

RESEARCH UPDATE

Analysing Deposition and Site Formation Processes in Medieval Cess Pits Using Bone Fragmentation

Emily V. Johnson, Hayley Forsyth-Magee and Ian Hogg

Signatures of animal bone fragmentation have huge potential for understanding deposition and archaeological site formation processes, yet they are scarcely studied, especially in medieval urban contexts. Archaeological investigations at 1–5 Benjamin Street, Farringdon uncovered a number of medieval cess pits and other contexts associated with the Hospitaller Priory of St John of Jerusalem. The well-preserved zooarchaeological assemblage from these contexts was deemed an excellent case study for in-depth bone fragmentation analysis to both test and display the utility of the method at this type of site.

The analysis revealed that material from the lowest fills of the cess pits differed from the upper fills in that fragmentation was more intensive. Based on the size and weight of fragments, and surface modifications related to burning and taphonomy, we postulate that floor and hearth sweepings were occasionally deposited in the cess pits whilst they were in use. This material was likely further fragmented when cess pits were periodically emptied. Faunal specimens in the upper fills have different fragmentation and taphonomic signatures and more likely relate to opportunistic refuse deposition or capping after the use of the cess pits. This analysis shows the archaeological potential of this approach when aligned with specific research questions concerning deposition.

Introduction

Between 2015 and 2017 Archaeology South-East (UCL Institute of Archaeology) conducted a series of archaeological investigations at 1–5 Benjamin Street, Farringdon. The site was located in the south-western corner of the outer precinct of the Hospitaller Priory of St John of Jerusalem. The work found evidence of medieval cess

pits associated with the priory; these large, deep and generally rectangular pits were laid out in a systematic manner, on the same alignment and frequently very close to one another. The 12 pits generally contained organic, cess-rich lower fills, leading to their determination as cess pits, with upper capping fills of clay and tile. The main phase of pitting was dated to the 13th–14th centuries, with a secondary phase of cess pit activity in the late medieval period before the break-up of the Priory during the dissolution.

Bone fracture freshness and fragmentation analysis has huge potential to contribute

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to an understanding of food preparation and consumption, deposition practices, and site formation (Johnson 1985; Johnson, Parmenter and Outram 2016; Outram 2001). Despite this, the use of this technique is rare, particularly for medieval urban assemblages. The cess pits from Benjamin Street make a particularly interesting application for this type of analysis based on the cess and non-cess material often found in these contexts (Smith 2013), and the disturbance caused through periodic emptying (Evans 2010). The zooarchaeological material itself ($n = 2647$, 1954.6g) is also well-suited given the retention of small bone fragments through bulk sampling and excellent preservation. The research aim was to test the utility of bone fracture freshness and fragmentation analysis on a medieval cess pit assemblage to better understand the deposition processes contributing to the formation of the cess pit fills.

Methodology

Where possible, bones were identified to species, element and bone zone (Serjeantson 1996); taxa size (large/ medium/ small) and type (mammal/ bird/ fish) were recorded for partially identifiable material. Evidence of butchery, burning, gnawing and taphonomic agents was recorded by type and bone zone affected. Crucially, indeterminate material was included in this analysis as it contains important information about the assemblage despite not being identifiable to taxon (Outram 2001).

Analysis of fragmentation, which assesses how broken up the whole assemblage is, involved recording bone weight and a size class based on maximum dimensions (Outram 2001). All bones were weighed to within 0.01g. Size classes were in 10mm increments up to 60mm, then 60–79mm, 80–99mm, and 100mm or over. Correspondence analysis was used to visualise the differences in population frequencies between contexts using PAST3 software (Hammer, Harper and Ryan 2001).

Fracture freshness analysis has the potential to explain patterns of fragmentation, as

bones break in different ways depending on how much moisture has been lost during degradation (Johnson 1985; Outram 2001). For example, fractures caused when splitting long bones from a recently killed animal to access marrow look very different from those on bones broken during the disturbance of an old midden context. Fresh (peri-mortem) bone breaks with a helical (curving) fracture outline, a smooth fracture surface, and acute angles of the internal and external cortical surfaces to the fracture surface. Fresh fracture is usually indicative of marrow extraction. As bone dries out, fracture outlines become jagged or straight, the fracture surface is rough or grainy and the angle of the fracture surface to the cortical surface becomes closer to a right angle. These 'dry' fracture characteristics are most pronounced in mineralised bone, which has lost all moisture content and thus presents fractures with flat, straight outlines, 90° angles and grainy surface textures. Dry and mineralised fracture often occurs as a result of taphonomic disturbance, such as trampling, re-deposition, or recutting of contexts. Recent breaks, caused during and after excavation, look different again, being white and chalky. The presence of any of these four fracture types (fresh, dry, mineralised and new) was recorded on marrow-bearing bone (the humerus, femur, radius, tibia, mandible and metapodia), and partially identifiable long bone fragments.

Results

The focus of this analysis is on the fills of suspected cess pits dating to the 13th–14th centuries, with two non-cess pit contexts (quarry pit [1003] and refuse pit [1077]) also compared from this period. Two fills of a further cess pit [1072] were dated to the 17th century (**Table 1**). Contexts are discussed as fills of their parent, to make associations clearer.

A full analysis of zooarchaeological data was undertaken for a post-excavation assessment (ASE 2019; see also Hogg et al. in prep.). Briefly summarised, faunal remains

Table 1: Zooarchaeological assemblage from 1–5 Benjamin Street by context. Contexts are arranged by period, and grouped within those periods based on their parent context. The [Cut] is used in graphical representation.

[Cut] Fill	Context	Bulk sample	Description	N	Weight (g)
[1003] 1	1045	14	Primary fill of <i>quarry</i> pit [1003], likely used for deposition of cess	60	4.5
[1077] 1	1080	20	Primary fill of <i>refuse</i> pit [1077]	460	47.36
[1005] 1	1026	10	Primary fill of cess pit [1005]	66	23.2
[1005] UP	1004		Upper fill of cess pit [1005]	1	10.2
[1014] 1	1013		Primary fill of cess pit [1014]	7	41.4
[1014] 2	1012		Secondary fill of cess pit [1014]	2	11.3
[1014] UP	1011		Upper fill of cess pit [1014]	28	264.6
[1020] 2	1019	11	Secondary fill of cess pit [1020]	167	94.8
[1024] 1	1023	13	Lowest fill of cess pit [1024]	170	55
[1024] 2	1043	15	Secondary fill of cess pit [1024]	542	475.7
[1033] 1	1032	12	Primary fill of cess pit [1033]	11	4
[1033] 2	1031		Secondary fill of cess pit [1033]	1	14.2
[1037] 1	1046	16	Primary fill of cess pit [1037]	111	16.9
[1047] 1	1050	18	Primary fill of cess pit [1047]	129	8.7
[1055] 2	1053	17	Secondary fill of cess pit [1055]	195	474
[1065] 3	1062		Tertiary fill of cess pit [1065]	1	67.1
[4/008] 2	4/006		Secondary fill of cess pit [4/008]	1	42.9
[4/010] S	4/009		Single fill of cess pit [4/010]	5	115.5
[1072] 1	1076	19	Primary fill of cess pit [1072]	689	182.1
[1072] UP	5/008		Upper fill of cess pit [1072], from evaluation slot	1	2.91

present include domestic cattle, ovicaprids, and pigs, as well as dogs and cats, birds such as chicken, duck and goose and large quantities of wild taxa consisting of small mammals; rabbit, rat, mouse/vole and especially fish. Some elements were whole, including a dog skull from the secondary fill of cess pit [1024], ovicaprid cranial and post-cranial elements from the single fill of cess pit [4/010] and the upper fill of cess pit [1014] respectively, and also including small mammal and avian bones. However, the assemblage was dominated by highly fragmented bone for which taxon could not be determined.

Fragmentation

Analysis of this bone fragmentation yielded interesting results aiding interpretations of the depositional sequence of the cess pits. It suggested that the primary fills of the cess pits, refuse pit [1077] and quarry pit [1003] were subjected to a higher degree of fragmentation than later fills. **Figure 1** displays this variance in fragmentation using correspondence analysis (CA) to visualise the distribution of weight in different size classes for each fill. The CA shows that many primary fill contexts associate with size classes <40mm in maximum dimensions, indicating

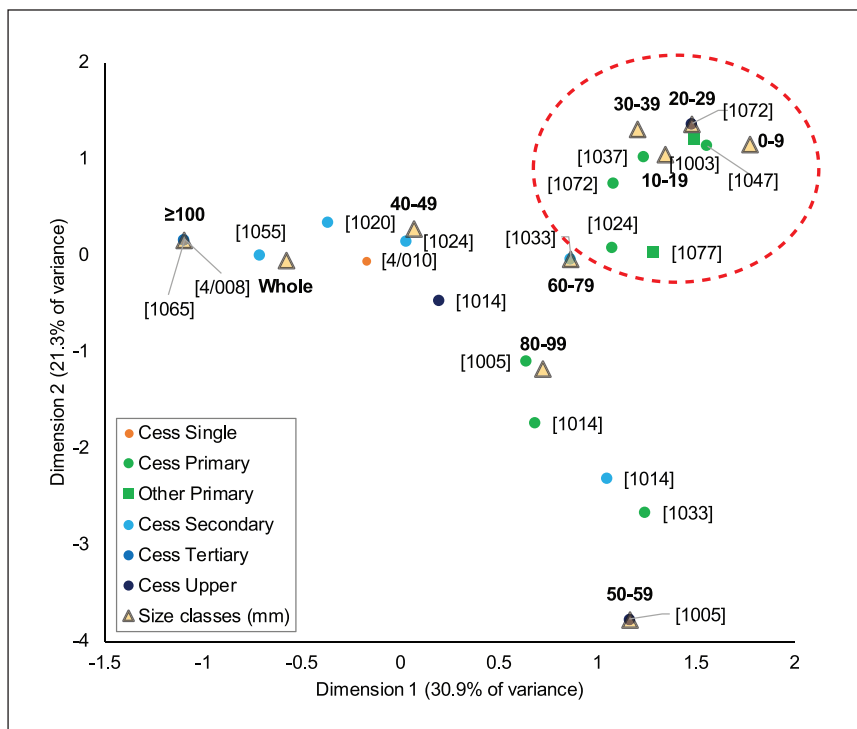


Figure 1: Correspondence analysis of the weight proportion in each size class (mm), with whole bones categorised separately. Figure: E. V. Johnson

that the majority of the assemblage weight was comprised of bones of this size (circled in **Figure 1**). Later fills tended to be less fragmented, having much larger bone fragments or whole bones. Although fragmentation was better represented in bulk-sampled fills due to increased retention of small bone fragments, bulk-sampled secondary fills were still generally less fragmented (for example, the secondary fills of [1020] and [1055]) than their bulk-sampled primary counterparts. The lower and secondary fills of cess pit [1024] were particularly good examples of this trend, with the primary fill [1023] <13> having 40.3% of its assemblage weight in the <30mm size classes (n = 55.03g), whereas secondary fill [1043] <15> had just 12.4% (n = 475.7g), a significant difference ($\chi^2 = 27.596$, d.f. = 1, $p < 0.001$).

Fracture freshness

The excellent condition of the assemblage and rarity of recent breaks (n = 6) indicates that fragmentation was not a result of poor

preservation. Fracture freshness analysis has the potential to explain the processes contributing to this fragmentation, yet suitable bones were scarce (n = 58 across all contexts) and cannot be compared contextually. The presence of fresh (peri-mortem) fracture affecting 32.8% of fractured bones suggests some exploitation of bone marrow, but taphonomic fracture was the dominant fracture type, with dry fracture affecting 63.8% of fractured specimens and mineralised fracture 3.4%. This suggests disturbance and breakage after the bone had lost moisture – either before deposition in the pits, when pits were emptied, or if material from the upper fills was redeposited from temporary dumps.

Taphonomy

Analysis of bone surface modifications revealed that contexts with high fragmentation also had high frequencies of burnt bone, almost entirely carbonised and calcined (i.e. burnt at high temperatures). There was a

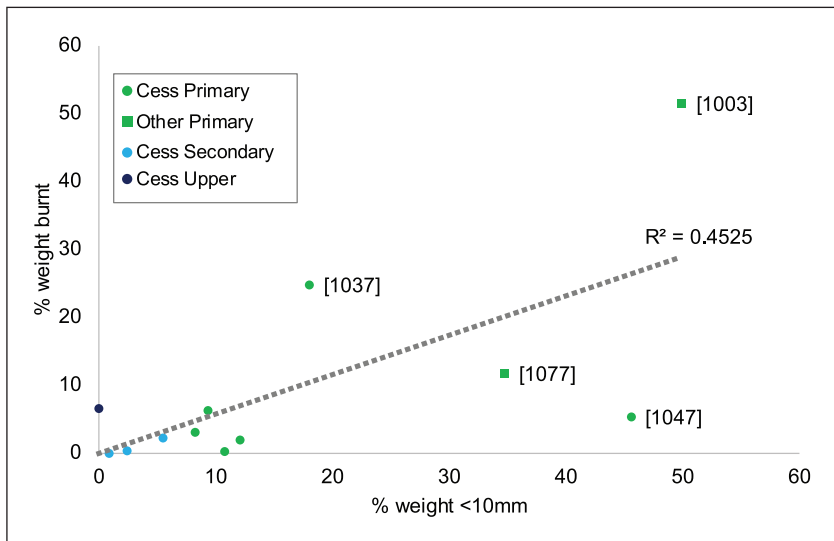


Figure 2: Proportion of bones showing evidence of heat exposure (by weight) against the proportion of the assemblage weight <10mm in maximum dimensions in each context. Figure: E. V. Johnson

positive correlation between the weight of bone <10mm in maximum dimensions and the weight proportion of all bones burnt ($R^2 = 0.45$; **Figure 2**) in contexts with over 10 specimens (see **Table 1**). Highly fragmented bone burnt at high temperatures could suggest that fills were partially comprised of hearth sweepings, particularly in the two non-cess pit contexts [1077] and [1003].

Although there was no direct evidence of digestion, evidence of mastication was present. Gnawing activity by domestic dogs ($n = 21$) and rodents ($n = 3$) was identified on bones from cess pits and associated contexts, including both primary and upper fills. This suggests that scavengers had access to refuse, and may have contributed to fragmentation levels. Fish bones with crushing may be indicative of human digestion where the bones are very small, but those over 1cm in maximum dimensions more likely represent accidental mastication and subsequent expectoration by humans, possibly further evidence of floor sweepings.

Conclusion

Analysing the signatures of bone fragmentation in the assemblage at Benjamin Street

has enabled a better understanding of the nature of the deposition practices associated with the Hospitaller Priory of St John of Jerusalem and its surrounds. The animal bone from the primary fills of cess, refuse and quarry pits is suggestive of floor and hearth sweepings, although it is likely that a mixture of material is represented, including cess. Already fragmented by burning and other taphonomic processes such as trampling, further fragmentation may have occurred during periodic emptying, as has been postulated from similar medieval cess pit assemblages (Greig 1981: 275; Rielly 2006; Smith 2013). Larger bones and other archaeological material including CBM and pottery in upper fills may represent refuse opportunistically dumped once cess pits fell out of use, or intentional capping. These upper fills are likely to have derived from the tile making industry which was active in the area (Betts 2002: 10) and suggests that a relationship may have existed between this industry and the priory (ASE 2019; Hogg et al. in prep.).

This analysis is particularly significant in that it reveals the wealth of information that can be gained from a largely indeterminate

zoarchaeological assemblage, which could be key to understanding depositional histories on archaeological sites with similar faunal material.

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Competing Interests

The authors have no competing interests to declare.

Author Contribution

EVJ and HFM did the zooarchaeological analysis. EVJ drew the figures and wrote the article with contributions from HFM and IH.

References

Archaeology South-East 2019 *Post-excavation assessment and updated project design report: Archaeological excavations at 1–5 Benjamin Street, Farringdon, London Borough of Islington*. ASE report no: 2018146. Brighton: ASE.

Betts, I 2002 *Medieval 'Westminster' floor tiles*. MoLAS monograph 11. London: Museum of London Archaeology Service.

Evans, D 2010 A good riddance of bad rubbish? Scatological musings on rubbish disposal and the handling of 'filth' in medieval and early post-medieval towns. In: De Groot, K, Tys, D and Pietersn, M (eds) *Exchanging Medieval Material Cul-*

ture: Studies on archaeology and history presented to Frans Verhaeghe. Brussels: Flemish Heritage Institute. pp. 267–278.

Greig, J 1981 The investigation of a medieval barrel-latrine from Worcester. *Journal of Archaeological Science*, 8(3): 265–282. DOI: [https://doi.org/10.1016/0305-4403\(81\)90003-0](https://doi.org/10.1016/0305-4403(81)90003-0)

Hammer, Ø, Harper, D A T and Ryan, P D 2001 PAST: Paleontological statistics software package for education and data analysis. *Palaeontologia Electronica*, 4(1): 9.

Hogg, I et al. In prep. *Excavations at 1–5 Benjamin Street, Farringdon; activity and tile making at the Hospitaller Priory of St John of Jerusalem*.

Johnson, E 1985 Current developments in bone technology. *Advances in Archaeological Method and Theory*, 8: 157–235. DOI: <https://doi.org/10.1016/B978-0-12-003108-5.50010-5>

Johnson, E V, Parmenter, P C R and Outram, A K 2016 A new approach to profiling taphonomic history through bone fracture analysis, with an example application to the Linearbandkeramik site of Ludwinowo 7. *Journal of Archaeological Science: Reports*, 9: 623–629. DOI: <https://doi.org/10.1016/j.jas-rep.2016.08.047>

Outram, A K 2001 A new approach to identifying bone marrow and grease exploitation: why the "indeterminate" fragments should not be ignored. *Journal of Archaeological Science*, 28: 401–410. DOI: <https://doi.org/10.1006/jasc.2000.0619>

Rielly, K 2006 The animal bone. In: Seeley, D, Phillpotts, C and Samuel, M (eds.) *Winchester Palace: Excavations at the Southwark Residence of the Bishops of Winchester*. Museum of London Archaeology Service Monograph 31. London: Museum of London Archaeology Service. pp. 130–141.

Serjeantson, D 1996 The Animal Bones. In: Needham, S and Spense, T (eds.), *Runnymede Bridge Research Excavations, Volume 2: Refuse and Disposal at Area*

16 East, Runnymede. London: British Museum. pp. 194–233.

Smith, D N 2013 Defining an indicator package to allow identification of 'cesspits'

in the archaeological record. *Journal of Archaeological Science*, 40(1): 526–543. DOI: <https://doi.org/10.1016/j.jas.2012.06.014>

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