	–	–	–	–	–	–	–	–	–

Ecological coding (Kenward and Hall, 1995): oa (& ob) – species which will not breed in human housing. w – aquatic species. c – species associated with salt water and coastal areas d – species associated with damp watersides and river banks. rd – species primarily associated with drier organic matter. rf – species primarily associated with foul organic matter often dung. rt – insects associated with decaying organic matter but not belonging to either the rd or rf groups. g – species associated with grain. l – species associated with timber. p – phytophage species often associated with waste areas or grassland and pasture pu – species associated with pulses (peas and beans).
Synanthropic coding (Kenward and Hall, 1997): sf – facultative synanthropes – common in 'natural' habitats but clearly favoured by artificial ones. st – typically synanthropes – particularly favoured by artificial habitats but believed to be able to survive in nature in the long term. ss – strong synanthropes – essentially dependant on human activity for survival. h – members of the 'house fauna' this is a very arbitrary group based on archaeological associations (Hall and Kenward, 1990).

presence of cesspits, or at least fills with substantial quantities of faeces and urine, on archaeological sites. These each make up one indicator group that forms part of the larger indicator package for the detection of this type of deposit in the archaeological record.

4.1. Structure and nature of archaeological deposits

In a companion paper, which will deal solely with the archaeological aspects of cess disposal, the author will outline that archaeological features which are used for the disposal of faecal material and urine have a very distinctive nature and construction. These are summarised in Fig. 3. These features result from quite specific behaviour which is itself determined by the nature of the duration, level of use, maintenance and closing of these deposits. This range of archaeological structures and features is, of course, one of the clearest components of any 'package' that can be advanced for the identification of archaeological cesspits.

4.2. The nature of the insect remains from cesspits

The analysis of the insects from the cesspits in this survey clearly demonstrates that there is a distinct 'indicator group' (*sensu* Kenward and Hall, 1997; Hall and Kenward, 2003) of insects directly associated with cesspits.

The DCA of insect faunas from a wide range of archaeological deposits in London established that a number of 'groups' of insects routinely occur together at archaeological sites (see Fig. 2). Most of these interpretive groupings closely match those that have been outlined by Kenward elsewhere (Kenward, 1978, 1982; Hall and Kenward, 1990; Kenward and Hall, 1995; Carrott and Kenward, 2001; Kenward and Carrott, 2006). This includes:

1) A group of species (labelled 'settlement/dry' in Fig. 2) that have been linked to dry materials in settlements, seem to be particularly synanthropic, and have been labelled as the 'house fauna' by Kenward (Hall and Kenward, 1990; Kenward and Hall, 1995).
2) A group of species (labelled 'stabling?/ wet ground' in Fig. 2) that seem to be indicative of stabling material and/or wet ground (essentially the taxa common to stabling material as outlined in Kenward and Hall, 1997; Kenward et al., 2004; Smith and Chandler, 2004).
3) A group associated with foul and rotting material (labelled 'foul/rotting' in Fig. 2) particularly from the archaeological record (equivalent to ecological group 'rf' in Kenward and Hall, 1995).
4) A set of insects associated with decaying grain (labelled 'grain' in Fig. 2)
5) A group of insects associated with decaying vegetation (labelled 'decaying material' in Fig. 2) and settlement waste in general (equivalent to ecological group 'rt' in Kenward and Hall, 1995).

It is the sixth group (labelled 'cess' in Fig. 2) seen in the plot of the DCA data (see Fig. 2) that is of interest here. When traced back to the original archaeological contexts, this grouping of insect taxa usually is associated with Medieval and Late Medieval cesspits. This includes a range of flies which in their larval stage (as maggots) often are found with sewage today. For example *Sepsis* (Rank Order (hereafter RO) 12 in Table 2), *Telomerina flavipes* (RO3), *Hydrotaea dentipes* (RO47), and *Heleomyza serrata* (RO34) often are associated with cess or sewage, or prey on other fly maggots that breed in cess (Smith, 1989). The 'drain' fly *Scatopse notata* (RO4 in Table 2), which is often associated with the mats of microbial slime that build up in drains and filter beds in sewage works (Smith, 1989), is also common in many archaeological cesspits, although it was not encountered in the London material. This species and the 'trickling filter fly' *Psychoda alternata*, which is found in similar habitats, were dominant in the material examined from a range of medieval pits and cesspits at Finzel's Reach, Bristol (Smith, 2010) and also occurred in large numbers in the barrel-latrine at Worcester (Greig, 1981). Other flies which are significant in the DCA analysis from London are the 'rat tailed maggot' *Eristalis tenax* (RO22) and the 'latrine fly' *Fannia scalaris* (RO14). Both are specialists in pools of stale urine and saturated cess (Smith, 1973, 1989). Kenward (in Hall et al., 1983) suggests that the vegetation and bran-rich fills of Medieval cesspits may also have created an environment which would have been more similar to that found in herbivore dung than to that in the sewage produced by our modern 'trash diet'. There is, however, one modern parallel study that suggests this fly fauna, at least at the level of genus, is found associated with modern 'composting toilets' in California (Enferadi et al., 1986).

One species of fly, which falls into the 'cess grouping' in the DCA diagram and also has the distinction of occupying rank order 1 in Table 2, is the small 'seaweed' fly *Thoracochaeta zosterae*. This species is an ideal 'indicator species' for cess (*sensu* Kenward, 1978; Kenward and Hall, 1997). Today *T. zosterae* is mainly recovered from underneath seaweed washed onto the shore but, in the past, it seems to have been particularly common in waterlogged archaeological cesspits (e.g. Belshaw, 1989; Skidmore, 1999; Webb et al., 1998). Webb et al. (1998) carefully explored both its modern ecology and compared the $\delta^{13}C$ and $\delta^{15}N$ isotope ratios for a modern coastal population with that of the population from a medieval cesspit from High Street, Oxford. They found that the modern specimens clearly produced $\delta^{13}C$ ratios that were indicative of marine situations but those from the cesspits produced ratios which were indicative of terrestrial areas. They also suggested that the raised $\delta^{15}N$ ratios in the archaeological material indicated that decayed rather than fresh vegetation was being consumed by the maggots. They identified that the larvae and the puparia of this fly need vastly different environments in terms of moisture levels. Today the larvae of *T. zosterae* live and feed on damp to fully saturated seaweed, but the puparia need the drier environment that develops as the seaweed dries out, either above the tide line or towards the surface of sea wrack (any seaweeds found on shore), in order to develop fully into the adult fly (Webb et al., 1998; Belshaw, 1989). In the archaeological record, it is likely that maggots would develop within semi-fluid 'filth', which contains a high level of dissolved salts derived from urine and cess. This is an environment which would also favour flies such as *Sepsis*, *E. tenax* and *F. scalaris*. As the contents of the pit dried out, possibly due to seasonal changes, *T. zosterae* would then pupate. This drier environment would also appear to favour the development of the puparia of the larger species of Muscinae such as the 'house fly' *Musca domestica* (RO35), and the 'stable fly' *Stomoxys calcitrans* (RO39). This would suggest that the *T. zosterae* must, therefore, also be indicative of cesspits that contain a 'cline' of saturated to damp foul materials through to dry, foul conditions.

Several of the beetles recovered confirm a pattern of semi-fluid and dry materials within these pits. The DCA analysis clearly places 'rove beetles' such as *Omalium rivulare* (RO11 in Table 2), *Phyllodrepa floralis* (RO19) and *Quedius* spp. (RO9) into the 'cess grouping'. Though unable to survive in semi-fluid environments, these are all species that today are associated with damp and well-rotted stable manure and vegetable waste (Tottenham, 1954; Smith, 2000). Species with a similar ecological preference, for example *Cercyon analis* (RO17) and *Philonthus* spp. (RO5) also appear high in the rank order in Table 2, despite not being plotted within the 'cess group' by the DCA analysis of London sites (see Fig. 2).

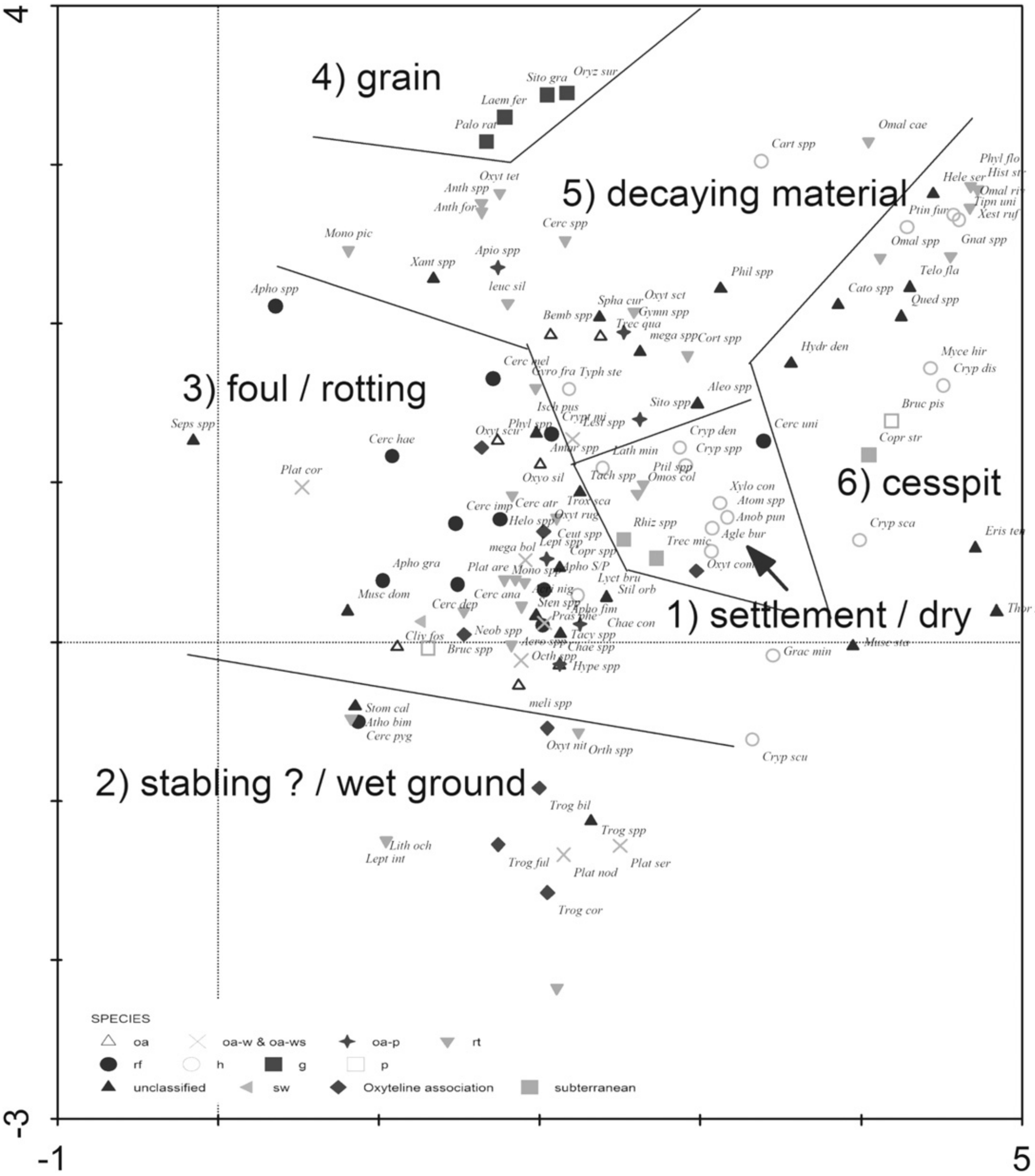

Fig. 2. DCA analysis of the insect faunas from a range of archaeological sites in London.

Other beetles which are common in these pits are usually associated with drier materials such as straw, hay, roofing thatch and settlement waste. These are all considered to be key components of Kenward's 'house fauna' (Hall and Kenward, 1990; Kenward and Hall, 1995). Classic examples of taxa that the DCA analysis has within the cesspit group are *Cryptophagus* species (RO17), *Mycetea hirta* (RO6) and the two 'spider beetles' *Ptinus fur* (RO10) and *Tipnus unicolor* (RO2). Though not plotted within the cesspit group by the DCA ordination, *Enicmus minutus* (RO8) and *Xylodromus concinnus* (26) are frequently recovered archaeologically from similar dry materials and are common in these cesspit deposits. *M. hirta*, *P. fur* and *T. unicolor* also have been found to be particularly common in roofing thatch (Smith et al., 1999, 2005). Other components from 'the house fauna' which also occur in these cesspits are associated with decaying structural timbers possibly from any 'shacks' or outhouses associated with the cesspit; for example the 'woodworm' *Anobium punctatum* (RO13) and the 'death-watch beetle' *Xestobium rufovillosum* (RO32). The question is how does this range of insects come to occur in such high numbers in these pits? Certainly, at first glance, their ecology would not appear to enable them to survive in semi-fluid cess. It has been suggested that most of these species enter pits in household and settlement waste either as the result of rubbish disposal or in materials deliberately added to the pit to 'tamper' the cess or to encourage faster 'composting' of the material. However, as the ecology of *T. zosterae* discussed above suggests, if these pits contain a mix of saturated and drier material, or periodically dry out, there is the potential that some of these taxa could live in the dry material in the pit itself. Certainly, modern analogue work has indicated that fairly wet and saturated farm yard middens can develop elements of this fauna in the summer as the material dries (Smith, 2000). Osborne's (1983) insect faunas from cess within a shallow pit in his own back garden also included many of these taxa.

There often is a range of pests of stored products in these archaeological cesspits. This includes the 'pea weevil' *Bruchus pisorum* (Rank Order 7 in Table 2) which is a field pest of beans and peas. The 'granary weevil' *Sitophilus granarius* (RO21), the 'saw

Table 3
The plant macrofossil remains recovered from a range of archaeological cesspits.

Latin binomial*	English common name	Coventry	Freeschool Lane, Leicester	Charter-house (mineral-ised only in 518)	Poultry (8) mineral-ised only in sample 129	Winchester Palace (6) (mineralised in top sample (290)	Corpus Christi (2)	Southampton waterlogged (samples 146, 150, 159, 70, 48)	Southampton mineralised (samples 72, 141, 176,68,143,`96, 96,182,108)	Worcester Barrel (2)
Charred plant macrofossils										
Vitis vinifera L.	grape								+	
Vicia spp./*Pisum sativum* L.	vetch/ pea								+	
Urtica dioica L.	common nettle								+	
Corylus avellana L.	hazelnut shell				+			+	+	
Linum usitatissimum L.	flax								+	
Brassica sp.	wild cabbage/ mustard								+	
Raphanus raphanistrum L.	wild radish								+	
Polygonum spp.	knot grass								+	
Rumex spp.	dock								+	
Agrostemma githago L.	corn cockle								+	
Silene spp.	campions								+	
Chenopodium spp.	goosefoots							+	+	
Prunella vulgaris L.	self-heal								+	
Glebionis segetum L.	corn marigold								+	
Centaurea spp.	knapweed								+	
Anthemis cotula L.	stinking mayweed								++	
Sambucus nigra L	elder								+	
Eleocharis palustris (L.) Roem. & Schult./*uniglumis* (Link) Schult.	common/ sleder spike-rush								+	
Carex spp.	sedge								+	
Avena cf. *sativa* L	possible cultivated oat		+		+	+		+	++	
Bromus spp.	bromes				+				+	
Secale cereale L	rye				+	+		+	+	
Triticum aestivum L.	bread/club wheat		+		+			+	+	
Triticum spp.	wheat			+	+			+	++	
Hordeum spp.	barley		+		+			+	+	
Cerealia	indet. cereal				+			+		
Waterlogged macrofossils										
BRYOPHYTA indeterminate	mosses				++			+		
Nuphar lutea (L.) Sm.	white water lily									++
Papaver somniferum L.	opium poppy				+					
Papaver spp.	poppy			+				+		
Ranunculus cf. *acris* L./ *repens* L./*bulbosus* L.	buttercups	+		++	+	+				++
Ranunculus flammula L.	lesser spearwort					+				++
Ribes nigrum L.	black current						++			
Ribes cf. *uva-crispa* L.	possible gooseberry						+			+
Ribes spp.	black current / gooseberry						++			
Vitis vinifera L.	grape	+		+++	+	+++	+++	+		+++
Prunus spinosa L.	sloe, blackthorn				++			+		
Prunus cf. *spinosa* L.	possible sloe (blackthorn)				+					+
Prunus domestica L.	plum/ bullace/ greengage	+		+++	++	+	+	++		+
Prunus avium (L.) L./ *cerasus* L.	cherry	+		+++	+		+			+
Prunus spp.	indet. plum/ sloe/ bullace/ greenage			+	+		++			
cf. *Pyrus*/ *Malus* spp.	possible pear/ apple				+			+		+
Malus pumilla Mill./ *sylvestris* (L.) Mill.	apple/ crab apple	+		+++	+++		+	+		+++
Crataegus monogyna Jacq.	hawthorn haw				+					

(continued on next page)

Table 3 (*continued*)

Latin binomial*	English common name	Coventry	Freeschool Lane, Leicester	Charter-house (mineral-ised only in 518)	Poultry (8) mineral-ised only in sample 129	Winchester Palace (6) (mineralised in top sample (290)	Corpus Christi (2)	Southampton waterlogged (samples 146, 150, 159, 70, 48)	Southampton mineralised (samples 72, 141, 176,68,143,`96, 96,182,108)	Worcester Barrel (2)
Rubus cf. *idaeus* L.	possible raspberry				+		+++			
Rubus cf. section Rubus	blackberry	+		++	++		++			
Rubus section Glandulosus Wimm. & Grab.	blackberry/ raspberry				+++	++		++		+++
Potentilla cf. *erecta* (L.) Rausch	tormentil	++			+					
Potentilla spp.	cinquefoil			++						
Potentilla spp./ *Fragaria* spp.	cinquefoil / strawberry			+++	+					
Fragaria vesca L.	wid strawberry	++		+++	+	+++		+		+++
Fragaria spp.	strawberry					++	++++			
Rosa spp.	rose				+					++
cf. *Cannabis sativa* L.	hemp				+					
Ficus carica L.	fig			++++		++++	+++	+		++++
Morus nigra L.	black mulberry			++			++			
Urtica dioica L.	common nettle			++++	+			+		+
Urtica urens L.	small nettle				+					
Myrica gale L.	bog myrtle							+		
Juglans regia L.	walnut			+						
Corylus avellana L.	hazelnut				+					+
Euphorbia helioscopia L.	sun spurge			+						
Malva silvestris (L.) Mill.	common mallow									
Malva spp.	mallow			+++						
Reseda luteola L.	weld/ dyer's rocket			+	+			+		+
Brassica cf. *oleracea* L./ *napus* L.	e.g. cabbage							+		+
Brassica nigra (L.) Koch	black mustard					+	++	+		++
Brassica/ Sinapis spp.	wild cabbage, mustard etc.			+	+					
Raphanus raphanistrum L.	wild radish	+						+		
Persicaria lapathifolia (L.) Delarbre	pale persicaria	++			+			+		
Persicaria mitis (Schrank) Assenov	tasteless water-pepper				+					
Persicaria sp.	knotweed				+					
Polygonum aviculare L.	knotgrass	+		++	+		+	+		+
Fallopia convolvulus (L.) Á. Löve	black bindweed	+		+	+					
Rumex acetosella L. agg.	sheep's sorrel				+					
Rumex spp.	docks	+		+	+			+		+
Stellaria media (L.) Vill.	common chickweed	+		+	+	+		+		+
Cerastium spp.	mouse-ear chickweed					+				
Scleranthus cf. *annuus* L.	annual knawel				+					
Spergula arvensis L.	corn spurrey									
Agrostemma githago L.	corn cockle			++	+++			+		
Silene flos-cuculi (L.) Clairv.	ragged robin					+				
Silene spp.	campions	+		+	+	+		+		
Chenopodium hybridum L.	maple-leaved goosefoot				+					
Chenopodium album L.	fat hen				++	+				
Chenopodium spp.	goosefoots	+		++++	+++	+		+		
Atriplex spp.	oraches			++	++		+	+		
Beta vugaris L.	beet	+			+					
Vaccinium myrtillus L.	bilberry									+
Galium cf. *spurium* L.	false clevers									+
Lithospermum arvense L.	corn gromwell					+				
Atropa belladonna L.	deadly nightshade									+
Hyoscyamus niger L.	henbane									+
Solanum nigrum L.	black nightshade				+					+
Veronica officinalis L.	common speedwell									

Plantago major L.	greater plantain			+						
Plantago spp.	plantain							+		
Stachys cf. *sylvatica* L.	hedge woundwort				+					
Lamium purpureum L.	red dead nettle			+						
Galeopsis cf. *tetrahit* L.	common hemp-nettle				+					
Marrubium vulgare L.	white horehound			++						
Ajuga cf. *reptans* L.	bugle				+					
Prunella vulgaris L.	self-heal	+		+	+					+
Mentha cf. *aquatica* L.	water mint				+			+		
Mentha spp.	mint				+					
Carduus spp./ *Cirsium* spp.	thistles	+			+					
Cirsium cf. *vulgare* (Savi) Ten.	common thistle									+
Centaurea cyanus L.	corn flower	+								
Centaurea cf. *nigra* L.	lesser knapweed				+			+		+
Centaurea spp.	knapweeds			+						
Lapsana communis L.	nipplewort	+		++	++			+		+
Leontodon spp.	hawkbit				+					+
Sonchus oleraceus L.	smooth sow-thistle				+					+
Sonchus asper (L.) Hill	prickly sow-thistle			+	+					+
Anthemis cotula L.	stinking mayweed	+		+	++			+		+++
Glebionis segetum (L.) Fourr.	corn marigold							++		++
Leucanthemum vulgare Lam.	oxeye daisy									+
Senecio cf. *vulgaris* L.	groundsel									+
Sambucus nigra L.	elder			++	++	+	+	++		
Chaerophylum temulum L.	rough chervil			++				+		+
Coriandrum sativium L.	coriander			+		+	+			+
Oenanthe crocata L.	hemlock water dropwort									+
cf. *Oenanthe* sp.	dropwort				+					
Aethusa cynapium L.	fool's parsley			+		+				
Foeniculum vulgre Mill.	fennel									++
Anethum graveolens L.	dill					+	+			
Conium maculatum L.	hemlock				+					
Bupleurum rotundifolium L.	thorow-wax							+		
Apium graveolens L.	wild/ cultivated celery							+		
Apium graveolens L./ *nodiflorum* (L.) Lag.	wild celery/ fool's watercress				+					
Torilis japonica (Houtt.) DC.	upright hedge parsley							+		+
Daucus carota L.	wild carrot			+	+					+
APIACEAE indeterminate	Carrot Family				+					
Juncus spp.	rushes			++	++	++		+		
Scirpus sylvaticus L.	wood club-rush				+					
Eleocharis palustris (L.) Roem. & Schult./ *uniglumis* (Link) Schult.	common/ sleder spike-rush			+	++	+				+
Carex spp.	sedges	+		+++	+	+		+		++
CYPERACEAE indeterminate	Sedge Family				+					
Cerealia indeterminate - bran	indet. cereal (Bran)	++++		+++	++++			+++		+
POACEAE indeterminate	Grass Family				+					
Mineralised plant macrofossils										
Vitis vinifera L	grape		+	++	+	++			+	
Pisum sativum L.	garden pea		+						+	
FABACEAE indeterminate	Pea Family		+		++				+	
Prunus spinosa L	sloe, blackthorn		+++							
Prunus domestica L.	plum/ bullace/ greengage		+++					+	+++	
Prunus avium (L.) L./ *cerasus* L.	cherry		+++							
Prunus spp.	plum/ bullace/ greengage/ sloe			+	+++					
Pyrus/ *Malus* spp.	pear/ apple					++				
Malus pumilla Mill./ *sylvestris* (L.) Mill.	apple/ crab apple		+++							

(*continued on next page*)

Table 3 (*continued*)

Latin binomial*	English common name	Coventry	Freeschool Lane, Leicester	Charter-house (mineral-ised only in 518)	Poultry (8) mineral-ised only in sample 129	Winchester Palace (6) (mineralised in top sample (290)	Corpus Christi (2)	Southampton waterlogged (samples 146, 150, 159, 70, 48)	Southampton mineralised (samples 72, 141, 176,68,143,`96, 96,182,108)	Worcester Barrel (2)
Rubus section Glandulosus Wimm. & Grab.	blackberry/ raspberry		++			++++			+	
Ficus carica L	fig		+			++++		+	+++	
Corylus avellana L.	hazelnut		+					+		
Brassica spp./ *Sinapis* spp.	wild cabbage, mustard etc.				++					
Raphanus raphanistrum L.	wild radish								+	
Agrostemma githago L.	corn cockle								+	
cf. *Agrostemma githago* L.	possible corn cockle				++					
Chenopodium spp.	goosefoot								+	
Sambucus nigra L.	elder								++	
APIACEAE indeterminate	Carrot Family				+					
Carex spp.	sedge							+	+	
cf. *Avena* spp.	possible oat								+	
Secale cereale L.	rye				+					
Triticum aestivum L.	bread/club wheat				+					
Cerealia indeterminate - bran	indet. Cereal Bran				+				+ l (more than 50 in s96)	
POACEAE indeterminate	Grass Family		++							
POACEAE – indeterminate stalk fragments	indeterminate wild or cultivated grasses								+ more than 50 in s68	

Nomenclature and taxonomic order follows Stace (2010).

toothed grain beetle' *Oryzaephilus surinamensis* (RO36) and, less commonly, 'the rust red grain beetle' *Laemophloeus ferrugineus*, are often recovered from cesspits as well. These are all species that are associated with stored grain. It has been suggested that these grain pests enter pits via the human dietary tract rather than as part of the disposal of damaged or spoilt stored goods (Osborne, 1983). Their presence in cesspits is probably a direct result of being consumed in lightly processed food, such as pottage and 'horse' bread (a coarse, low-quality loaf which could be made entirely of legumes or a mixture of legumes and grain). Certainly, the infamous experiments of Osborne (1983) directly established that insect exoskeleton can travel through the dietary track with no evident damage or erosion.

4.3. *The nature of the plant macrofossils recovered from cesspits*

The data for plant macrofossils (see Table 3) are actually quite striking, producing relatively restricted and very similar plant assemblages across the eight sites in this survey. Previous attempts to summarise or comment on the types of plant remains recovered from cesspits have, sensibly enough, concentrated on the food plants present and the extent to which they dominate the assemblage (e.g. Greig, 1981; Hall, 2000; Moffett, 1992).

The assemblages summarised in Table 3 often are dominated by large numbers of food plants, mainly consisting of a range of small fruit seeds or pips. For example, grape (*Vitis vinifera* L.), plum/bullace (*Prunus domestica* ssp. *domestica*/ssp. *insititia* (L.) Bonnier & Layens), blackberry/raspberry (*Rubus fruticosus* L./*idaeus* L.), wild or cultivated strawberry (*Fragaria vesca* L./*Fragaria* spp.) and fig (*Ficus carica* L.) often can occur in the hundreds or thousands. Other taxa such as sloe (*Prunus spinosa* L.), and apple/crab apple (*Malus pumila* Mill./*sylvestris* (L.) Mill.) often are abundant. Many of these food plant remains probably entered the deposits as inclusions in cess after having been consumed as fresh, dried or rehydrated fruit, with the pips/stones consumed whole (see Greig, 1981; Hall, 2000; Moffett, 1992 for discussions as to the range of tolerance and preferences in terms of ancient consumption of seeds, pips and pits). This dominance of fruit remains in Medieval cesspit archaeobotanical assemblages has lead to these assemblages being described as a 'typical medieval fruit salad' (Dennell, 1970; Wilson, 1975). However, the dominance of fruit pips/stones probably owes more to their robust, woody structures and, most likely preferential preservation of these remains, than the existence of any particular frugivore diet trend at the time.

Cereal grains, unless carbonised, are rarely encountered in these deposits. This clearly results from an observable preservation bias against grain in waterlogged contexts (Greig, 1982a; Hall, 2000). This is a pattern often confirmed in the archaeological record where substantial faunas of granary pests are present in deposits but where whole grain is frequently absent (Smith and Kenward, 2011). However, cereal bran is commonly recovered from many cesspits (i.e. Hall et al., 1983; Greig, 1981). Although the 'pea weevil' *B. pisorum* is often recovered in waterlogged deposits from cesspits, the recovery of peas and beans within the same features is frequently limited. Interestingly, there is a consistent pattern of low numbers of carbonised grains in these cesspit deposits, which may be significant given that ash is used regularly as a cleansing additive to cesspits (Jenkins, 2005; Del Porto and Steinfeld, 1999; Water Policy International, 2001). Other foods are usually represented by limited finds; for example walnut (*Juglans regia*), and hazel nutshells (*Corylus avellana*) at some of these sites. Hall (2000) and Kenward and Hall (1995) have demonstrated that these deposits can also contain 'non-seed' remains such as the epidermis of *Allium*, probably leek (*Allium porrum* L.), recovered from Coppergate.

Herbs, spices and flavourings often seem to be present in cesspits, even if only recorded in small numbers. Poppy, either wild or opium (*Papaver* spp./*somniferum* L.) was present at the Charterhouse site, Poultry, Winchester Palace and the French Quarter, Southampton. Black mustard (*Brassica nigra* (L.) Koch) seems to be ubiquitous and coriander (*Coriandrum sativium* L.), dill (*Anethum graveolens* L.), fennel (*Foeniculum vulgre* Mill.), and cultivated or wild celery (*Apium graveolens* L) occur in small, but regular, numbers across the majority of the sites. A similar range of spices and flavourings has been found in a number of cesspits at York and a number of other sites in the English Midlands (Kenward and Hall, 1995; Hall et al., 1983; Hall, 2000; Greig, 1982a; Moffett, 1992).

Other plants which have a use in dying, oil or fibre production such as dyers greenweed (*Reseda luteola* L), hemp (*Canabis sativa* L.) and flax (*Linum usitatissimum* L.) have also been recovered in low numbers at some of these sites and were probably introduced to the cesspits with the incorporation of domestic rubbish. In the case of *C. sativa* this could also result from cannabis seed being consumed for medicinal purposes. The number of possible routes for economic and edible plants into such deposits is infinite (e.g. Greig, 1982a).

Remains of wild and uncultivated plants are quite consistently recovered from cesspits at the sites surveyed. Many such as common nettle (*Urtica dioica* – particularly common at the Charterhouse site), buttercups (*Ranunculus* spp.), mallows (*Malva* spp.), ragged robin (*Silene flos-cuculi*), elder (*Sambucus nigra*) and nipplewort (*Lapsana communis* L.) may have grown in the yards and open ground around the pits and may have entered the pit by accident (Greig, 1982a; Hall, 2000; Moffett, 1992). Alternatively, they could be introduced in hay (Greig, 1992; Moffett, 1992; Kenward and Hall, 1997). Other wild taxa, present in some numbers across the sites, such as stinking chamomile (*Anthemis cotula*), corncockle (*Agrostemma githago*) and corn marigold (*Glebionis segetum*), are all associated with arable cultivation and, because of their size (which is similar to that of cereal grains) are probably introduced to the pit as contaminants of processed cereals, most likely entering deposits via the same route as the cereal bran (Hall, 1981; Moffett, 1992) or in straw (Greig, 1981; Kenward and Hall, 1997).

Finally, many of the cesspits in this survey produce relatively large numbers of a range of waterside plants such as rushes (*Juncus* spp.), spike rushes (*Eleocharis palustris* (L.) Roem. & Schult./*uniglumis* (Link) Schult.), and sedges (*Carex* spp.). To a certain extent their presence in these pits may be over-emphasised by the high seed production of these taxa, but it probably does suggest that waste flooring materials (e.g. floor litter/matting) may also enter these cesspit deposits (Greig, 1992, 1982a; Moffett, 1992).

4.4. Other biological remains

Insect and plant remains are the most commonly investigated biological remains recovered and analysed from cesspits. The use of other biological indicators is less consistent. Pollen analysis is rarely undertaken on material from such deposits despite a past history of successful analysis and results (i.e. Greig, 1981; 1982b, 1994). It is suspected that this is mainly due to the perception that urban deposits are not productive locales for pollen sampling. Similarly it is held that pollen spectra from these deposits are difficult to interpret due to issues concerning pollen dispersal and the complexity of the depositional pathways that pollen can follow before it becomes incorporated into the archaeological record (Greig, 1982b). However, Greig (1981, 1982b, 1994) has clearly shown that faecal material has the potential to contain well-preserved pollen that often is derived from a single source, for example consumed food, and relatively straightforward to interpret and that high proportions of cereal pollen in a deposit are often characteristic of sewage. In particular pollen from cesspits can indicate the presence of food plants in addition to those seen in the plant macrofossil record. Examples are Scaife's (1982) record of buckwheat (*Fagopyrum esculentum* Moench) from Westminster, London and by Greig's (1994) identification of buckweat from Taunton. A similar example is the potential recovery of clove pollen (cf. *Eugenia* spp.) from a number of sites (Greig, 1994). Pollen can extensively 'amplify' (Greig, 1994) the quality of the results from plant macrofossil analysis by improving the representation of a number of food plants for example cereals, pulses, *Brassica* (probably mustards), borages (*Borago* type) and hops (*Humulus lupulus* L.).

Identification of intestinal parasite ova from cesspits is also infrequently carried out. Research into parasite ova was quite intense in the late 1970s and early 1980s with both whipworm (*Trichuris trichiura* L.) and maw worm (*Ascaris* spp.) recovered from a number of cesspit deposits dating from the 9th to the 11th century at 16–22 Coppergate, York (Hall et al., 1983; Jones, 1982, 1985; Kenward and Hall, 1995; McCobb et al., 2004), a 12–15th century pit from the Berdern York (Hall et al., 1983) and from the Worcester barrel latrine (Greig, 1981). However, the examination of parasite ova from cesspits seems to be less common than it was in the past with only deposits from the Charterhouse, London (Carrott, 2000) and the French Quarter Southampton (Jones, 2010) investigated for parasite ova in the survey of cesspit analyses presented here. To some extent this must relate to the limited number of people who practice this dark art (Andrew Jones and John Carrot being clear exceptions) but also must relate to preservation issues and the difficulty of directly linking the number of parasite ova recovered to any estimate of the quantity of faecal material present in archaeological deposits (Jones, 1982, 1985). In addition, the parasite ova results from a number of samples taken around the buildings at Coppergate sometimes failed to discriminate between cesspits *per se* and a range of other archaeological deposits which happen to contain small quantities of cess (Jones, 1985). Unfortunately, there seems to be a general perception amongst those who commission archaeological work that all that the study of parasite ova can contribute to archaeological interpretation is to show that cess is present within cesspits, which appears to be a rather circular argument.

As mentioned above one of the major problems encountered in this survey was the difficulty of linking large animal (mammal and domestic bird) bone assemblages to specific deposition events within the cesspits, because they are usually only discussed for a site at the level of phase. This is unfortunate since it is suspected that large animal bone has the potential to clearly indicate the presence of kitchen waste in these features. In particular the recovery of articulated skeletal elements (associated bone groups), burnt and clearly butchered bone seems to be particularly indicative of this form of domestic rubbish. In terms of the material in this survey, the only direct discussion of animal bone and its implications for the cesspit deposit is that of Rielly (2006) concerning the privy at Winchester Place, London.

Another potentially useful set of bioarchaeological remains for the identification of cesspits is fish bones. Fish faunas from cesspits in Britain often contain a range of species such as eel (*Anguilla anguilla* (L.)) often elvers (young eels), small culpeids (Herring family), Gobidae (gobies), a range of flatfish, and sand smelt (*Atherina presbyter* Curvier). It has been suggested that these could have been eaten whole as 'white bait' and, therefore, enter cesspit deposits in large numbers via the human dietary tract (Greig, 1982a; Hamilton-Dyer, 1997 cited in Nicholson, 2009; Hall et al., 1983; Kenward and Hall, 1995). Many of the fish bones exhibit evidence of damage that is particularly indicative of having been eaten (Kenward and Hall, 1995; Jones, 1986; Nicholson, 1993, 2009). However, experimental work has established that the human dietary track also can have very extreme and damaging effects on fish bone (Jones, 1986; Nicholson, 1993). As a result records of damage on fish bone recovered from cesspits could either suggest that very large quantities of fish were consumed or that they may have entered these pits through another route, such as disposal of kitchen waste. Unfortunately, fish bone is again an area of study with few practitioners, which does not seem to gain the attention it deserves and should be more regularly used on urban sites.

4.5. Other archaeological materials

One thing that is quite striking, particularly for several of the privies and garderobes discussed here, is the shear quantity of whole pots, glass vessels and crockery that can be recovered from these features. For example the extensive sets of material from St. John's Street, Coventry (Colls and Mitchell, 2012), Winchester Palace, London (Seeley et al., 2007) and, most spectacularly the late medieval garderobes from the castle of Middelburg-in-Flanders, Belgium (de Clercq et al., 2007). Fragile organic remains such as leatherwork, basketry, clothing and shoes also are commonly recovered. The disposal of undamaged and sometimes rather precious items (for example the bishop's ring from Winchester Palace) into cesspits seems problematic at times. Certainly some of this may be accidental, the hand slipping off the handle of the chamber pot or urinal, the loose ring that slipped off a finger or a shoe dropping down the shaft in a lax moment but this does not

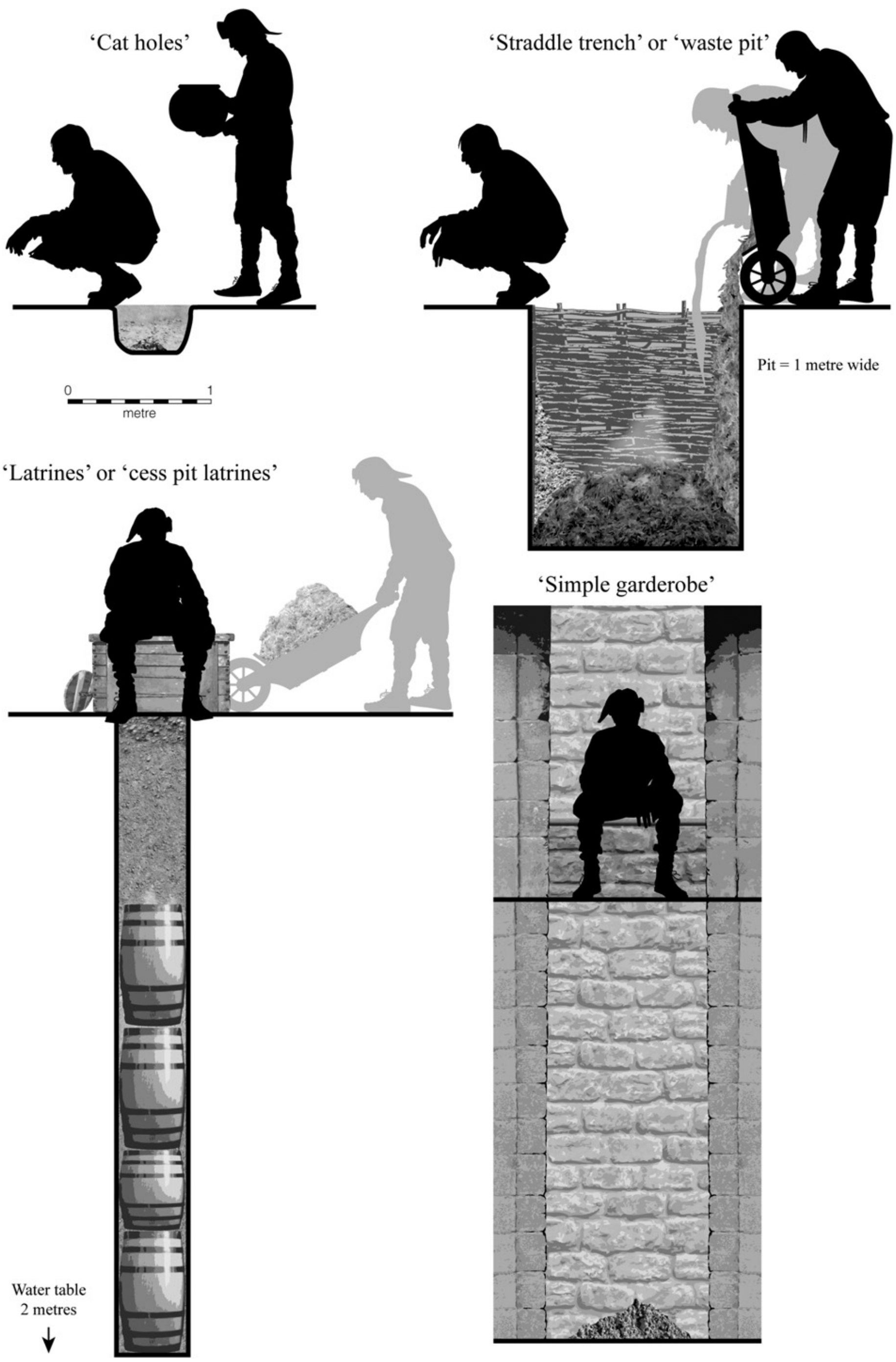

Fig. 3. Possible types of cesspits observed in the archaeological record.

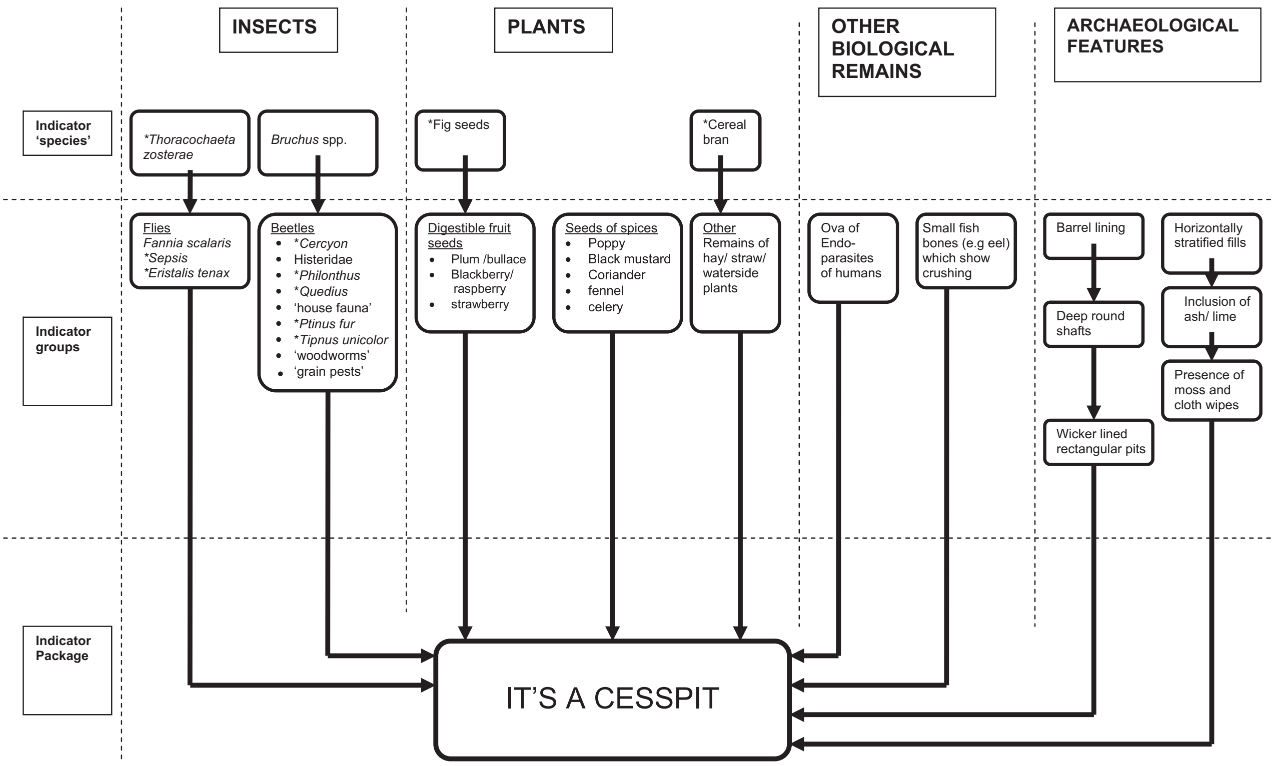

Fig. 4. A block diagram showing the formation of indicator packages, groups and taxa for the identification of cesspits.

explain the shear quantity of material or, often, its quality. Possibly such deposits may represent the final 'blocking' of shafts and features as buildings are altered presenting a convenient location for the disposal of that unwanted or out of fashion dinner service and/or other objects considered rubbish. This does seem to have been the case at Middelburg-in-Flanders where it appears that the extensive collection of pottery, glass and other artefacts recovered may have represented a clearing out of the castle prior to substantial structural and social changes (de Clercq et al., 2007). Cesspits often contain whole or fairly complete pots, bottles and jugs. The explanation for this, beyond clumsiness or disposal of the commonplace and unwanted, is problematic. It is worth noting that a common explanation amongst collectors of glass bottles ('latrine diggers') in the United States for the large numbers of whole vessels found in cesspits is that their contents (liquor and drugs) may have been consumed in 'shameful' privacy, possibly even within the privy, with the bottles disposed of 'secretly' down the shaft of a cesspit, secure in the knowledge that it was unlikely someone would investigate such a foul hiding place too closely.

Finally, we do need to consider that class of material known as 'anal wipes'. Moss pollsters and small sections of cloth are quite common in such features and it is widely observed that these are the medieval equivalent of toilet paper. Recently, the author was shown a collection of such screwed up wraps, persevered by mineral replacement from a cesspit lovingly excavated by a committed group of amateur archaeologists from the Coventry and District Archaeological Society. Kenward (pers. com.) has suggested that moss makes up the bulk of the fills of some pits.

5. Conclusions: an indicator package for cesspits in the archaeological record

The discussion above clearly suggests that there are many individual classes of remains ('indicator species') and groups of remains ('indicator groups'), both archaeological and biological, which could be used to define an archaeological indicator package for cess. This has of course been attempted before (i.e. Hall et al., 1983; Hall and Kenward, 1990, 394; de Clercq et al., 2007) but this review provides an opportunity to formalise this 'cesspit indicator package'. Fig. 4 outlines this proposed indicator package for cess in the archaeological record and its possible range of components. It is expected that a consistent use of this indicator package, by a multidisciplinary team of archaeologists, may help to clarify the function of a wide range of archaeological features.

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