Feeding the city: zooarchaeological perspectives on urban provisioning and consumption behaviours in post-medieval England (AD1500 - AD1900)

Volume II: Appendices

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by

Rebecca Louise Gordon BSc MSc
School of Archaeology and Ancient History
University of Leicester

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Abstract

Zooarchaeological enquiry of animals and their products in the post-medieval period has largely been disregarded in British archaeology. Yet, there is multitude of ways in which animals can inform upon the profound social and economic changes that took place during this era. This research reveals how fruitful the study of post-medieval animals can be in improving our understanding of: the meat trade; agricultural economies; urban history; industries; livestock 'improvement'; urban culture; and food consumption in England.

The thesis explores the transformations in the production and consumption of animals and animal products by drawing upon primary and secondary faunal data and historical accounts. Primary investigations of animal bones excavated from Chester were analysed along with secondary faunal data from the city, in order to undertake a detailed zooarchaeological analysis of an urban centre, and to consider the potential challenges of undertaking post-medieval faunal analyses. Zooarchaeological data from urban sites in England were also sourced from grey literature and published reports to conduct a regional review of animal bones from the post-medieval period.

These investigations showed that innovations in agriculture and the industrialisation of food production had a considerable effect on the size and shape of livestock, which coincided with the introduction of imported breeds and morphotypes. Animals provisioned to towns and cities reflected regional husbandry practices as well as urban supply and demand for various meat and animal products for consumption, crafts and industries. The diversity of wild mammals and birds on domestic sites demonstrated the increasing wealth generated in industrial Britain and the emergent middle classes' desire to emulate elite tastes. Other evidence points to the environmental repercussions that hunting, urban expansion and industrialisation had on the proportion of wild species.

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1 Appendix One – Animals in Post-medieval Chester: intra-site analysis

This appendix presence the results of the Chester zooarchaeological primary analysis conducted on the animal bones from Chester's Roman Amphitheatre, 12 Hamilton Place and Nicholas Street Mews. Each site is presented similar to a standalone report; however, comparison of the site results will be addressed in Chapters Three and Four, Volume I. For all sites the taphonomic history; species and body part representation; mortality and sex profiles; biometrical results; butchery data and pathologies/non-metric traits, were described in detail. Each site was recorded and quantified using the methods outlined in Chapter Two. The results from the medieval animal bones from Chester's Roman Amphitheatre were also drawn upon to aid in the comparison of the results (Gordon 2013).

1.1 Chester's Roman Amphitheatre

Taphonomy

In Area B, the preservation of hand-collected post-cranial bones was, overall, in 'good' condition (figure 1.1). Preservation was generally worst in the mid-late 16th - early 17th century and then improved over time, although by the later phases it was slightly poorer. Some of the bones from the mid-late 16th - early 17th century came from demolition and levelling deposits which could be why there were a higher percentage of 'fair' bones in the phase (Garner 2011). The preservation of bones from Area C was poorer compared to Area B (figure 1.2). Although preservation conditions for the mid-late 16th - early 17th and late 17th - early 18th century were similar; bones from the early-mid 17th century were the least well preserved. The most likely explanation for this is that more bones came from layers rather than pit fills. An analysis of the preservational differences between pits and layers shows that bones from the latter were less well preserved (figure 1.3).

Overall the percentage of gnawed bones on site was relatively low which suggests that animal bones were rapidly disposed of after consumption or butchery (figure 1.4). These results are lower than the proportion of gnawed bones from contemporary urban sites (Albarella *et al*. 2009: 47; Thomas 2005a) which implies that waste management was fairly efficient on site. Most of the gnawed bones

had resulted from carnivores; only three bones had rodent gnawing in the early-mid 17th century. Two bones belonging to a femur of a hare and woodcock displayed marks typical of cat gnawing (Moran and O'Connor 1992). Figure 1.4 revealed that the proportion of gnawed bones fluctuated over time and by the 19th century it was at its lowest at 2%. This pattern could be attributed to the improvement of waste management strategies during this period as concerns for sanitation and public health prompted more stringent regulations regarding household waste disposal (Velis *et al.* 2009: 1282). This pattern has been observed elsewhere at Dudley and Stafford Castle (Thomas 2005a; 2011).

A small number of hand-collected bones showed evidence of burning; only seven were burnt, calcined or singed. Sieved samples had 25 bones that exhibited burning and a number of unidentifiable bone fragments from Area B in the mid-late 16th - early 17th century [2377] had 308 calcined fragments, which suggests there was an episode of burning for fuel or waste disposal.

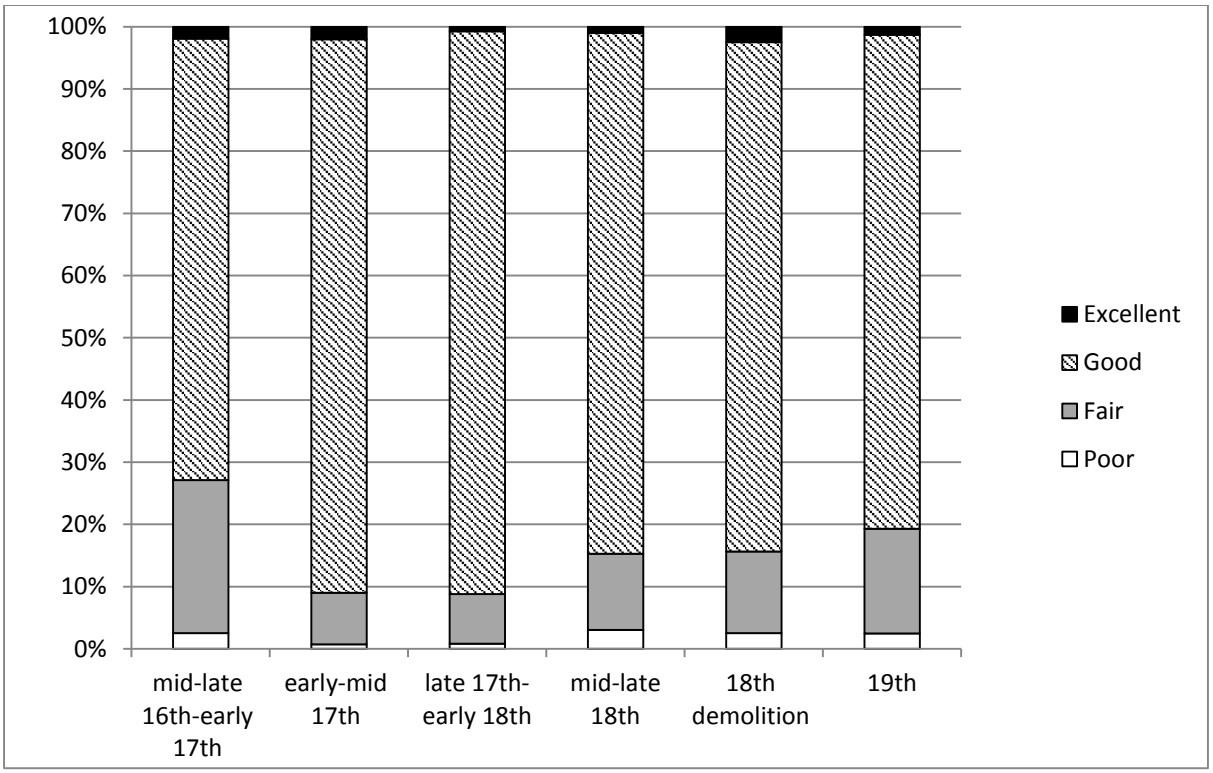

Figure 1.1: Preservation of identifiable hand-collected post-cranial bones from Area B (after Harland *et al.* 2003)

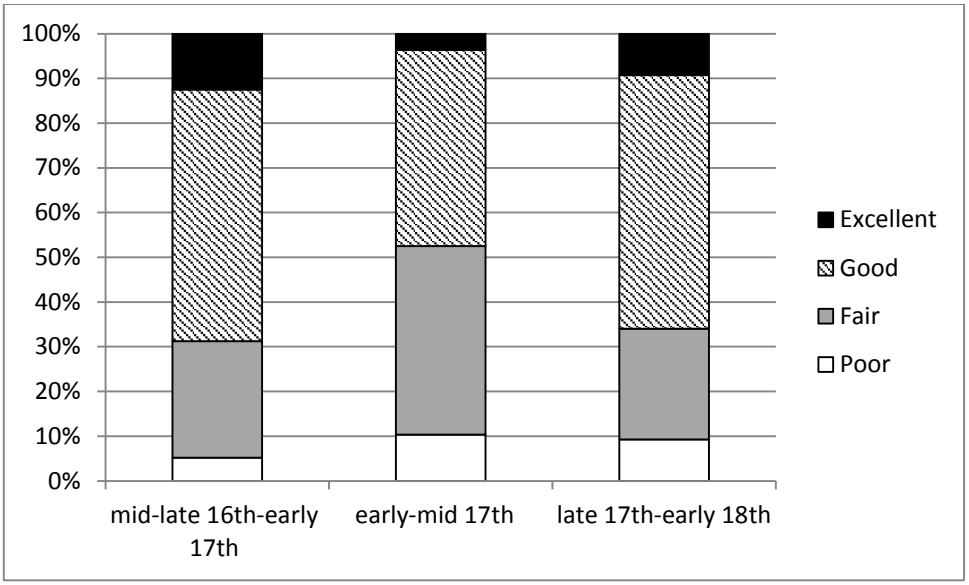

Figure 1.2: Preservation of identifiable, hand-collected post-cranial bones from Area C (after Harland *et al.* 2003)

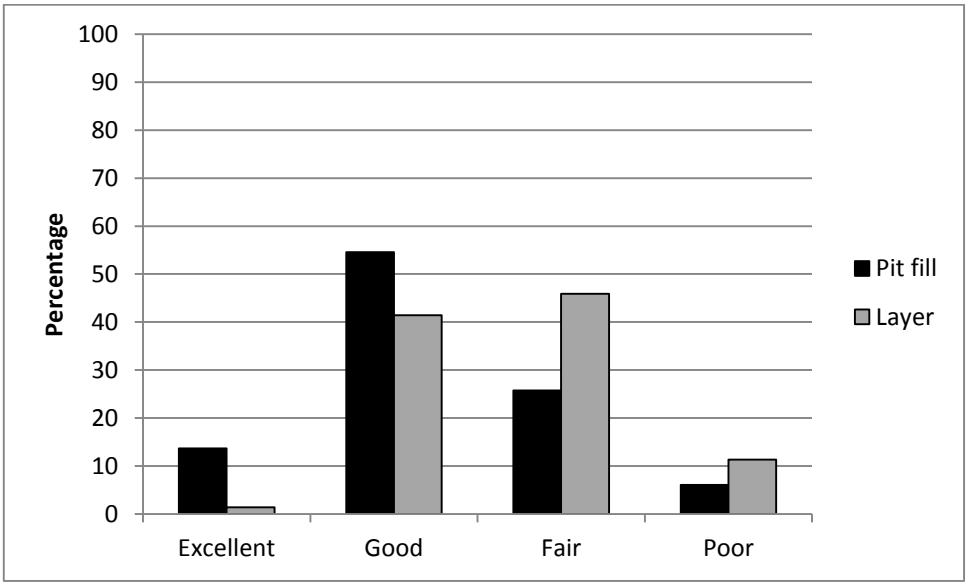

Figure 1.3: Preservation stages for identifiable, post-cranial bones from pit fills and layer from the early-mid 17th century (after Harland *et al.* 2003)

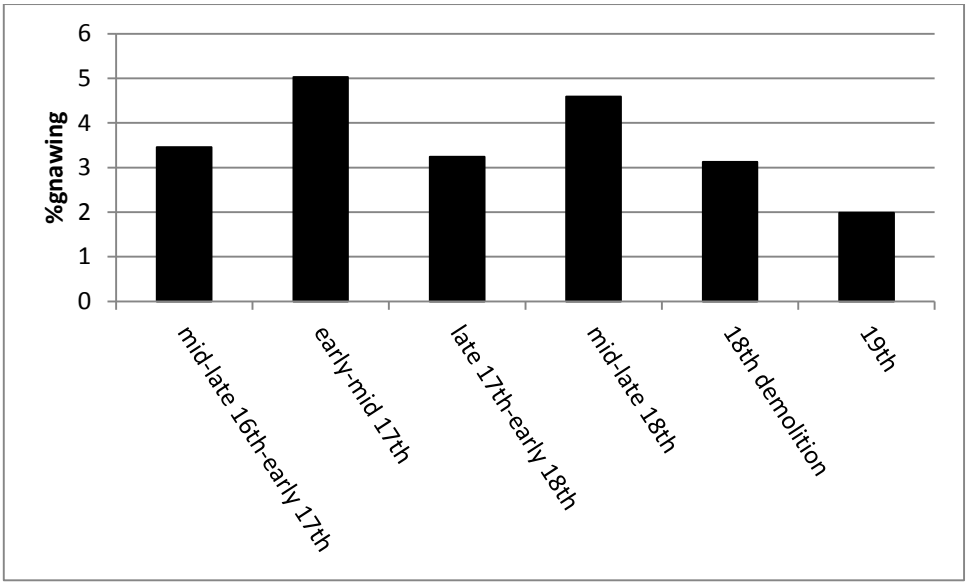

Figure 1.4: Percentage of gnawing marks on identifiable, hand-collected post-cranial bones

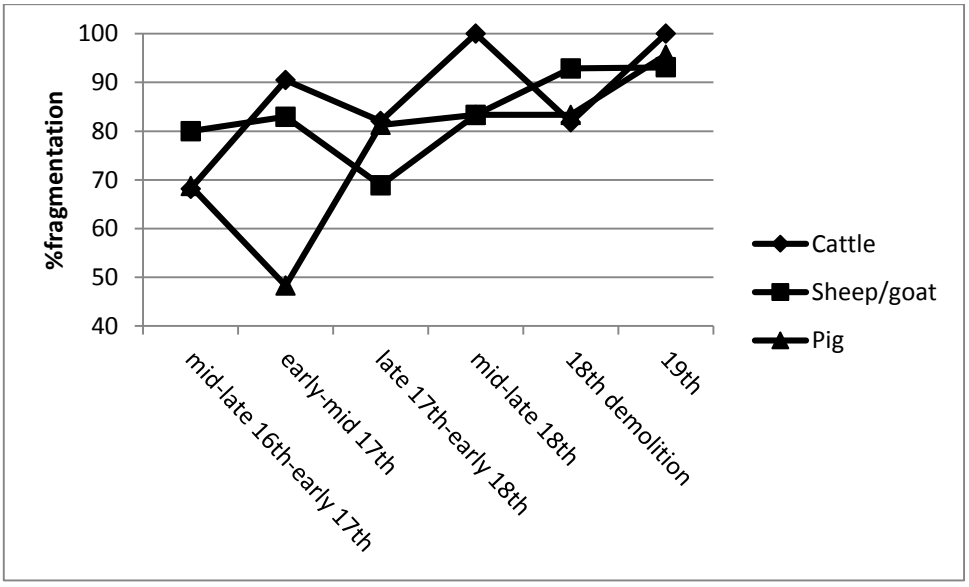

Figure 1.5: Percentage of loose teeth out of the total number of loose teeth and mandibles/maxillae

	XIV	XV	XVI	XVII	XVIII	XIX
Cattle	113 (77)	84 (76)	78 (64)	18 (18)	22 (18)	71 (71)
Sheep/goat	35 (28)	41 (34)	45 (31)	6 (5)	14 (13)	29 (27)
Pig	112 (77)	29 (14)	16 (13)	6 (5)	6 (5)	23 (22)

Table 1.1: The total number of mandibles/maxillae and loose teeth. The total number of loose teeth is presented in the brackets. Key: XIV- mid-late 16th - early 17th; XV - early-mid 17th; XVI - late 17th - early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX - 19th

The majority of teeth on site were loose, rather than located in the mandibles/maxillae indicating a high degree of fragmentation (figure 1.5). In some phases 100% of cattle teeth were loose but generally the percentage of loose teeth was either 68% or above. The early-mid 17th century had a lower proportion of pig teeth that were loose, which runs counter to the poorer representation (figure 1.5). There was also a general increase in fragmentation over time. It is possible that this may be attributed to the presence of younger animals, which have more fragile maxillae/mandibles (see mortality profiles). The ratio of loose teeth to mandibles/maxillae was higher for cattle which most likely reflect site recovery biases, as larger bones and species are easier to spot during an excavation. The average number of zones per bone for cattle, sheep/goat, pig and chicken are similar through time. Cattle typically had an average of two, for sheep/goat and pig it was three and chicken ranged between three and six. These results support the loose teeth to mandibles ratio showing that bone fragmentation was high. However, it is important to consider the impact that butchery has on the number zones as larger animals will require more disarticulation prior to consumption in comparison to smaller animals. This would account for why cattle remains have a lower average of zones per bone in comparison to chicken.

An examination of the percentage of identifiable fragments by animal group showed that the vast majority of large mammals were retrieved by hand-collection whereas smaller animals like birds were found in greater abundance in sieved samples (figure 1.6). This is in-keeping with earlier investigations by Payne (1972, 1975) which demonstrated that hand-collected samples are biased towards larger bones because they are easier to spot during excavation.

In summary, the taphonomic analysis shows that the animal bones were well-preserved, although, there were preservational differences between Areas B and C. The paucity of gnawing marks on post-cranial bones suggests that waste was disposed of rapidly and the decrease in the proportion of gnawed bones over time may be indicative of the introduction of more effective waste management initiatives. Bone fragmentation was high; however, this was also affected by butchery and recovery biases. Burning contributed very little to the taphonomic processes on site. The recovery of hand-collected bone was fairly good, although the high proportion of sieved bird bone demonstrates that hand-collected samples are likely to under-represent smaller bones (including unfused epiphyses and loose teeth) as well as the smaller species.

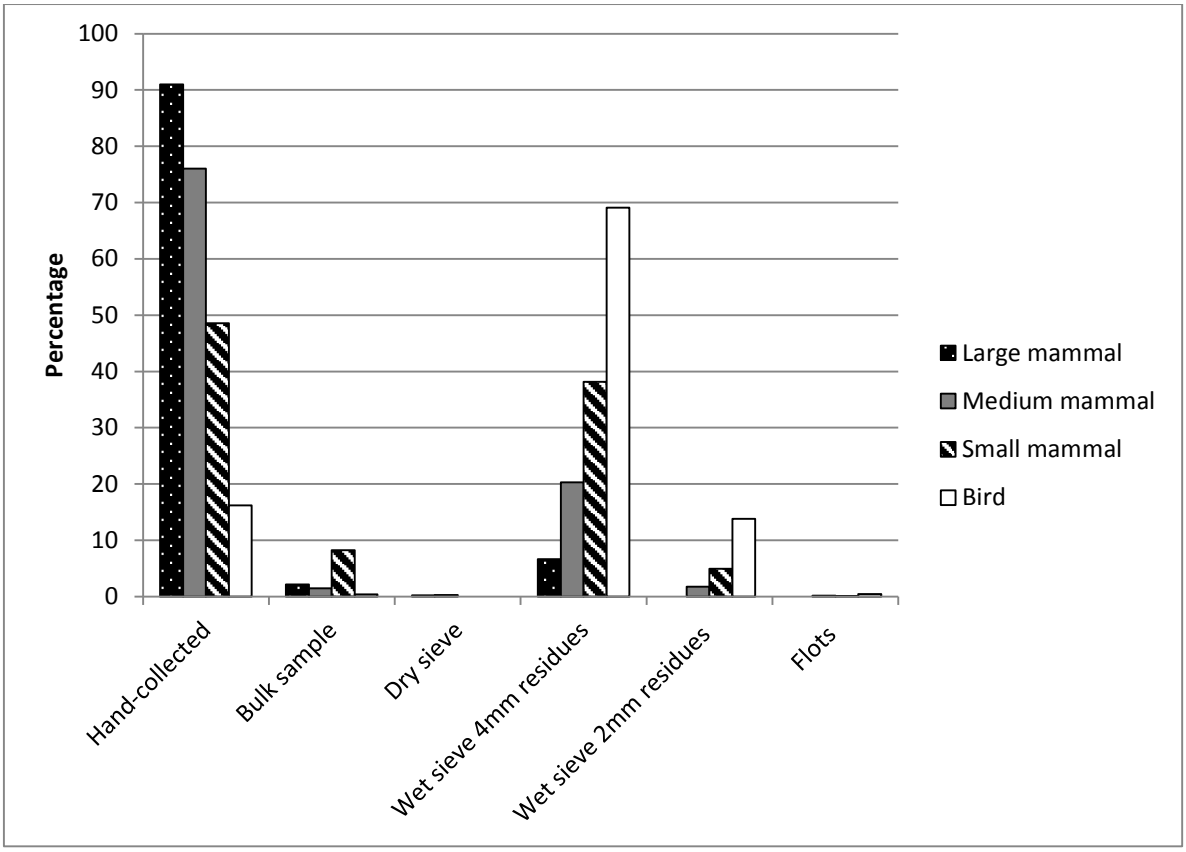

Figure 1.6: Relative proportion (%NISP) of different animal groups by recovery method for Chester's Amphitheatre

Species representation

Domestic mammals

The three main domesticates dominated the assemblage; cattle (*Bos taurus*) was the most common followed by sheep/goat (*Ovis aries/Capra hircus*) and pig (*Sus scrofa*) (figure 1.7; see tables 1.3-1.13). There is very little variation in the relative proportion of cattle, sheep/goat and pig throughout time. One notable feature is the high proportion cattle, which is consistently over 50%. This high frequency of cattle is clearly typical of the Cheshire region, which was heavily reliant on cattle farming and actively involved in the leather industry.

Other domestic mammals included small numbers of goat (*Capra hircus*) and horse/donkey (*Equus* spp.) (see tables 1.3-1.13). It is well-attested that goats were not are particularly suited to the British landscape making them difficult to raise (Albarella 1999: 213; Grant 1988: 155). They also declined in economic importance after the Middle Ages (Albarella 2003; Dyer 2004b). Most of the goats in the

assemblage were represented by horncore fragments expect for one complete metacarpal from the mid-late 16th - early-17th century in Area C. Horse was more common than goat but was often represented by loose teeth and isolated elements. The number of cat (*Felis catus*) and dog (*Canis familiaris*) remains varied throughout the phases. Cat was found in higher quantities in Area C, although none of these appeared to have belonged to partial skeletons. In Area B, a partial cat skeleton was recorded in the 19th century context and was excavated from pit that probably represented the burial of a companion animal (Gardner 2011: 36). Dog remains were quite common in the mid-late 16th - early 17th, early-mid 17th and 19th century in Area B; although none came from partial skeletons.

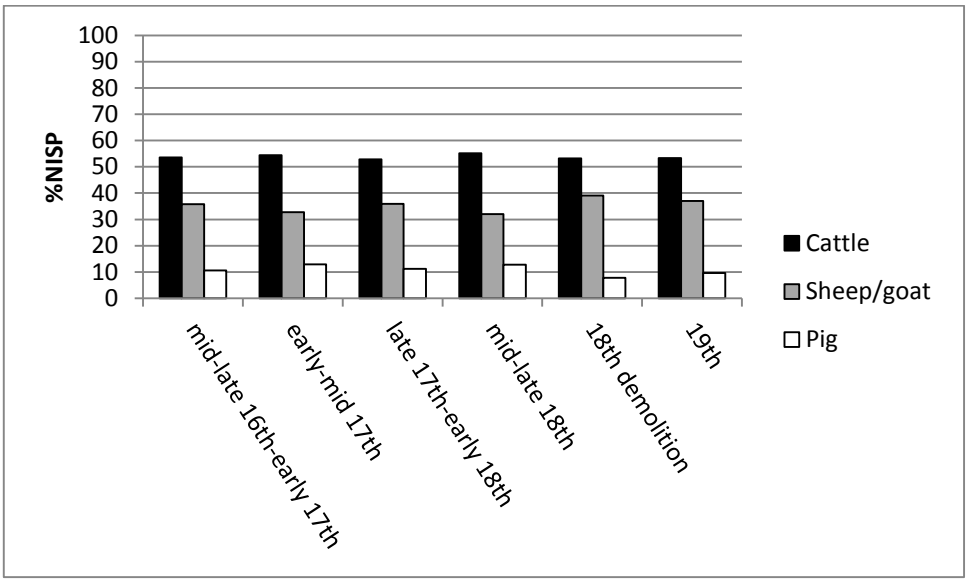

Figure 1.7: Relative proportion (%NISP) of hand-collected cattle, sheep/goat and pig. Total NISP in brackets: mid-late 16th -early 17th (NISP=1147); early-mid 17th (NISP=1563); late 17th-early 18th (NISP=1069); mid-late 18th (NISP=212); 18th demolition (NISP=220); 19th (NISP=823)

Domestic birds

Figure 1.8 shows that chicken (*Gallus gallus*) was the most common domestic bird, followed by goose (*Anser* sp.) and then duck (*Anas* sp.). The mid-late 16th - early 17th century had the highest proportion of chicken at 80% most of which derived from a 16th-century feasting pit (see Chapter Two). Based on the MNE at least 25 chickens were deposited in this pit. The proportion of chicken appears to have declined steady after the early-mid 17th century, thereafter the relative proportion changes very little. Although, no pheasant (*Phasianus colchicus*) was identified there was one

proximal humerus from the early-mid 17th century (Area C) that exhibited morphological characteristics consistent with the attributions of guinea fowl (*Numida meleagris*). When compared with identification criteria outlined in Tomek and Bocheński (2009: 31) the specimen compared with two of the three characteristics described for the proximal humerus which had the small oval foramen pneumaticum and the long, narrow and deep musculus latissimi. Based on the evidence is it highly likely this specimen is a guinea fowl. Guinea fowl arrived in Britain by the 16th century, however, its abundance in the archaeological record is hard to assess due to the difficulty in separating it from chicken and pheasant (Poole 2010: 164). Three turkey (*Meleagris gallopavo*) bones were found in the mid-late 16th - early 17th century and late 17th - early 18th century context. Turkey was originally imported from North America from at least 1541. Initially its consumption was restricted to the elite (Fothergill 2012: 43).

Although there appears to have been a cumulative increase in the relative abundance of goose up until the mid-late 18th century the sample size for phase XVII - XVIII (mid-late 18th - 18th century demolition deposit) was low; therefore, caution is advisable with this interpretation (figure 1.8). However, there definitely seems to have been an increase in goose, relative to chicken, up until the late 17th - early 18th century which levels off by the 19th century. Duck appears to have only been of minor importance which starts to decreases after the mid-late 16th - early 17th century and then reappears in the mid-late 18th century deposit. Again, the sample size for the mid-late 18th century deposit was low therefore this result is unlikely to be significant.

Wild mammals

Wild mammals consisted predominately of rabbit (*Oryctolagus cuniculus*) and hare (*Lepus europaeus*). While the presence of hare provides evidence of hunting; the interpretation of rabbit remains is not as straightforward because they are burrowing animals. However, none of the bones appeared to have derived from articulated skeletons, and the majority were skeletally mature exhibiting some butchery marks which suggest that they were eaten. Only two rabbit bones looked as though they may have been intrusive and this was given away by their light weight and colour.

Fallow deer (*Dama dama*) was the most abundant of the deer species; only six red and roe deer (*Cervus elaphus*/*Capreolus capreolus*) bones were recorded. This is not uncommon as fallow deer became more popular in Britain after the species was re-introduced by the Normans and became a hunting animal for the elite (Sykes 2010: 57). However, by the 19th century the proportion of fallow deer on site declines; the most significant dropped occurred from after the 17th century. Other wild

mammals included mice, rats, moles and voles which would have represented commensal or intrusive species and therefore will not be discussed in further detail. One loose tooth belonging to a small insectivore was recorded but could not be identified to species.

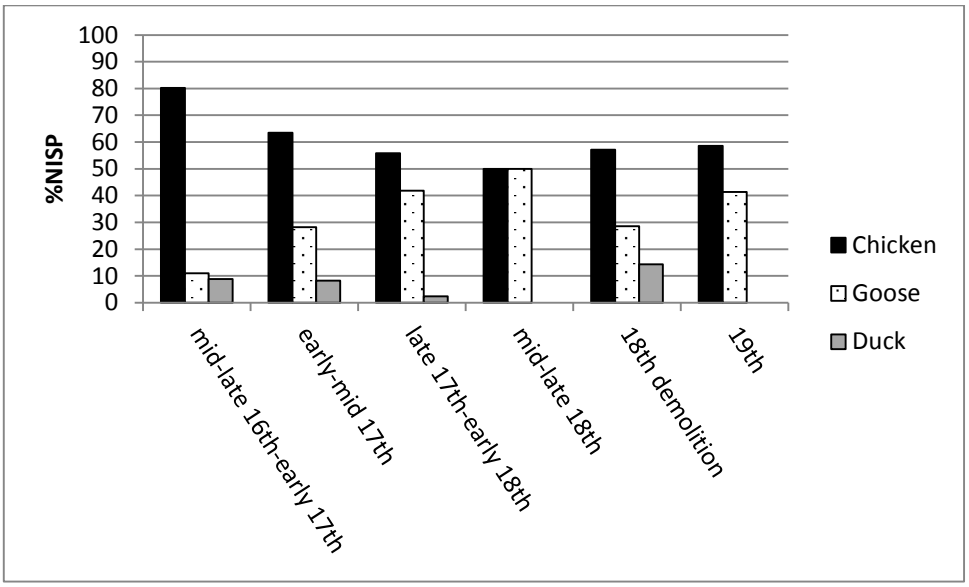

Figure 1.8: Relative proportion of hand-collected chicken, goose and duck. Total NISP in (brackets): mid-late 16th -early 17th (NISP=91); early-mid 17th (NISP=85); late 17th-early 18th (NISP=43); mid-late 18th (NISP=10); 18th demolition (NISP=7); 19th (NISP=29)

Wild birds

The site produced a wide variety of wild birds; the majority of which came from the feasting pit in Area C (Table 1.10). Species found in Area B included: peafowl (*Pavo cristatus*), grey partridge (*Perdix perdix*), swan (*Cygnus* sp.), teal/garganey (*Anas crecca/querquedula*), woodcock (*Scolopax rusticola*), golden plover (*Pluvialis* cf. *apricaria*), heron? (*Ardea* sp.), curlew (*Numenius arquata*) and gull (*Larus* spp/*Larus* cf. *fucus*). All the above species (excluding swan) were found in Area C, in addition to: grouse (*Tetrao* sp.), red shank (*Tringa* cf. *totanus*), plover (*Pluvialis* cf. *apricaria*/*squatorola*), lapwing (*Vanellus vanellus*), snipe (*Gallinago gallinago*), sandpiper (*Calidris* spp.) and heron (*Ardea* sp.). The most abundant wild bird was woodcock however; snipe and sandpiper were also present in high numbers. Previous published works have addressed the occurrence of wild bird species and their connection to elite consumption (Albarella and Thomas 2002; Thomas 2007). A number of the species noted above have been found in the archaeological record on high-status sites and have been documented as food favoured by the elite. More ambiguous species included pigeons/doves,

various corvids, thrushes and passerines. Although these birds are commensal species, they could have been eaten. No butchery marks were recorded on any of the bones, although that does not preclude the possibility that these birds were eaten whole. A small number of corvid bones were juvenile which probably represent natural fatalities of site scavengers or nesting birds.

Amphibians and fish

Only five amphibians were record; two bones were identified as common frog (*Rana temporaria*) and toad (*Bufo bufo*). One cod bone (*Gadus morhua*) was identified; however, the majority of fish bones were separated out of the mammal collection and were assessed by Harland (2010), which will be summarised below.

The assessment of the fish remains conducted by Harland (2010) evaluated the potential of the assemblage and provided an account of the taphonomy, element and taxon identification (which was recorded to family level or broader categories), measurable elements and species count. Unfortunately, fish remains from the early-mid 17th century to 19th century were groups together as 'post-medieval', therefore preventing comparison between these phases. It should also be noted that as this was an assessment some species may have not been identified taxon.

The vast majority of fish were recovered by wet sieving; only a small number were retrieved via hand-collection. This included one Salmonid, cod and Pleuronectidae from the mid-late 16th - early 17th-century and one cod from a post-medieval context (Table 1.2). Specimens from the halibut family (i.e. Pleuronectidae or flatfish) and herring were the most abundant species (figure 1.9). Herring has been noted in higher quantities in medieval and post-medieval sites in the England (Serjeantson and Woolgar 2006, tables 8.1-8.5). Migratory species such as eel as well as gadid and smelt (i.e. Osmeridae) were also frequently recovered from both phases. Notable differences between the two phases include a decrease in smelt and an increase in the herring by the post-medieval period. Salmonid, ray and sole were also absence by the later period (Table 1.2). Herring has commonly been found in higher quantities at medieval and post-medieval sites in the England (Serjeantson and Woolgar 2006, tables 8.1-8.5).

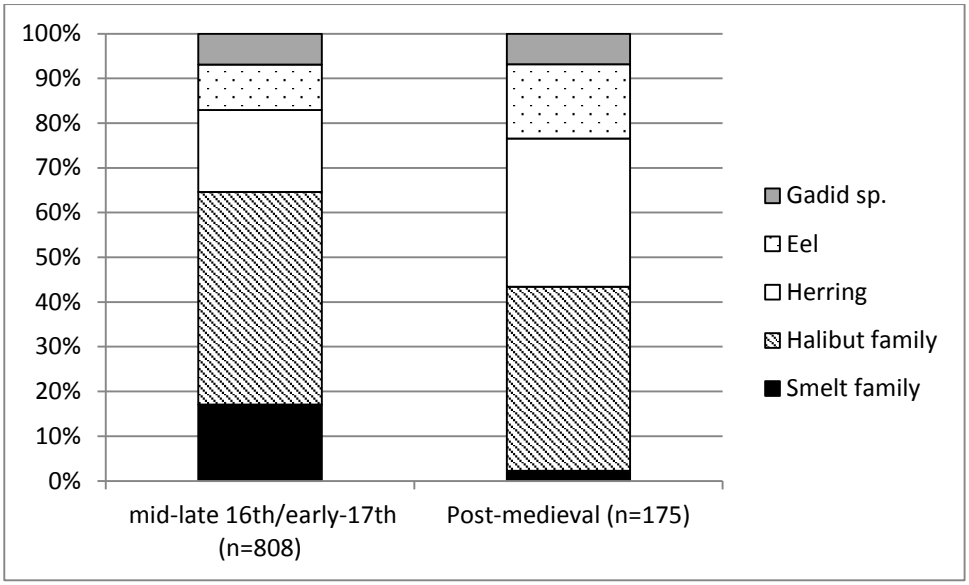

Figure 1.9: The relative proportion of the main food fishes from the sieved samples at Chester's Roman Amphitheatre by family/species based on data in Harland (2010)

Species	mid-late 16th/early-17th	Post-medieval	Total
Atlantic horse-mackerel/scad (*Trachurus trachurus*)		1	1
Cod (*Gadus morhua*)	10		10
Cyprinid	11	9	20
Eel (*Anguilla Anguilla*)	82	29	111
European seabass (*Dicentrarchus labrax*)	6		6
Flatfish	25	6	31
Gadid	56	12	68
Halibut family	384	72	456
Herring (*Clupea harengus*)	148	58	206
Mackerel family	1		1
Monkfish family		1	1
Perciformes	2	1	3
Ray family	19	3	22
Salmonid	26	2	28
Shad *Trachurus trachurus*		2	2
Smelt family	138	4	142
Sole (*Solea solea*)	30		30
Turbot family	5		5
Total	943	200	1143

Table 1.2: Number of identifiable fish from sieved samples from Chester's Roman Amphitheatre based on Harland (2010)

Species	XIV	XV	XVI	XVII	XVIII	XIX	TOTAL
Cattle (*Bos taurus*)	210	617	506	117	117	439	**2006**
Sheep/goat (*Ovis/Capra)*	157	352	321	67	83	277	**1257**
Sheep (*Ovis aries*)	14	26	16	1	3	27	**87**
Goat (*Capra hircus*)			3			1	**4**
Pig (*Sus scrofa*)	52	159	104	27	17	79	**438**
Horse (*Equus caballus*)			1				**1**
Equid (*Equus* sp.)	2	10	7	1	1	5	**26**
Dog (*Canis familaris*)	41	45	9	6		66	**167**
Cat* (*Felis catus)*	5	4	13	1	3	277	**303**
Red deer (*Cervus elaphus*)	2						**2**
Fallow deer (*Dama dama*)	15	17	8	2		1	**43**
Roe deer (*Capreolus capreolus*)			2				**2**
Rabbit (*Oryctolagus cuniculus*)	11	9	5	1	1	6	**33**
Hare (*Lepus europaeus*)		2	3	1		5	**11**
Lagomorph					1		**1**
Rat (*Rattus* sp*.)*		2	2				**4**
Brown rat (*Rattus norvegicus*)		2					**2**
Chicken (*Gallus gallus*)	25	52	21	5	4	17	**124**
Turkey (*Meleagris gallopavo*)	1		2				**3**
Gallus/Numida/Phasianus		1					**1**
Small galliform	3						**3**
Large galliform	1	2					**3**
Goose (*Anser* sp.)	10	24	18	5	2	12	**71**
Duck (*Anas* sp.)	1	4	1		1		**7**
Medium anseriform		1					**1**
Large anseriform	2	3					**5**
Peafowl (*Pavo cristatus*)		1					**1**
Grey partridge (*Perdix perdix*)	1		1	1		1	**4**
Swan (*Cygnus* sp.)	5						**5**
Teal/Garganey (*Anas crecca/querquedula*)		2					**2**
Pigeon (*Columba* sp.)		2	1				**3**
Woodcock (*Scolopax rusticola*)		6	1			3	**10**
Golden plover (*Pluvialis* cf*. apricaria*)		1					**1**
Heron? (*Ardea* sp.)		1					**1**
Curlew (*Numenius arquata*)		1					**1**
Lesser black-backed gull (*Larus* cf*. fucus*)	1						**1**
Gull (*Larus* spp.)	1	2					**3**
Crow/rook (*Corvus corone/frugilegus*)	2					2	**4**
Jackdaw/magpie (*Corvus monedula*/*Pica pica*)	1	1	4				**6**
Corvid			1		1		**2**
Small Corvid	1						**1**
Small Turdid		1	1				**2**
TOTAL	**564**	**1350**	**1051**	**235**	**234**	**1218**	**4652**

Table 1.3: Number of identifiable hand-collected specimens present (NISP) from Area B. Antler fragments not included. *denotes partial skeleton. Key: XIV- mid-late 16th -early 17th; XV - early-mid 17th; XVI - late 17th-early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX - 19th

Species	XIV	XV	XVI	XVII	XVIII	XIX	TOTAL
Cattle (*Bos taurus*)	3	8	3	5		6	**25**
Sheep/goat (*Ovis/Capra)*	1	12	2	3	1	9	**28**
Sheep (*Ovis aries*)		1					**1**
Pig (*Sus scrofa*)	3	6		2	1	7	**19**
Dog (*Canis familaris*)	1		1			3	**5**
Cat* (*Felis catus)*						103	**103**
Fallow deer (*Dama dama*)				1			**1**
Rabbit (*Oryctolagus cuniculus*)		4		1		1	**6**
Hare (*Lepus europaeus*)						1	**1**
Vole (Arvicolinae sp.)		2					**2**
Rat (*Rattus* sp.*)*		2					**2**
Small rodent		1			1	1	**3**
Chicken (*Gallus gallus*)	2	4					**6**
Gallus/Numida/Phasianus	1	1	1				**3**
Goose (*Anser* sp.)	3	1				1	**5**
Grey partridge (*Perdix perdix*)		2					**2**
Teal/Garganey (*Anas crecca/querquedula*)				1			**1**
Pigeon (*Columba* sp.)		1					**1**
Woodcock (*Scolopax rusticola*)		4	1				**5**
Small charadiiform		1					**1**
Corvid		1					**1**
Small Turdid		1					**1**
Passeriform		1		1			**2**
TOTAL	**14**	**53**	**8**	**14**	**3**	**132**	**224**

Table 1.4: Number of identifiable 4mm wet sieved specimens present (NISP) from Area B. Antler fragments not included. Key: XIV- mid-late 16th -early 17th; XV - early-mid 17th; XVI - late 17th-early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX - 19th

Species	XIV	XV	XVI	XVII	XVIII	XIX	TOTAL
Sheep/goat (*Ovis/Capra)*		2					**2**
Pig (*Sus scrofa*)		1					**1**
Cat (*Felis catus)*						1	**1**
Rabbit (*Oryctolagus cuniculus*)	1	3			1		**5**
Mole (*Talpa europaea*)						1	**1**
Vole (Arvicolinae sp.)	2	1	1			2	**6**
Mouse (*Apodemus* spp.)		4				2	**6**
Small insectivore				1			**1**
Small rodent	7	21	5	3		9	**45**
Chicken (*Gallus gallus*)		1					**1**
Woodcock (*Scolopax rusticola*)		1					**1**
Small charadiiform	2	1					**3**
Small Turdid	2	2		1			**5**
Passeriform	4	1	1			2	**8**
TOTAL	**18**	**38**	**7**	**5**	**1**	**17**	**86**

Table 1.5: Number of identifiable 2mm wet sieved specimens present (NISP) from Area B. Antler fragments not included. Key: XIV- mid-late 16th -early 17th; XV - early-mid 17th; XVI - late 17th-early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX - 19th

Species	XV
Small rodent	2
TOTAL	**2**

Table 1.6: Number of identifiable flot specimens present (NISP) from Area B. Antler fragments not included. Key: XIV- mid-late 16th -early 17th; XV - early-mid 17th; XVI - late 17th-early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX - 19th

Species	XIX
Chicken (*Gallus gallus*)	1
Medium anseriform	1
Small charadiiform	1
TOTAL	**3**

Table 1.7: Number of identifiable bulk sample specimens present (NISP) from Area B. Antler fragments not included. Key: XIV- mid-late 16th -early 17th; XV - early-mid 17th; XVI - late 17th-early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX - 19th

Species	XV	XVII	XIX	TOTAL
Cattle (*Bos taurus*)	1	2	3	**6**
Sheep/goat (*Ovis/Capra)*	3	1	3	**7**
Pig (*Sus scrofa*)	1	1		**2**
TOTAL	**5**	**4**	**6**	**15**

Table 1.8: Number of identifiable dry sieve specimens present (NISP) from Area B. Antler fragments not included. Key: XIV- mid-late 16th -early 17th; XV - early-mid 17th; XVI - late 17th-early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX - 19th

Species	XIV	XV	XVI	TOTAL
Cattle (*Bos taurus*)	405	233	56	**694**
Sheep/goat (*Ovis/Capra)*	214	123	41	**378**
Sheep (*Ovis aries*)	25	9	2	**36**
Goat (*Capra hircus*)		1	1	**2**
Pig (*Sus scrofa*)	70	43	15	**128**
Horse (*Equus caballus*)	5		2	**7**
Equid (*Equus* sp.)	3	4		**7**
Dog (*Canis familaris*)	11	5	4	**20**
Cat (*Felis catus)*	3			**3**
Red deer (*Cervus elaphus*)	1			**1**
Fallow deer (*Dama dama*)	14	10		**24**
Roe deer (*Capreolus capreolus*)			1	**1**
Rabbit (*Oryctolagus cuniculus*)	2			**2**
Hare (*Lepus europaeus*)		1		**1**
Chicken (*Gallus gallus*)	48	2	3	**53**
Guineafowl? (*Numida meleagris?*)		1		**1**
Gallus/Numida/Phasianus	16			**16**
Large galliform	2			**2**
Duck (*Anas* sp.)	7	3		**10**
Large galliform/anseriform	1			**1**
Teal/Garganey (*Anas crecca/querquedula*)	1			**1**
Woodcock (*Scolopax rusticola*)	6			**6**
Curlew (*Numenius arquata*)	1			**1**
Gull (*Larus* spp.)	1			**1**
Large Turdid	1			**1**
Cod (*Gadus morhua*)		1		**1**
TOTAL	**837**	**436**	**125**	**1398**

Table 1.9: Number of identifiable hand-collected specimens present (NISP) from Area C. Antler fragments not included. Key: XIV- mid-late 16th -early 17th; XV - early-mid 17th; XVI - late 17th-early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX - 19th

Species	XIV
Cattle (*Bos taurus*)	176
Sheep/goat (*Ovis/Capra)*	167
Sheep (*Ovis aries*)	16
Pig (*Sus scrofa*)	406
Cat (*Felis catus)*	62
Fallow deer (*Dama dama*)	4
Rabbit (*Oryctolagus cuniculus*)	105
Hare (*Lepus europaeus*)	82
Lagomorph	60
House mouse (*Mus musculus*)	3
Black rat? (?*Rattus Rattus*)	1
Rat (*Rattus* sp.*)*	1
Small rodent	8
Chicken (*Gallus gallus*)	599
Gallus/Numida/Phasianus	569
Large galliform	5
Goose (*Anser* sp.)	17
Duck (*Anas* sp.)	6
Small anseriform	1
Medium anseriform	1
Large galliform/anseriform	4
Grouse (*Tetrao* sp.)	1
Peafowl (*Pavo cristatus*)	5
Grey partridge (*Perdix perdix*)	3
Teal/Garganey (*Anas crecca/querquedula*)	12
Pigeon (*Columba* sp.)	1
Woodcock (*Scolopax rusticola*)	60
Red shank (*Tringa* cf. *Totanus*)	2
Plover (*Pluvialis* cf. *apricaria*)	9
Plover *Pluvialis* cf. *apricaria/squatorola*	4
Lapwing (*Vanellus vanellus*)	14
Snipe (*Gallinago gallinago*)	23
Sandpiper (*Calidris* spp.)	17
Curlew (*Numenius arquata*)	1
Small charadiiform	43
Gull (*Larus* spp.)	5
Heron (*Ardea* sp.)	1
Corvid	1
Small Turdid	34
Large Turdid	5
Passeriform	51
Amphibian	1
Toad (*Bufo bufo*)	1
TOTAL	**2587**

Table 1.10: Number of identifiable 4mm wet sieved specimens present (NISP) from Area C. Antler fragments not included. Key: XIV- mid-late 16th-early 17th; XV - early-mid 17th; XVI - late 17th-early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX - 19th

Species	XIV	XV	TOTAL
Sheep (*Ovis aries*)	5		**5**
Pig (*Sus scrofa*)	47		**47**
Cat (*Felis catus)*	8		**8**
Rabbit (*Oryctolagus cuniculus*)	27		**27**
Hare (*Lepus europaeus*)	1		**1**
Lagomorph	14		**14**
Mole (*Talpa europaea*)	1		**1**
House mouse (*Mus musculus*)	3		**3**
Vole (Arvicolinae sp.)	1		**1**
Small rodent	48	1	**49**
Large Rodent	1		**1**
Chicken (*Gallus gallus*)	12		**12**
Gallus/Numida/Phasianus	79		**79**
Woodcock (*Scolopax rusticola*)	3		**3**
Plover *Pluvialis* cf. *apricaria/squatorola*	2		**2**
Snipe (*Gallinago gallinago*)	10		**10**
Calidris spp.	12		**12**
Small charadiiform	32		**32**
Small Turdid	24		**24**
Large Turdid	4		**4**
Passeriform	109		**109**
Amphibian	2		**2**
Frog (*Rana temporaria*)	1		**1**
TOTAL	**446**	**1**	**447**

Table 1.11: Number of identifiable 2mm wet sieved specimens present (NISP) from Area C. Antler fragments not included. Key: XIV- mid-late 16th-early 17th; XV - early-mid 17th; XVI - late 17th-early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX - 19th

Species	XIV
Pig (*Sus scrofa*)	5
Rabbit (*Oryctolagus cuniculus*)	1
Small rodent	3
Gallus/Numida/Phasianus	3
Small charadiiform	1
Small Turdid	1
Passeriform	5
TOTAL	**19**

Table 1.12: Number of identifiable flot specimens present (NISP) from Area C Antler fragments not included. Key: XIV- mid-late 16th -early 17th; XV - early-mid 17th; XVI - late 17th-early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX - 19th

Species	XIV
Cattle (*Bos taurus*)	65
Sheep/goat (*Ovis/Capra)*	15
Sheep (*Ovis aries*)	4
Capra (*Capra hircus*)	1
Pig (*Sus scrofa*)	26
Dog (*Canis familaris*)	1
Cat (*Felis catus)*	31
Fallow deer (*Dama dama*)	1
Rabbit (*Oryctolagus cuniculus*)	18
Hare (*Lepus europaeus*)	34
Lagomorph	8
Mole (*Talpa europaea*)	1
Chicken (*Gallus gallus*)	1
Gallus/Numida/Phasianus	4
Peafowl (*Pavo cristatus*)	1
TOTAL	**211**

Table 1.13: Number of identifiable bulk sample specimens present (NISP) from Area C. Antler fragments not included. Key: XIV- mid-late 16th -early 17th; XV - early-mid 17th; XVI - late 17th-early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX - 19th

Unidentifiable fragments	XIV	XV	XVI	XVII	XVIII	XIX
Unidentifiable large mammal	473	1635	1085	515	190	1262
Unidentifiable medium mammal	538	1463	760	616	109	1387
Unidentifiable small mammal	20	18	10	1	0	172
Unidentifiable large bird	3	13	5	2	1	3
Unidentifiable medium bird	25	36	24	10	5	24
Unidentifiable small bird	14	26	9	8	1	8
Unidentifiable bird	35	76	34	9	1	19
Unidentifiable fish	2	3	1	0	0	1
Unidentifiable	1034	3144	1272	449	58	1061
TOTAL	**2144**	**6414**	**3200**	**1610**	**365**	**3937**

Table 1.14. Number of unidentifiable bones from Area B. Key: XIV- mid-late 16th -early 17th; XV - early-mid 17th; XVI - late 17th-early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX - 19th

Unidentifiable fragments	XIV	XV	XVI
Unidentifiable large mammal	5145	452	142
Unidentifiable medium mammal	2933	120	53
Unidentifiable small mammal	146	1	0
Unidentifiable large bird	31	3	0
Unidentifiable medium bird	280	0	1
Unidentifiable small bird	457	1	0
Unidentifiable bird	2004	1	0
Unidentifiable	16638	72	0
TOTAL	**27634**	**650**	**196**

Table 1.15: Number of unidentifiable bones from Area C. Key: XIV- mid-late 16th -early 17th; XV - early-mid 17th; XVI - late 17th-early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX - 19th

Body parts represented

Before presenting the results for the body parts representation it should be noted that animal bones from mid-late 18th century and 18th century (demolition deposit) did not produce a sufficiently large enough sample and therefore will not be discussed in detail.

All body parts were present for cattle which suggest that whole animals were brought to the site as undressed carcasses or butchered joints (figures 1.10-1.13). The pelvis and scapula are consistently the most represented elements, both of which are major meat-bearing bones. The proportions of other elements tend to differ throughout the phases; however, some show a slight preponderance towards hindlimbs or forelimbs (e.g. early-mid 17th and late 17th-early 18th century). This may be a reflection of the purchasing of pre-butchered joints from the urban market. In the 19th century, there is a slight dominance of the 'meaty' elements.

Dense elements such as the calcaneum and astragalus where commonly represented, whereas other dense elements, such as the distal tibia and femur, were only present in small numbers (Lyman 1994, table 7.6: 246-9). An explanation for this may be when the lower limb extremities are removed as the carcass is processed; the distal tibia is chopped through. The low abundance of phalanges could also be attributed to their removal during primary butchery as they carry little meat. Also, as an animal is skinned the head and feet are normally left attached and were transported with the skins, which are could be why the lower limb extremities are less abundant. Metapodials were always in high demand by bone workers, for that reason those involved in the tanning industrial almost always sold out of these elements (Yeomans 2006: 221). Cranial elements were fairly abundant in some instances (e.g. mid-late 16th – early 17th century). In this phase there were at least two complete cattle skulls from the large pit as well as 12 calf mandibles between 1-8 months (see mortality profile). This is interesting as the consumption of calf heads was considered to be a delicacy (Burnett 1966: 60; Colquhoun 2007: 169).

In general, the body part representations for sheep/goat showed a similar pattern over time (figure 1.14-1.17.). As most of the elements were represented, undressed carcasses were probably brought to the site. It is evident that major meat-bearing bones like the scapula, humerus, radius, pelvis and tibia were more common. The low occurrence of the ulna and femur suggests that taphonomic factors were involved as both elements have a low mineral density making them more susceptible to post-depositional destruction (Lyman 1994, table 7.6: 246-9). Metapodials and phalanges were also poorly represented, which could indicate their removal during primary butchery or they may have been kept with the animal skins. Recovery biases should be considered, as smaller bones like

phalanges are more commonly missed during excavation; however, the analysis of sheep/goat body parts from the wet sieved samples also had a low proportion of these bones. It is unlikely, therefore that recovery biases are the sole cause of the paucity of phalanges.

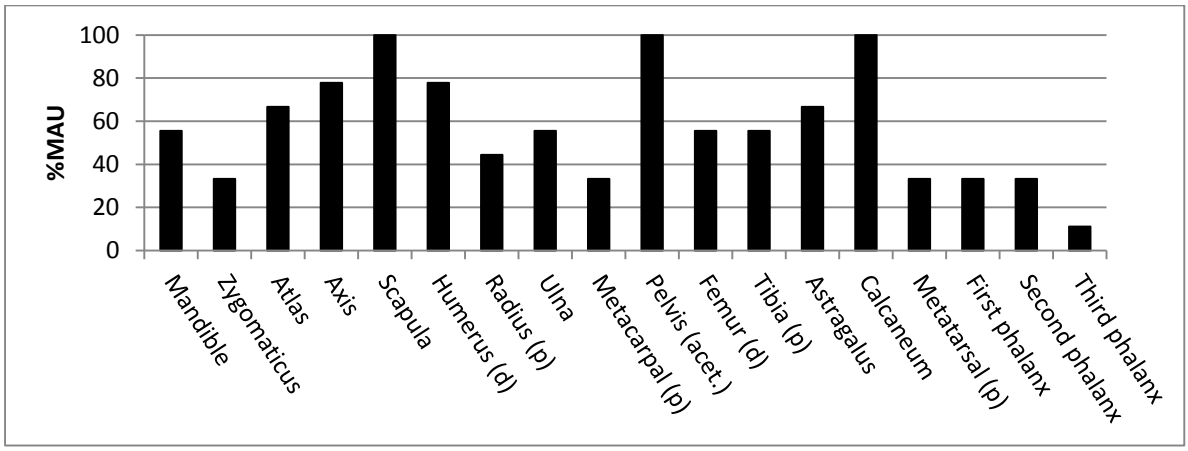

Figure 1.10: Percentage body part representation for hand-collected cattle bones from the mid-late 16th-early 17th C. (Total NISP 380; max MAU 9)

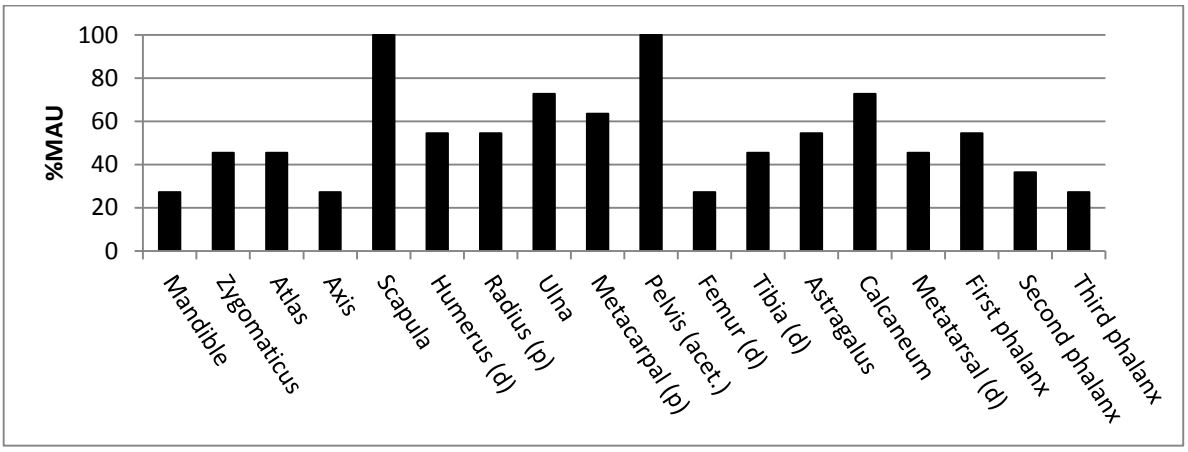

Figure 1.11: Percentage body part representation for hand-collected cattle bones from the early-mid 17th C. (Total NISP 480; max MAU 11)

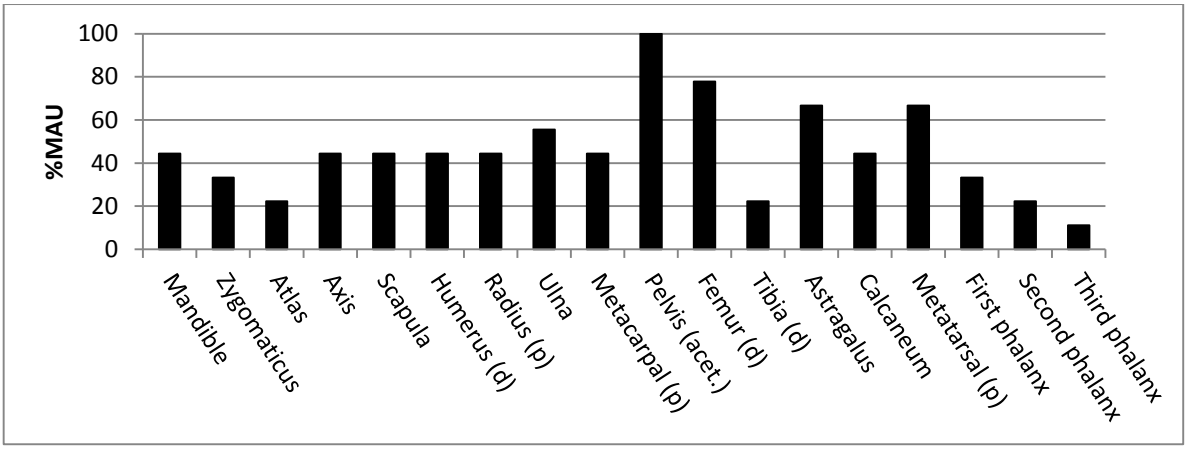

Figure 1.12: Percentage body part representation for hand-collected cattle bones from the late 17th-early 18th C. (Total NISP 315; max MAU 9)

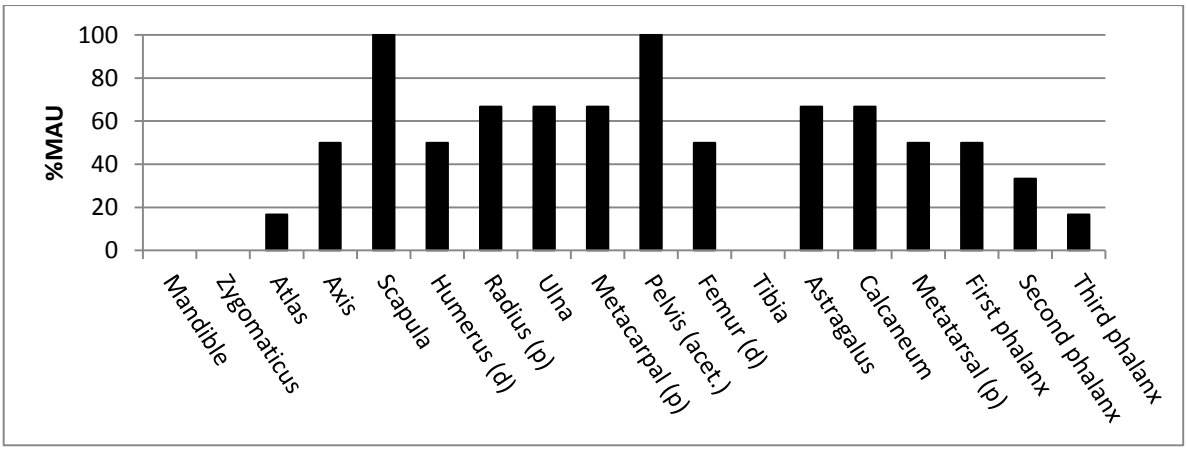

Figure 1.13: Percentage body part representation for hand-collected cattle from the 19th C. (Total NISP 247; max MAU 6)

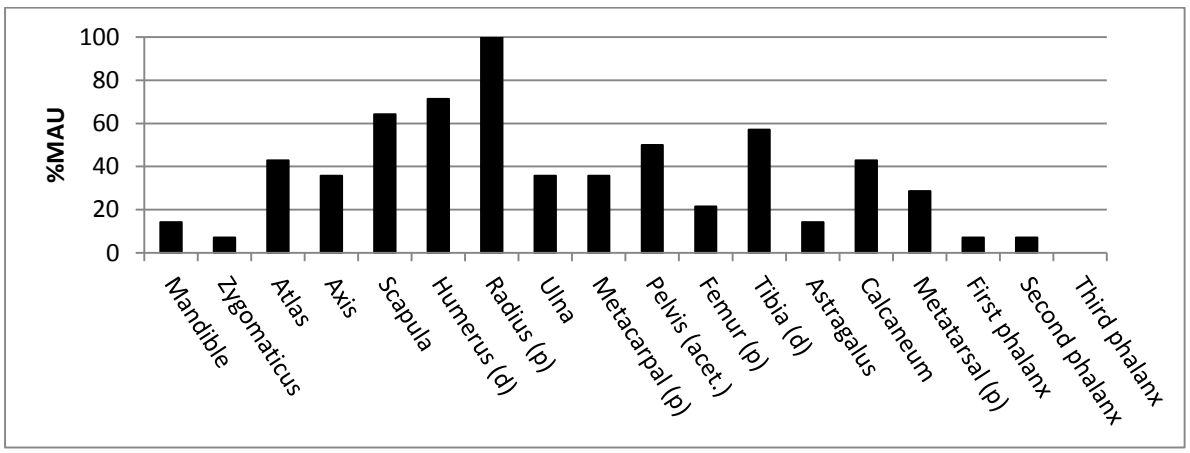

Figure 1.14: Percentage body part representation for hand-collected sheep/goat bones from the mid-late 16th-early 17th C. (Total NISP 309; max MAU 14)

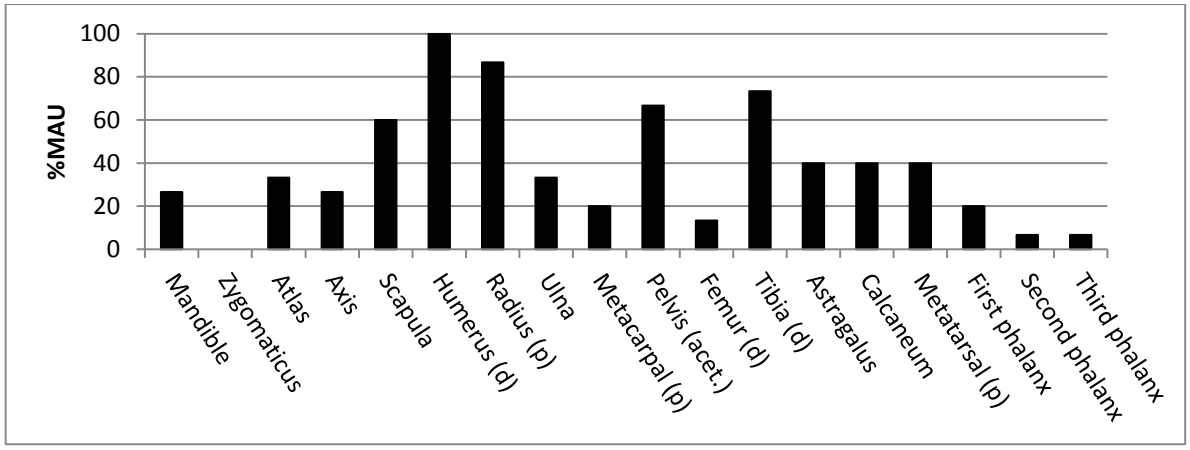

Figure 1.15: Percentage body part representation for hand-collected sheep/goat bones from the early-mid 17th C. (Total NISP 403; max MAU 15)

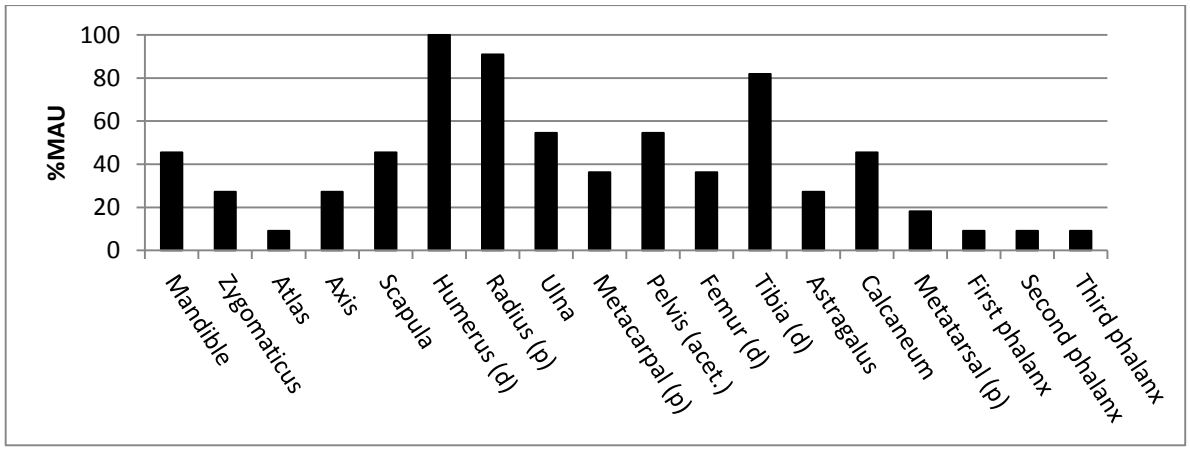

Figure 1.16: Percentage body part representation for hand-collected sheep/goat bones from the late 17th-early 18th C. (Total NISP 272; max MAU 11)

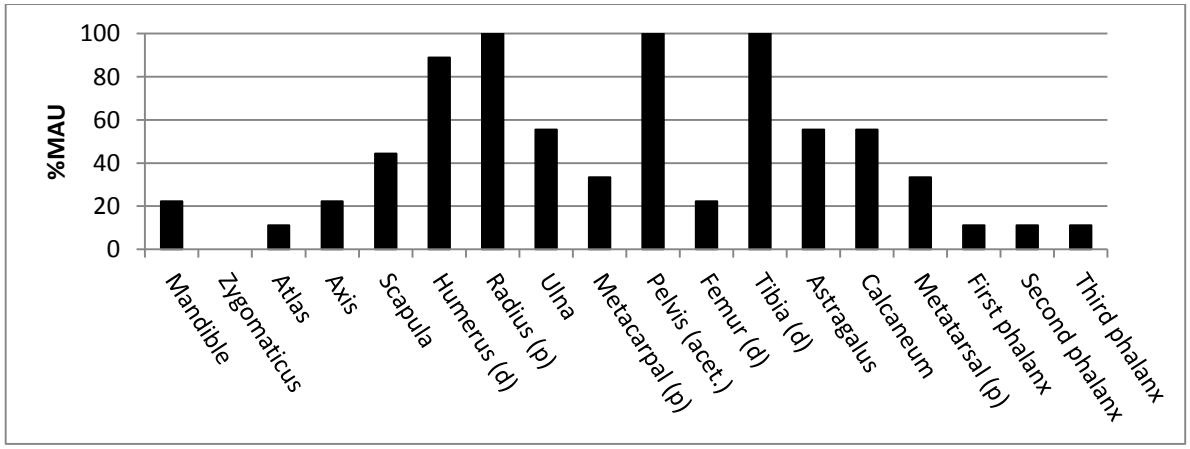

Figure 1.17: Percentage body part representation for hand-collected sheep/goat from the 19th C. (Total NISP 262; max MAU 9)

Nearly all elements for pigs were represented; however, the proportion of these elements differed between phases (figures 1.18-1.21). In general, post-cranial bones for pig were poorly represented in comparison to cattle and sheep/goat. This could be because pigs were consumed more often as filleted joints, which would explain the lack of post-cranial bones (Thomas 2005a: 49). In addition, pigs tend to be slaughtered by the time they reach prime meat age; consequently, their bones are more porous making them prone to post-depositional destruction. There are a high proportion of cranial elements which could imply a preference for this body part or their higher relative density. Pig head (brawn) was a well-known dish in medieval and Tudor cooking and have been noted on other contemporary sites (Dobney *et al.* 1996; Spencer 2004: 117; Thomas 2005a; Wilson 1973: 88). Major meat-bearing bones like the scapula, humerus and radius were well-represented as well as some of the lower limb bones. The astragalus, calcaneum and proximal metapodial are better represented in some phases but this is probably because these elements have a high mineral density. The low proportion of the tibiae and femora may too be attributed to preservation difference between high and low density bones.

The body part representation for fallow deer highlights that hindlimbs were more common (figure 1.22); a phenomenon that has been witnessed on other high-status medieval sites (Thomas 2007). This pattern has been attributed to the practice of 'unmaking' which takes place after hunt and capture of deer and involves the disarticulation and distribution of certain body parts to different members of the hunting party (Sykes 2007b; Thomas 2007). As the hindlimbs are normally given to the lord of the estate it is common to observe high frequencies of these elements on high-status sites. However, the presences of forelimb bones suggest that this practice was not always enforced (Thomas and Vann 2015).

For chicken, an analysis of the body parts could only be conducted for the mid-late 16th - early 17th century and early-mid 17th century since other phases produced a small sample size. Both phases had most body parts present which suggest that whole birds were processed on site (figures 1.23-1.25). Although, some of the chickens may have been raised on site, the sheer quantity in Area C suggests that some, if not most, were purchased. It is not surprising that the skull and cervical vertebrae are nearly absent as these bones are small and can be easily missed during excavation; furthermore, the head and feet are regularly removed during food preparation. The range of chicken elements from the mid-late 16th - early 17th century suggests the presence of articulated skeletons, which may have been consumed and disposed of as whole carcasses. In the early-mid 17th century, however, the chicken remains were disarticulated and the higher proportion of femora and humeri suggests that the meatier elements were eaten. Wing elements like the radius and carpometacarpus

were less abundant, which may reflect how the carcass was dismembered during preparation (Eriscon 1987; Serjeantson 2009a, table 6.2: 133). The low proportion of the tibiotarsus and tarsometatarus could be the result of taphonomic processes; however it may also relate to their removal prior to consumption. At Wigmore Castle a dump of chicken phalanges and tarsometatarsi, indicating removal during butchery, was recovered from an early 14th-century context (Thomas and Vann 2015).

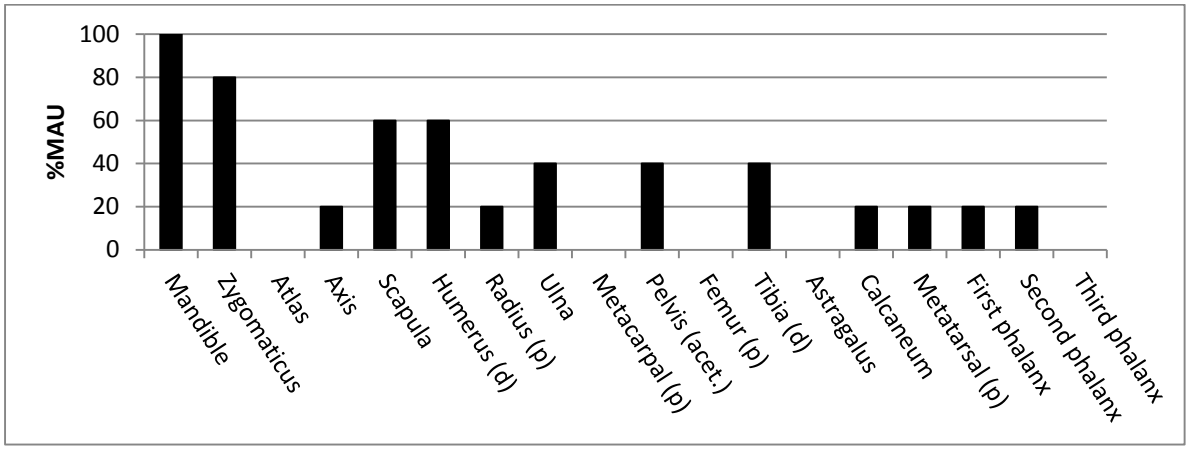

Figure 1.18: Percentage body part representation for hand-collected pig bones from the mid-late 16th-early 17th C. (Total NISP 78; max MAU 5)

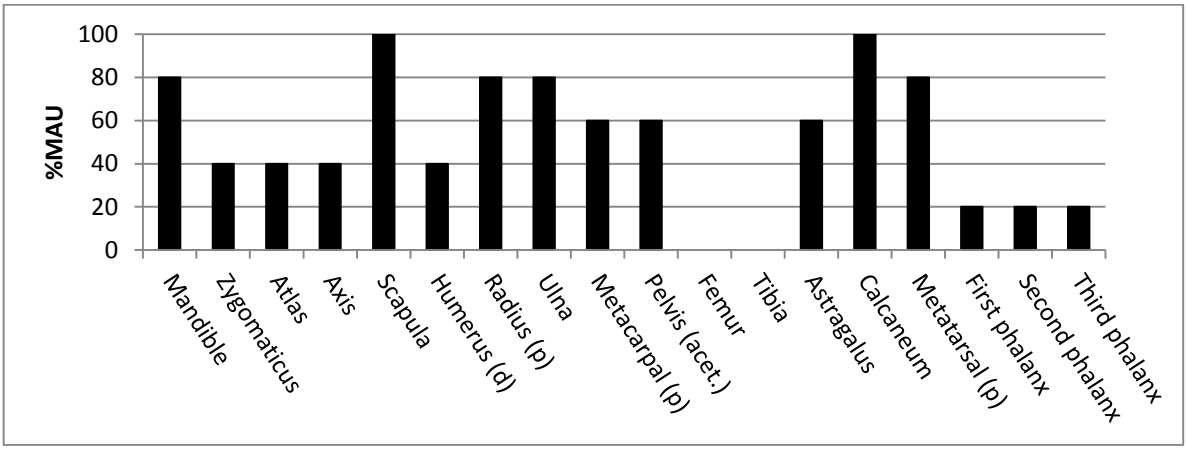

Figure 1.19: Percentage body part representation for hand-collected pig bones from the early-mid 17th C. (Total NISP 116; max MAU 5)

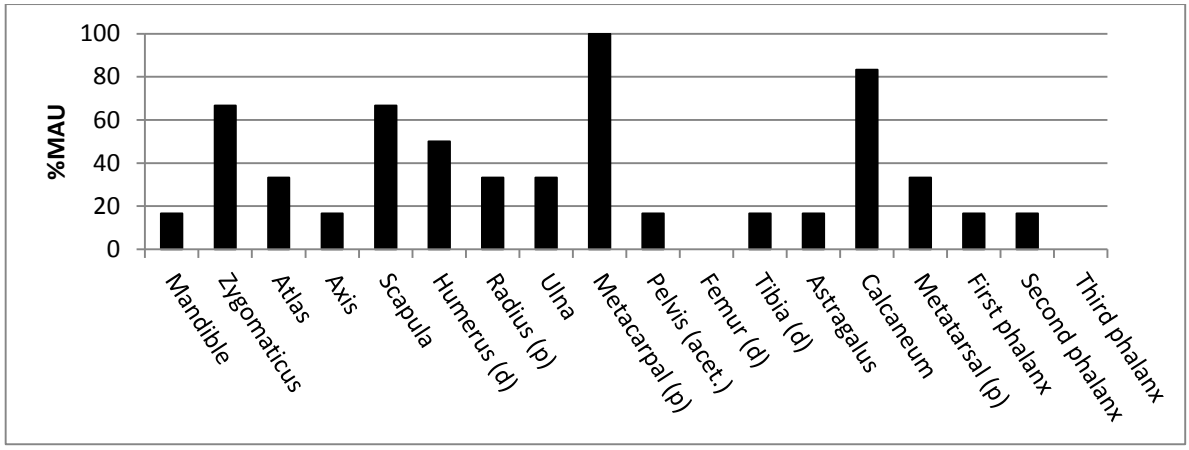

Figure 1.20: Percentage body part representation for hand-collected pig bones from the late 17th-early 18th C. (Total NISP 74; max MAU 6)

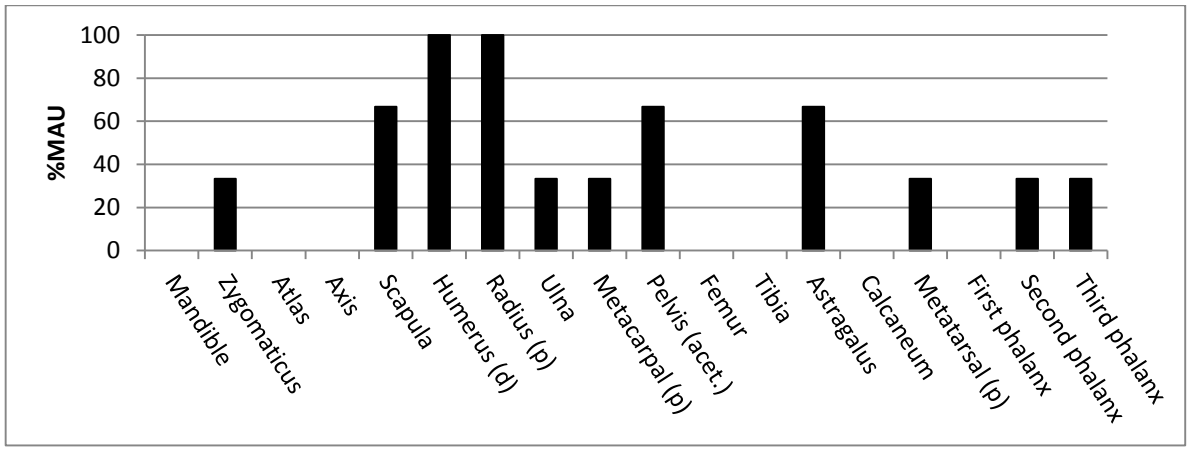

Figure 1.21: Percentage body part representation for hand-collected pig bones from the 19th C. (Total NISP 40; max MAU 3)

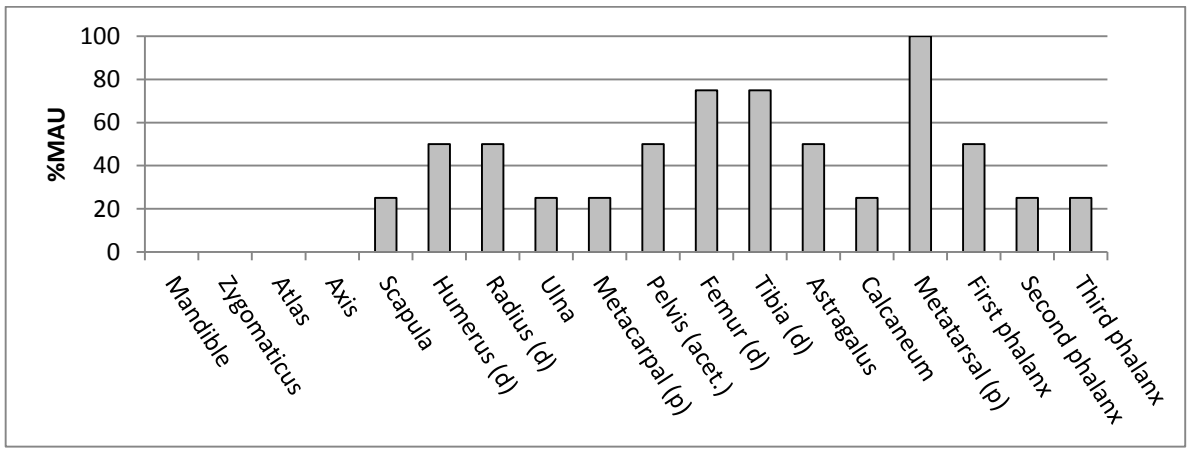

Figure 1.22: Percentage body part representation for hand-collected fallow deer bones from all phases. (Total NISP 62; max MAU 4)

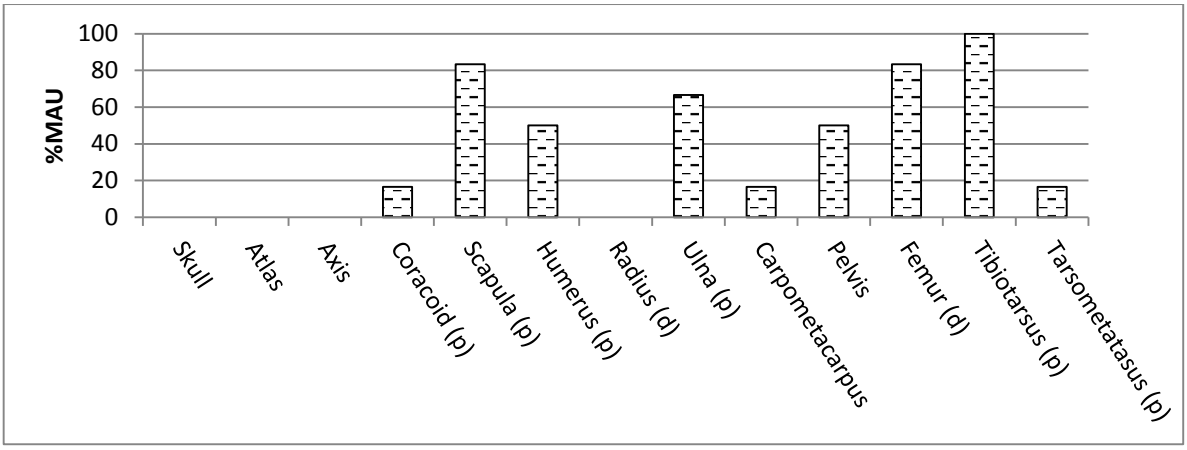

Figure 1.23: Percentage body part representation for hand-collected chicken bones from the mid-late 16th-early 17th C. (Total NISP 58; max MAU 6)

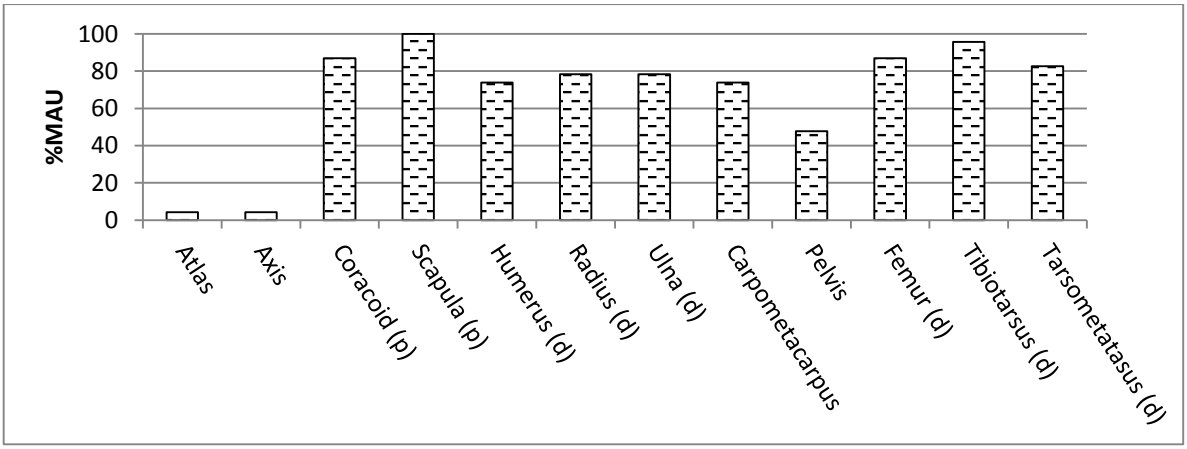

Figure 1.24: Body part representation for 4mm sieved chicken bones from the mid-late 16th-early 17th C. (Area C only). (Total NISP 407, max MAU 23)

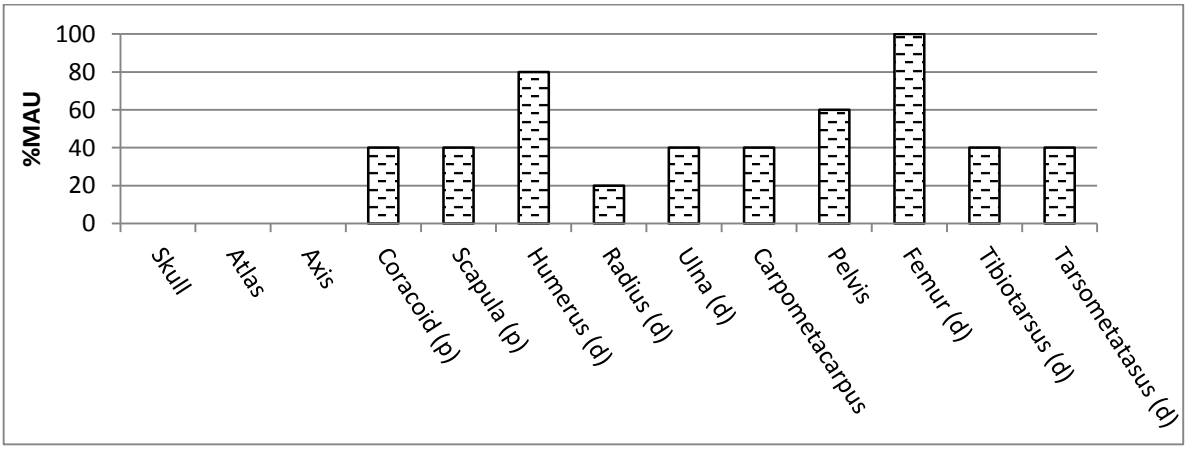

Figure 1.25: Percentage body part representation for hand-collected chicken bones from the early-mid 17th C. (Total NISP 46; max MAU 5)

Mortality profiles

Unfortunately, there were a paucity of cattle, sheep/goat and pig mandibles in some of the phases, therefore only broad statements could be made about the husbandry strategies based on the tooth wear data. In addition, some phases did not yield a large enough sample size to be included in the epiphyseal fusion results.

The tooth wear data for cattle from the mid-late 16th - early 17th and late 17th - early 18th century demonstrates that the majority were as calves (i.e. in the first eight months), with a higher percentage of older animals from the late 17th - early 18th century (figure 1.26-1.27). Despite this, the presence of young cattle implies a husbandry strategy geared towards meat and dairy production. Although the sample size is small, there does appear to be a lower emphasis on juveniles by the 19th century (figure 1.28). For the phases that produced an inadequate number of mandibles, the teeth that could be aged showed a mix of ages which ranged between 1 to 8 months and 18 to 30 months as well as ones that were classified as old adult and senile.

The fusion data for the mid-late 16th - early 17th century (figure 1.29) reveals a different pattern from the tooth wear data, showing a higher number of older individuals. This may be because younger animals are more prone to post-depositional destruction; however, another possibility could be that calf heads and beef from older animals were arriving on-site. Fifteen percent of cattle were younger than 1 to 2 years of age when they were culled and at least 71% were around 7 to 9 years of age. This is typical for cattle kept for their secondary products before being slaughtered for beef. The early-mid 17th century (figure 1.29) is strikingly different as there appears to have been a stronger emphasis on younger animals; compared to the mid-late 16th - early 17th, late 17th - early 18th and 19th centuries. Thirty-two percent were younger than 2 to 3½ years old and 45% were younger than 3½ to 4 years old. One explanation for this is that during 17th century farming in Cheshire was dominated by cheese production. The majority of farmers in the region kept cows that produced tons of cheese a year which would have resulted in a surplus of male calves (Beck 1969: 41; Hodson 1978: 71). Since this phase is also associated with the Civil War period it is worth considering whether this tumultuous time in British history had an effect on husbandry strategies in Cheshire. Thirsk (2007: 97) states that the way food was provisioned between 1640 and 1660 was unique and therefore should be considered as a separate phase in food history. There was a high demand for butter and cheese during the Civil War as it was seen as 'instant food' for the soldiers. As Cheshire was known as a dairy region it is not presumptuous to suggest that the high demand for dairy products during this period resulted in a surplus of calves. By the late 17th - early 18th century,

there was clearly a decline in the number of younger animals which may suggests there was shift from a dairy-focused economy to a mixed economy (see figure 1.29). This is partially supported by the tooth wear data. This is shown by an increase in the number of older individuals compared to the previous phase. The mortality for the 19th century is similar to the early-mid 17thcentury in that there are younger animals present. This is loosely supported by the tooth wear data showing that cattle rearing focused on meat and dairy production. Scholars also noted that dairy production was still an important economy for Cheshire's farmers in the 19th century (Scard 1981: 63-68).

For sheep/goat there were only enough mandibles with tooth wear data from the late 17th - early 18th century which showed that over 50% were 4-6 years of age which suggests that they were primarily exploited for secondary products (figure 1.30). In other phases, sheep/goat were aged at 2 to 6 months and between 1 and 6 years old. In general, the epiphyseal data for sheep/goat differed very little over time (figure 1. 31). However, the percentage of later fusing bones from the early-mid 17th century and late fusing bones from the late 17th - early 18th century shows a noticeable difference. In the early-mid 17th century, only 17% of later fusing sheep/goat bones were fused, therefore the majority were slaughtered younger than 5 years of age. For the late 17th - early 18th century, the fact that a higher proportion of sheep/goat were younger than 3½ to 4 years of age possibly suggests that they were reared for meat and wool. On the whole, even though some of these animals would have been reared for meat, the lack of very young sheep/goat suggests that mutton was consumed regularly. Most of these animals would have been able to produce at least several fleeces before they were slaughtered.

The mandibular wear stage data for pigs from the mid-late 16th - early 17th century shows that 40% were between 0 to 2 months old when they were slaughtered (figure 1.32). Of the remaining pigs, 20% were killed at 7 to 14 months, 30% at 14 to 21 months and the rest by 27 months; no pigs survived beyond two years of age. Unlike cattle and sheep, pigs are normally slaughtered at a young age because they are not exploited for secondary products (Albarella 2006: 83). A number of pigs were kept beyond prime meat age; these may have been pigs kept for breeding purposes and some may have been intentionally kept, as it was believed that older pigs produced better bacon and pork (Albarella 2006: 83). It is worth pointing out that most of the young pigs came from Area C. This is interesting because suckling pig was considered a delicacy among the elite (Hammond 2005: 60; Holderness 1989: 154). Mandibular teeth were scarce in other phases but the teeth that could be aged ranged between 14 to 21 months.

The epiphyseal fusion data for pigs from the mid-late 16th - early 17th century is particularly striking as it shows that very young pig dominated the assemblage, the majority of which represented

suckling pigs from Area C (figure 1.33). Only 21% of early and middle fusing bones were fused and just 3% of late fusing bones were fused, therefore the majority of pigs were 1 to 2½ years old or younger at the time of death. The early-mid 17th century and late 17th - early 18th century show a more typical slaughter profile for pigs (figure 1.33). Most were killed by the time they reached 3½ years old, around the time the optimum ratio between meat weight and age had been achieved (Grant 1988: 158). The mid-late 18th also had a similar slaughter profile; however, none were younger than one year old when killed.

The percentage of juvenile chicken bones could only be calculated for two phases: 10% of chicken bones from the mid-late 16th - early 17th century (Area C) and 14% from the early-mid 17th century (Area B) were juvenile. The presence of juvenile bones suggests some chickens were raised on site for meat. As most of the chickens were adult they would have been exploited for their eggs.

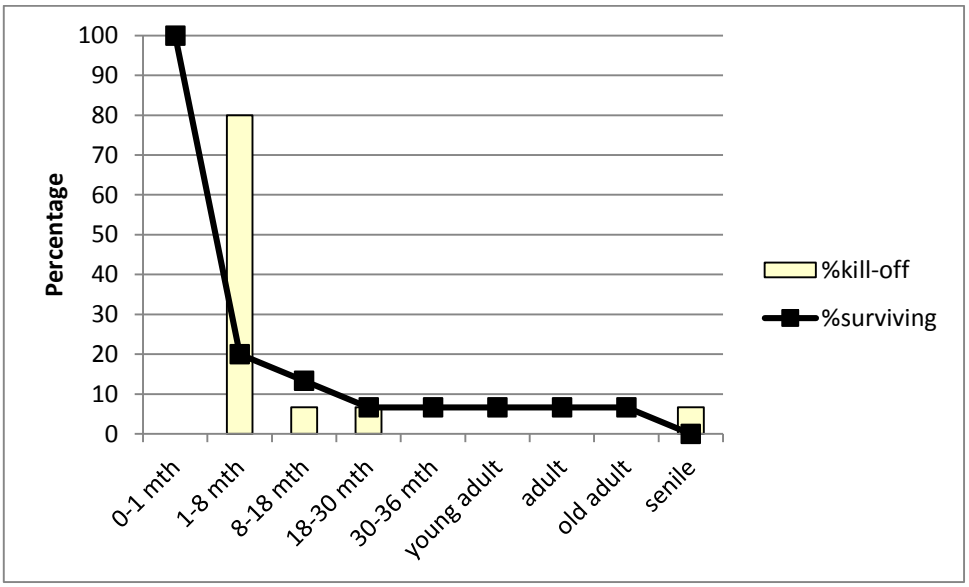

Figure 1.26: Tooth wear data for cattle mandibles from the mid-late 16th-early 17th C (n=15). This graph was produced using the methods of Hambleton (1999).

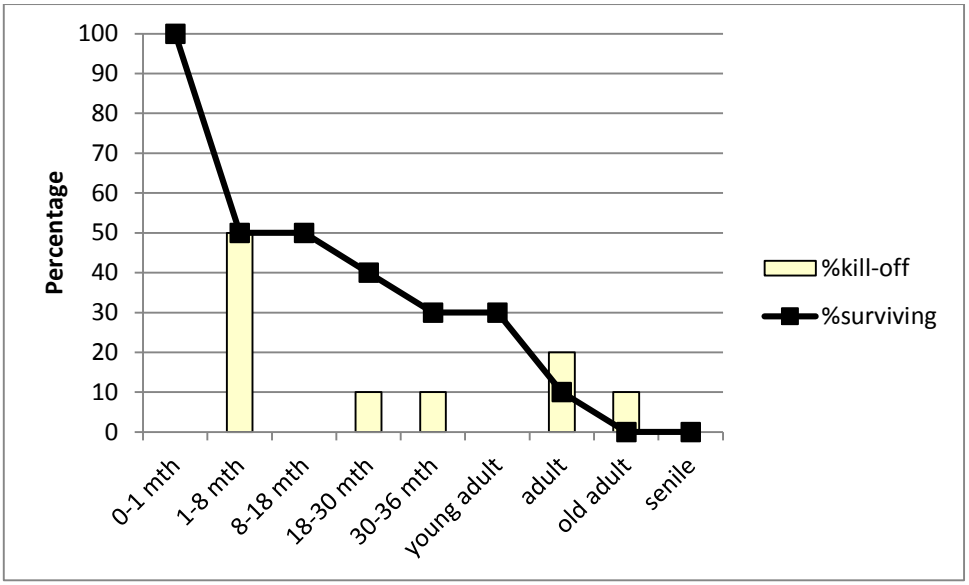

Figure 1.27: Tooth wear data for cattle mandibles from the late 17th-early 18th C (n=10). This graph was produced using the methods of Hambleton (1999).

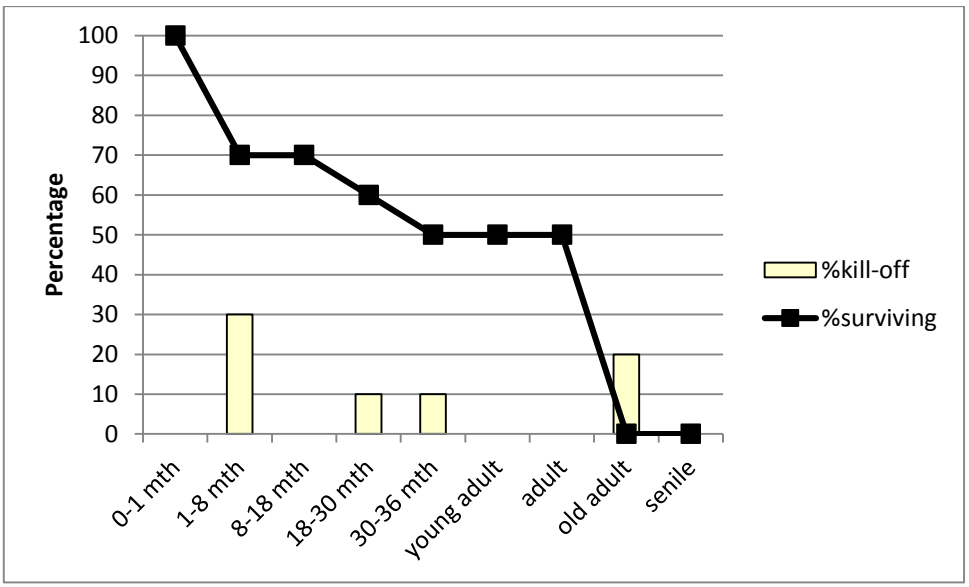

Figure 1.28: Tooth wear data for cattle mandibles the 19th C (n=7). This graph was produced using the methods of Hambleton (1999).

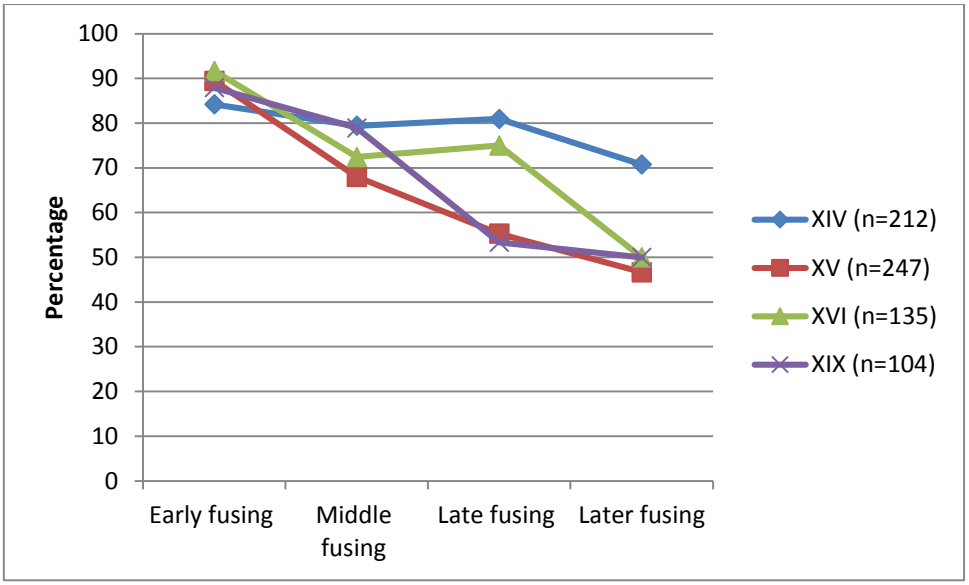

Figure 1.29: Epiphyseal fusion data for cattle (age categories following Reitz and Wing 2008). Key: XIV- mid-late 16th -early 17th; XV - early-mid 17th; XVI - late 17th-early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX - 19th

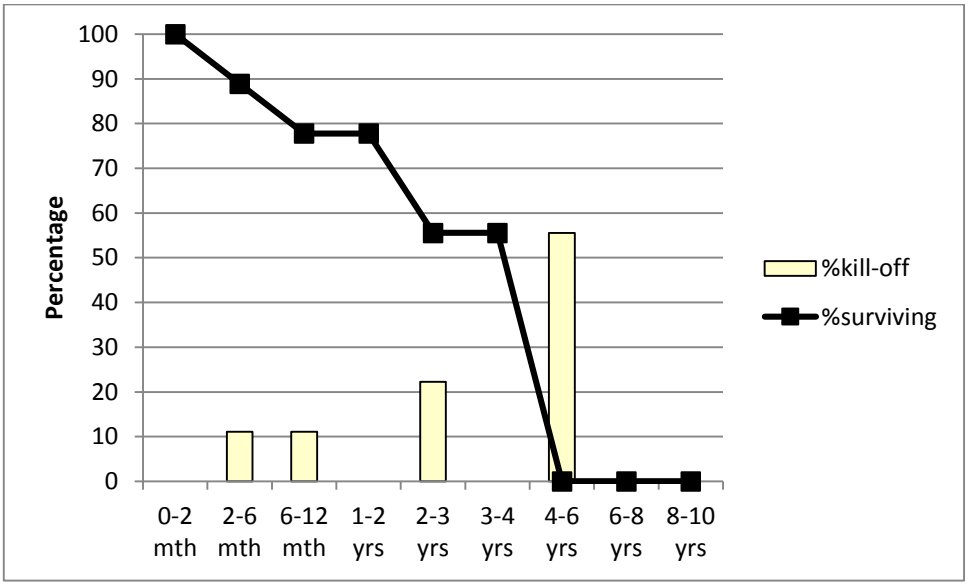

Figure 1.30: Tooth wear data for sheep/goat mandibles from the late 17th-early 18th C (n=9). This graph was produced using the methods of Hambleton (1999).

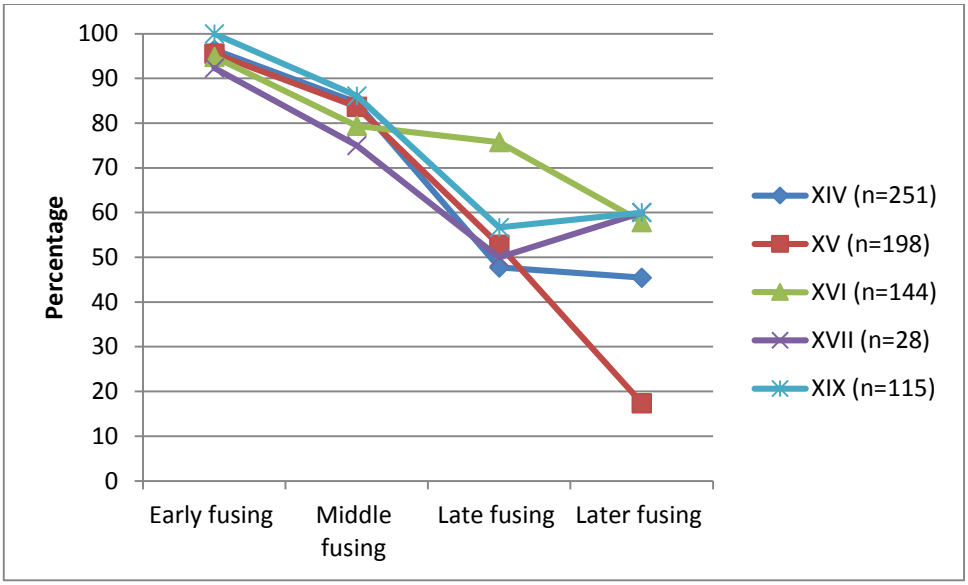

Figure 1.31: epiphyseal fusion data for sheep/goat (age categories following Reitz and Wing 2008). Key: XIV- mid-late 16th -early 17th; XV - early-mid 17th; XVI - late 17th-early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX - 19th

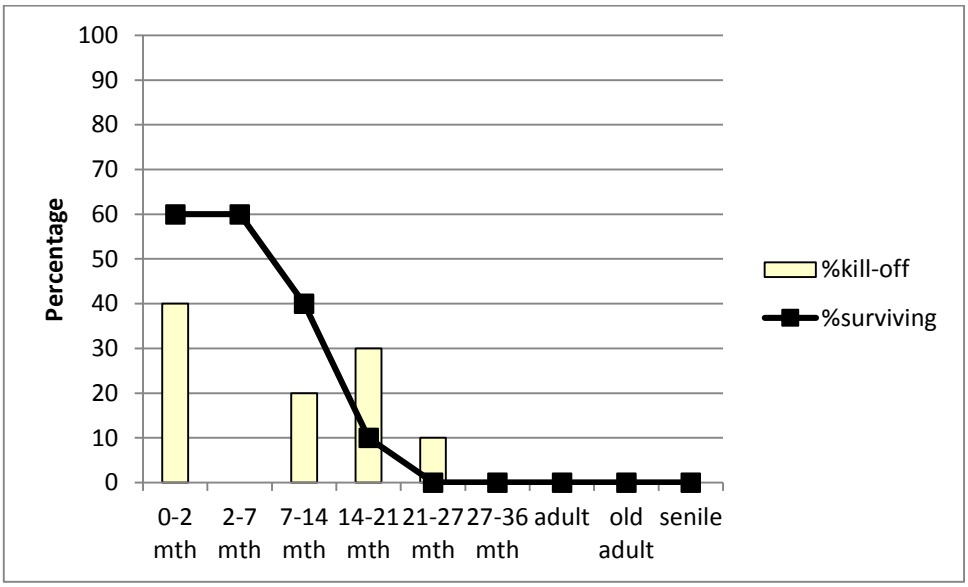

Figure 1.32: Tooth wear data for pig mandibles from the mid-late 16th-early 17th C (n=10). This graph was produced using the methods of Hambleton (1999).

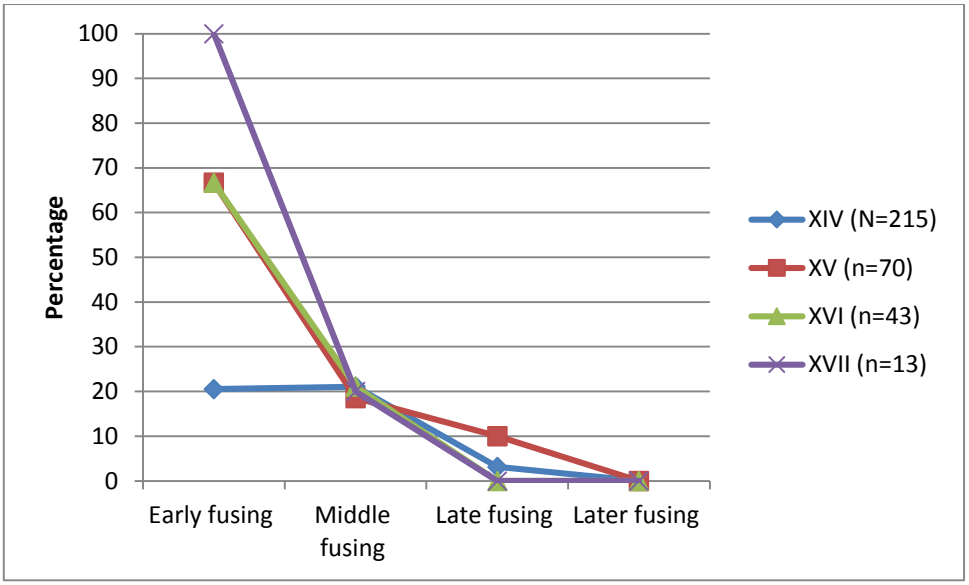

Figure 1.33: Epiphyseal fusion data for pig (age categories following Reitz and Wing 2008). Key: XIV- mid-late 16th -early 17th; XV - early-mid 17th; XVI - late 17th-early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX - 19th

Sexing

Due to the small number of domestic mammals that could be sexed it is difficult to determine the sex ratio of animals brought to site (table 1.16). There were, however, a large number of complete chicken bones from Area C which did allow for an analysis of sex ratios (figure 1.34-1.35).

The biometrical analysis of the tarsometatarsus suggests that there were more females than males; however, this difference is only slight. Nevertheless, the biometrical results for the tibiotarsus show a predominance of hens which suggest an emphasis on egg production. The male chicken tibiotarsus highlighted as an 'outlier' articulated with a tarsometatarsus which both displayed characteristics of the skeletal disorder chondrodystrophy and may indicate the presence of a 'creeper' chicken (see pathology; Gordon *et al.* 2015).

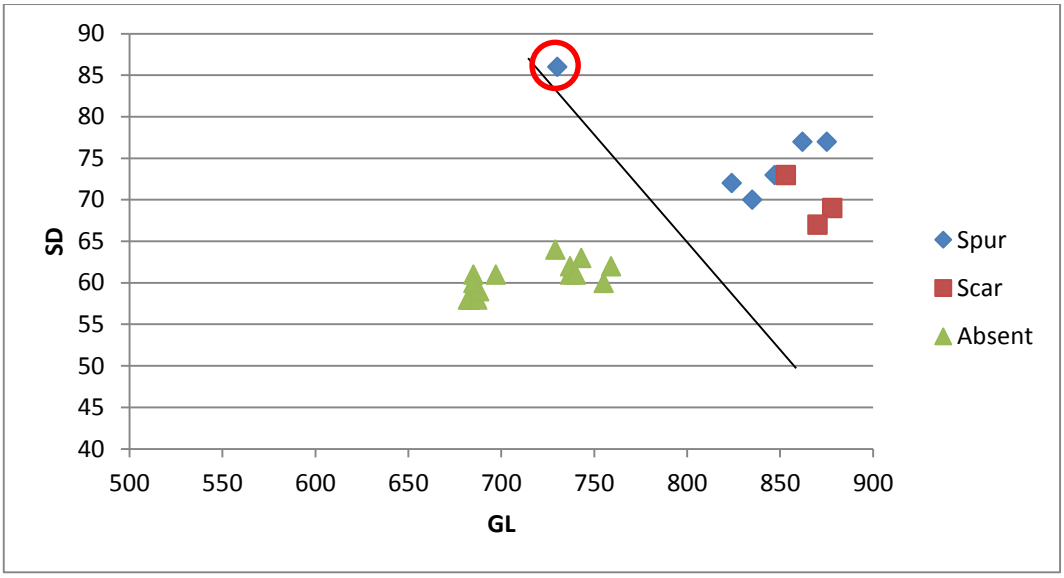

Figure 1.34: Scatter diagram of GL against SD for domestic fowl tarsometatarsus from the mid-late 16th - early 17th century, Area C (n=23)

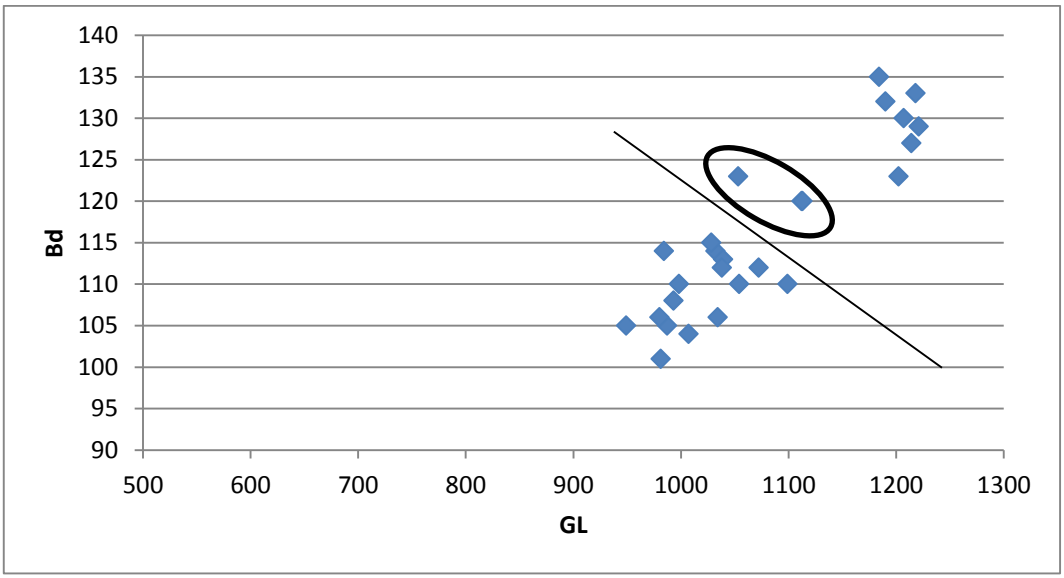

Figure 1.35: Scatter diagram of GL against Bd for domestic fowl tibiotarsus from the mid-late 16th - early 17th century, Area C (n=26). Possible castrates highlighted in the circle.

Phase	Element	Species	Sex	No. of fragments
XIV	Pelvis	Cattle	Female	3
	Pelvis	Cattle	Male	1
	Pelvis	Sheep/goat	Female	4
	Pelvis	Sheep/goat	Male	2
	Pelvis	Sheep/goat	Male?	2
	Canine	Pig	Male	3
	Canine	Pig	Female	1
	Alveolus	Pig	Male	1
	Various	Chicken	Female (Medullary)	11
	Tarsometatarus - spur	Chicken	Male	9
	Tarsometatarus - spur scar	Chicken	Male	3
XV	Pelvis	Cattle	Male	1
	Pelvis	Cattle	Female	2
	Pelvis	Sheep/goat	Female	3
	Pelvis	Sheep/goat	Male?	1
	Canine	Pig	Female	1
	Canine	Pig	Male	2
	Femur	Chicken	Female (Medullary)	2
	Tibiotarsus	Goose	Female (Medullary)	1
XVI	Pelvis	Sheep/goat	Female	2
	Pelvis	Sheep/goat	Male	1
	Canine	Pig	Male	1
	Femur	Chicken	Female (Medullary)	1
XVIII	Pelvis	Sheep/goat	Female	1
XIX	Pelvis	Sheep/goat	Male	1
	Pelvis	Sheep	Female	1
	Tarsometatarus - spur	Chicken	Male	2
	Tarsometatarus - spur scar	Chicken	Male	1
	Canine	Pig	Male	1
	Canine	Pig	Female	3

Table 1.16: List of male and female domestic mammals and birds. Key: XIV- mid-late 16th -early 17th; XV - early-mid 17th; XVI - late 17th-early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX - 19th

Biometry

To assess diachronic changes in the size and shape of domestic species a log scaling technique was employed (see Chapter Two, Volume I). Unfortunately, a lack of tooth measurements limited the biometric analysis to post-cranial bones.

Analysis of post-cranial cattle bones reveals that there was a statistically significant increase in mean size between the medieval period and the mid-late 16th - early-mid 17th century (U=323; *P*=0.006) (figure 1.36-1.37). Zooarchaeological evidence for the size increase of animals from the later medieval and early modern period has also been witnessed at a number of archaeological sites in England (e.g. Albarella 1997b; Dobney *et al.* 1996; Maltby 1979; Thomas 2005b; Thomas *et al.* 2013). The early modern period was a time when selective breeding was a high priority for farmers, who actively attempted to improve meat yields in their livestock (Kerridge 1967; Russell 1986: 128). The evidence for the size increase of cattle at Chester's Roman Amphitheatre demonstrates that similar breeding strategies were implemented in the Cheshire region. There was a decrease in the mean size between the mid-late 16th - early-mid 17th and late 17th - early 18th century; however, this is not statistically significant. There was a statistically-significant size increase by the mid-18th to 19th century (U=227; *P*=0.043). As Cheshire was a famous dairy producing region, this increase could be attributed to the 'improvement' of cattle to supply the dairy industry during 18th and 19th century (Thirsk 1989: 159).

Analysis of sheep/goat post-cranial bones showed that there was an increase in length measurements after the medieval period, followed by another size increase in the late 17th - early 18th century (figure 1.38). Statistical analysis revealed that the increase in length in the late 17th-early 18th century was statistically significant (U=24; *P*=0.007). The average breadth decreased after the medieval period, followed by a gradual increase in the mid-18th-19th century; although, this was not statistically significant (figure U=2119.5; *P*=0.935). It is possible that improvement in sheep breeds occurred much later in Cheshire because there was less of an emphasis on farming sheep, as most farmers focused on producing cattle. Although analysis of distal breadth measurements does reveal a size increase between the medieval period and the mid-late 16th - early-mid 17th century (U=22; *P*=0.048). By the mid-18th - 19th century the breadth measurements demonstrates a greater range (figure 1.35). This could reflect the presence of different 'breeds', which are documented in Cheshire in the 18th-century (Davies 1960: 139).

Pig post-cranial measurements were limited; therefore, length/breadth measurements and archaeological phases were combined to produce a larger sample. The biometrical analysis showed

that there was an increase in the mean size by the late 17th - 19th-century (figure 1.40), although this was not statistically significant (U=29; P=0.153).

Chicken post-cranial bones appear to have increased after the medieval period on all three anatomical planes, which was followed by a decrease after the mid-late 16th-early 17th century (figure 1.41-1.42). However, this is not statistically significant. Regardless, it is worth considering whether this decline is attributed to the presence of different chicken breeds in the early modern period (Gordon *et al.* 2015).

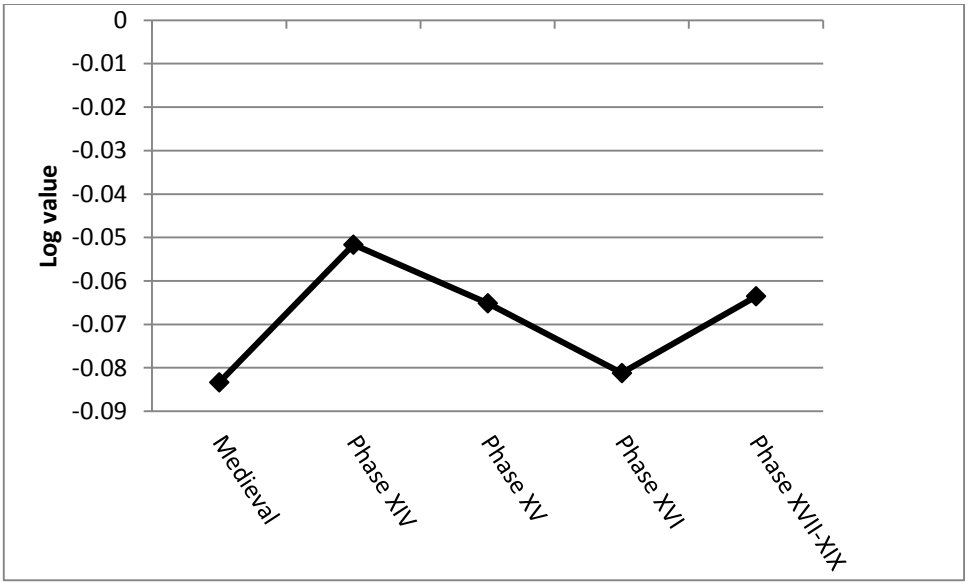

Figure 1.36: Mean log-scaled cattle for breadth post-cranial bone measurements from Chester's Roman Amphitheatre. Key: XIV- mid-late 16th -early 17th; XV - early-mid 17th; XVI - late 17th-early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX - 19th

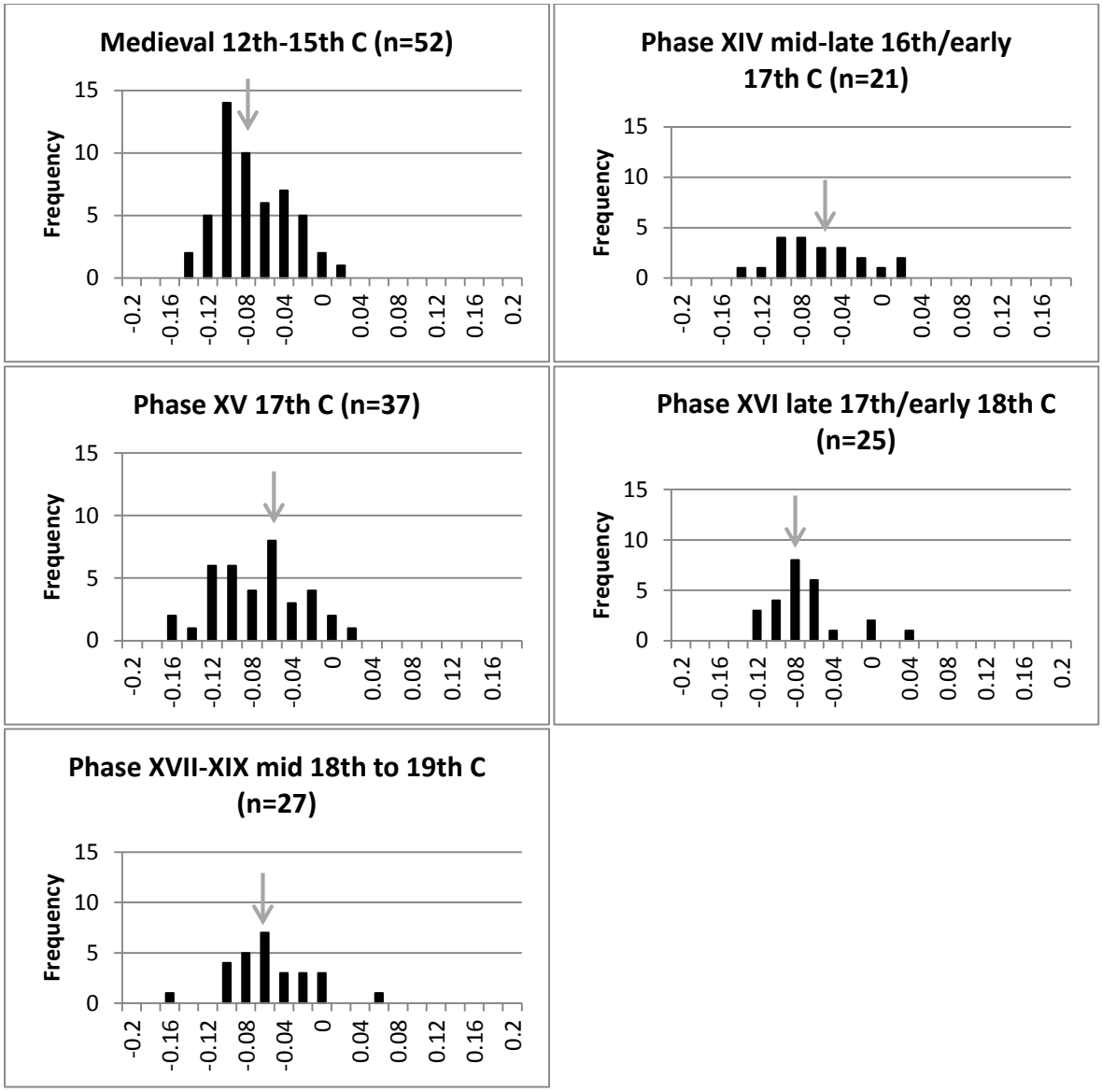

Figure 1.37: Log-scale of cattle post-cranial bone breadth measurements from Chester's Roman Amphitheatre. The arrow indicates the mean.

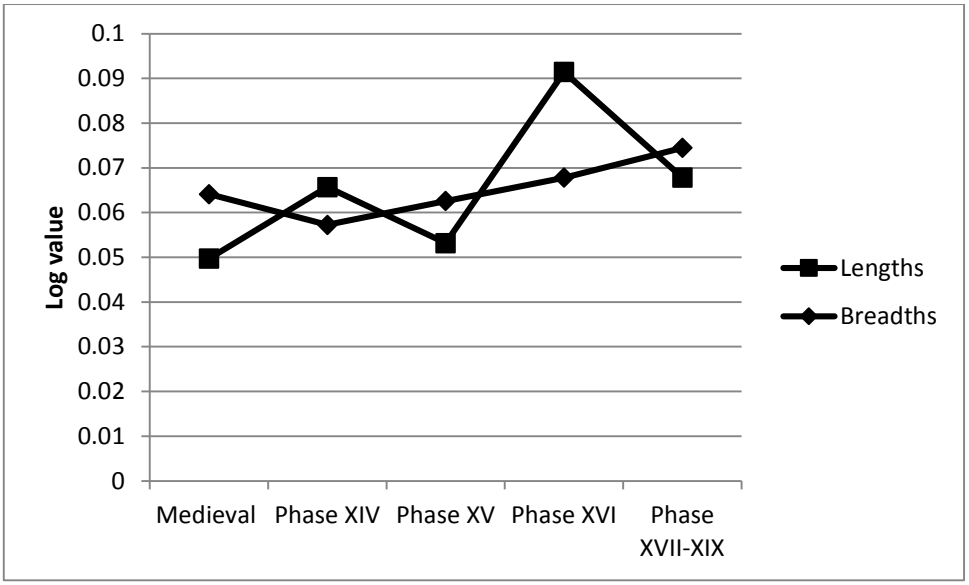

Figure 1.38: Mean log-scaled sheep/goat for length and breadth post-cranial bone measurements from Chester's Roman Amphitheatre. Key: XIV- mid-late 16th -early 17th; XV - early-mid 17th; XVI - late 17th-early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX – 19th

Butchery

A total of 15% of the post-cranial bones exhibited butchery marks (figure 1.43); the mid-late 16th - early 17th and early-mid 17th century had the most butchered bones and the 18th century (phase XVII and XVIII) had the least. Most of the butchery marks were inflicted by a knife, axe or cleaver. However, by the 18th and 19th century the saw obviously became more common which probably coincides with the industrialisation of meat production and the standardisation of butchery (Rixson 2000).

Cattle bones exhibited more butchery compared to other animals, which is unsurprising as larger bones tend to require more dismemberment prior to consumption (Lyman 2008). The majority of these butchery marks were reminiscent of disarticulation and dismemberment. For example, the femur, humerus, tibia and radius displayed cut and chop marks on the proximal and distal articulations. The occipital, atlas, axis and tarsal bones were commonly chopped through, probably to remove the feet and head during primary butchery. A common butchery practice was the sagittal splitting of the vertebrae. This is done by hanging the carcases up by its legs and cutting the body in half down the middle. Occasionally, the hyoid bone exhibited cut marks which is characteristic of removing the tongue and cheek meat and could also indicate the method of slaughter. Some cattle phalanges had cuts marks on the volar and dorsal side which may point to skinning.

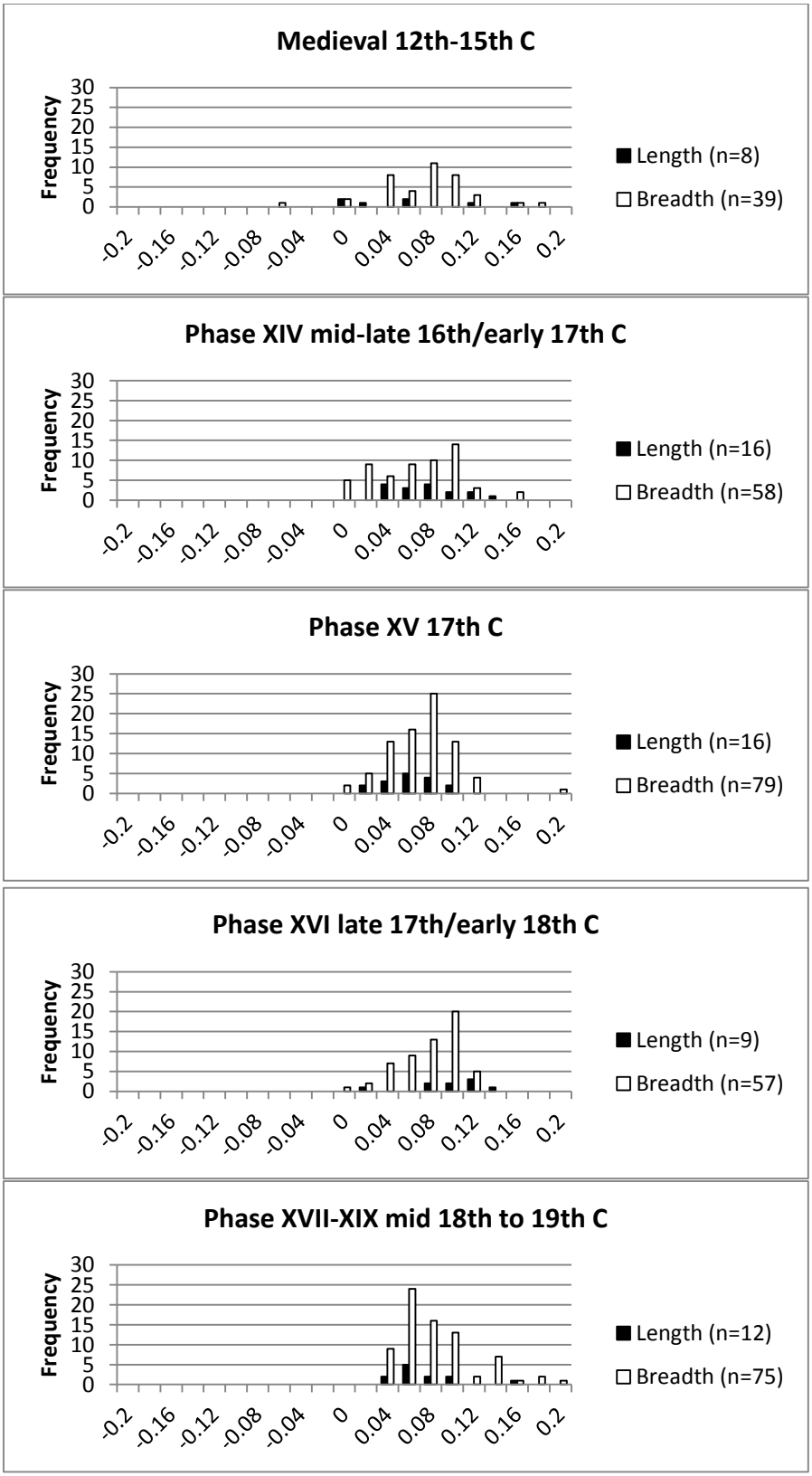

Figure 1.39: Log-scaled of sheep/goat post-cranial bone breadth measurements from Chester's Roman Amphitheatre

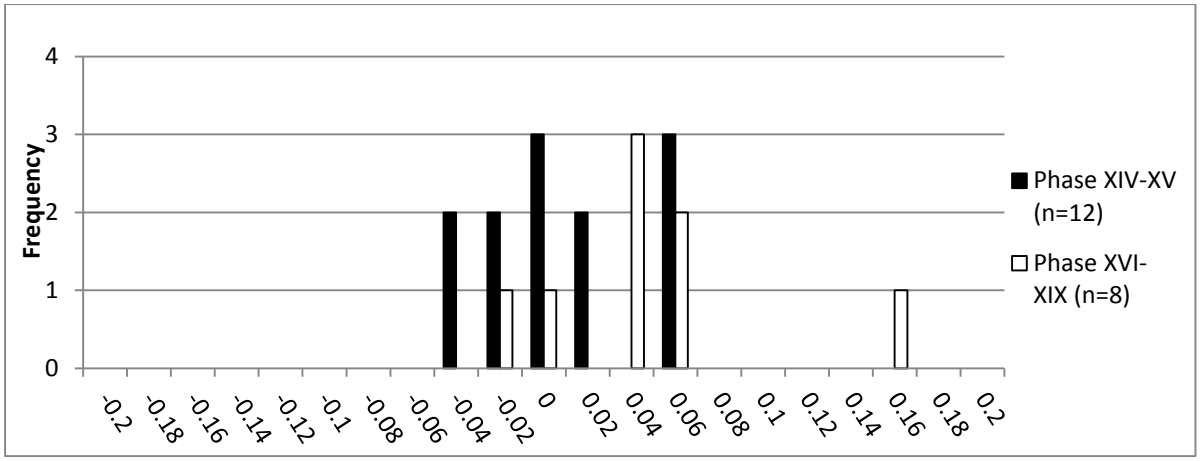

Figure 1.40: Log-scaled of pig post-cranial bone width measurements from Chester's Roman Amphitheatre. Key: XIV- mid-late 16th -early 17th; XV - early-mid 17th; XVI - late 17th-early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX - 19th

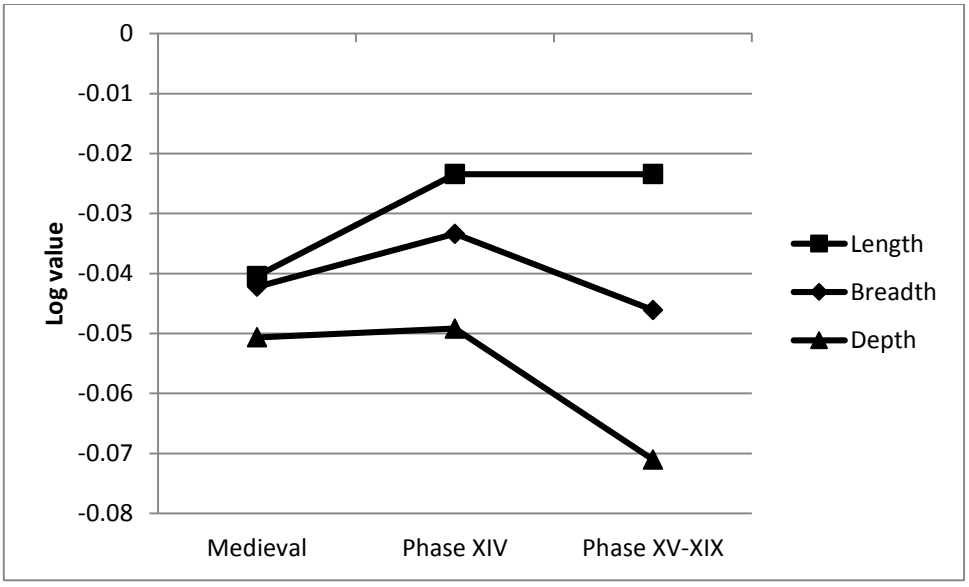

Figure 1.41: Mean log-scaled chicken for length, breadth and depth post-cranial bone measurements from Chester's Roman Amphitheatre. Key: XIV- mid-late 16th -early 17th; XV - early-mid 17th; XVI - late 17th-early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX - 19th

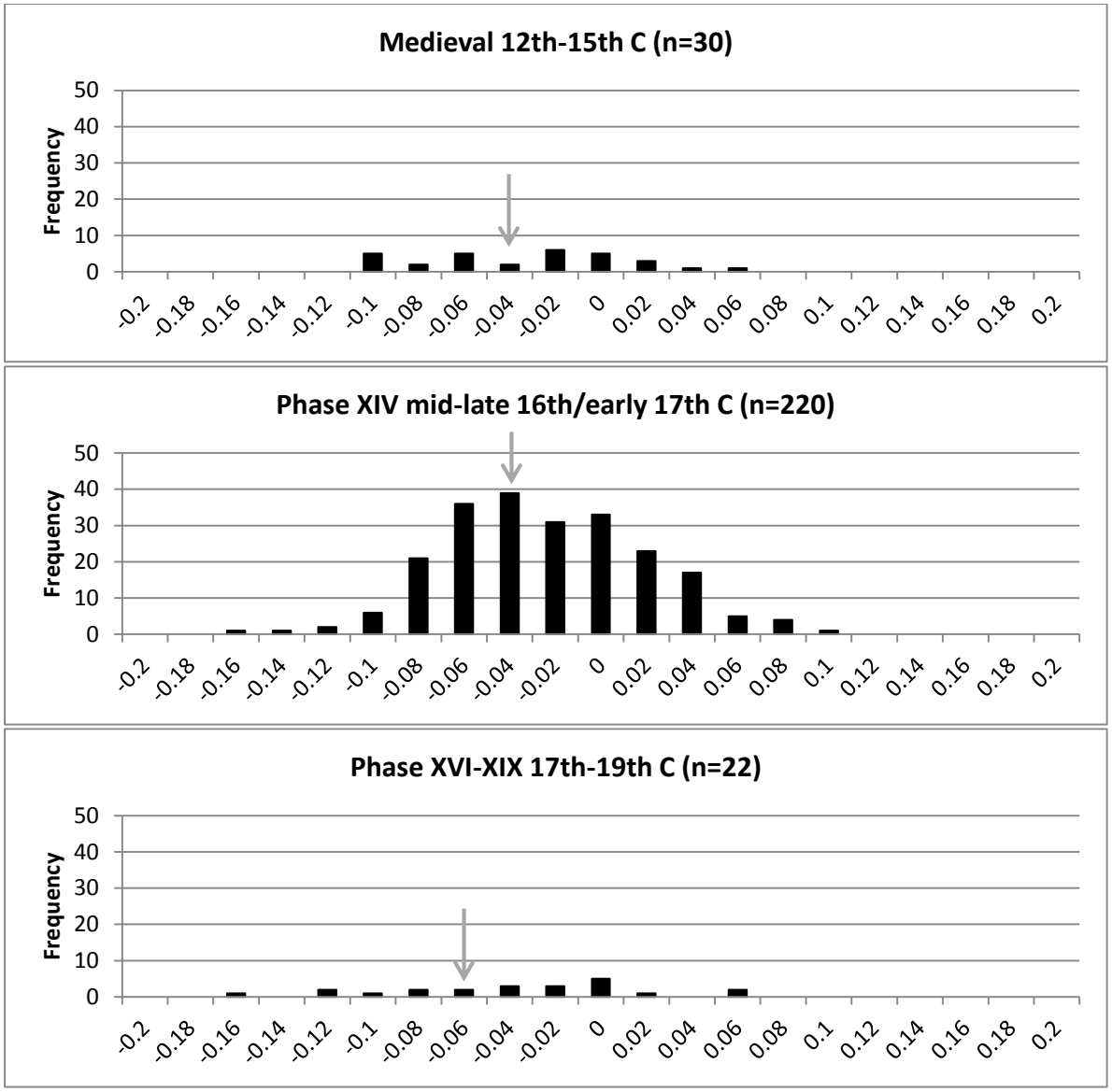

Figure 1.42: Log-scale of chicken post-cranial bone breadth measurements from Chester's Roman Amphitheatre

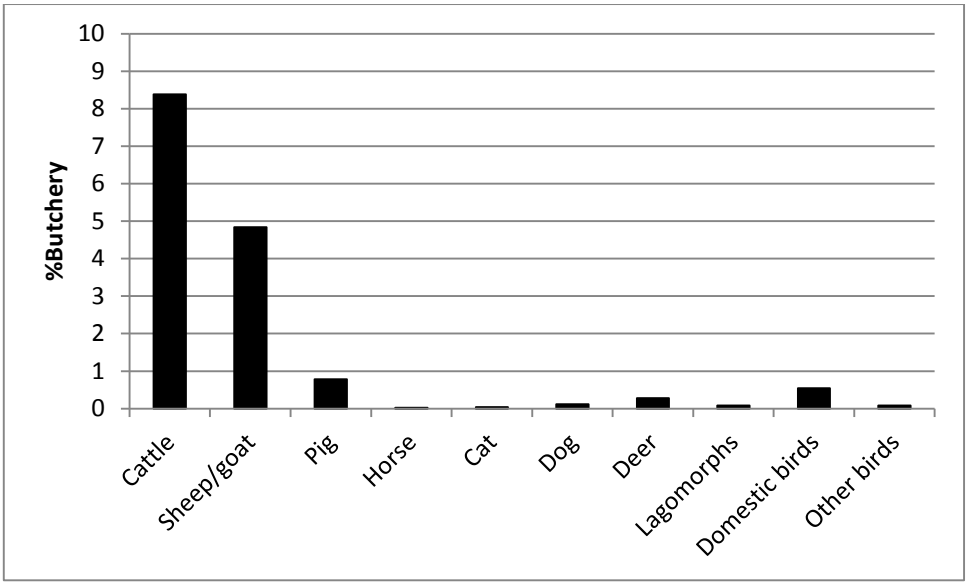

Figure 1.43: Proportion of hand-collected, identifiable post-cranial bones with butchery for the Chester Amphitheatre.

Butchery marks were also seen on cranial bones. One horncore was chopped through from the base and another was chopped through the tip of the horn. This would have been done to remove the horncore from the skull or the horn sheath from the horncore which is also associated with the professionalisation of butchery (Seetah 2006). Mandibles had cut and chops mark on the coracoid process and diastema which could also be associated with skinning or reflect marrow extraction.

Similar to cattle, sheep/goat butchery was characterised by disarticulation and primary butchery. Cut and chops marks were commonly noted around the proximal and distal articulations and sometimes through the acetabulum. Once again the atlas and axis displayed chop marks and the vertebrae were split sagittally. Cuts marks were seen typically along the shaft of long bones such as the humerus and femur and one circumferential cut mark was recorded around the mid-shaft of a humerus (mid-late 16th - early 17th century). Identical cut marks have also been seen on sheep/goat humerii at late medieval and post-medieval sites; as a result of separating the scapula and humerus (Bourdillon 1999: 148; Connell and Davis 1997: 13; Thomas 2005a: 47Cranial butchery marks were observed on the occipital, horncore and mandible.

Only a few pig remains had butchery marks which were also indicative of disarticulation. Cut and chop marks were seen around the articulations as well as along the shaft of long bones which is typical of filleting marks. Cut marks were located on the fibula and two pig tibiae were sawn through

the distal and proximal ends. As with cattle and sheep, the vertebrae were chopped down the middle and butchery marks were on the mandible.

There other mammals with butchery marks that were noteworthy. In the mid-late 16th - early 17th century (Area B) one second phalanx belonging to a horse had a cut mark which probably occurred as result of skinning. It was common for horses to be taken to the knacker's yard once they were old so they could be exploited for their hides (Baxter 1996; Thomas and Locock 2000). In the mid-late 16th - early 17th century, a cat radius, ulna, femur and mandible had cut marks which indicate they their exploited for their fur. A few dog remains from the mid-late 16th - early 17th and early-mid 17th century (Area B) also had cut marks on the atlas, humerus, femur and lumber vertebrae. Interestingly, cut marks were observed on the dorsal side of the atlas and on the femoral head, both of which are typical of slaughtering and dismemberment. It is important to stress that these particular remains came from the early to mid-17th century context. Taking into consideration Chester's involvement in the Civil War and that the city suffered from serious food shortages thereafter, it is not presumptuous to suggest that people ate dogs when food supplies were limited (Forster 2003: 120). Thomas (1983, 116 as cited by Smith 2008) noted that during the 1620s, dog meat was considered a 'dainty dish'. Only a few deer remains had butchery marks but the most interesting was the circumferential cut mark on a fallow deer humerus; similar to the butchery pattern seen on sheep/goat humerii. Two red deer antler fragments had chop marks which indicates craft-working.

Bird remains mainly had cut marks around the articulations and on the shaft, presumably resulting from dismemberment and/or carving. Unusually, two chicken skulls were chopped sagittally down the centre. This same practice was seen on chicken, geese and swan skulls at Castle Mall (mid/late-15th to early 16th century) and Leicester (AD1400-1550) (García 2009: 125; Gidney 1993: 7). The reason for this is unclear; however Gidney offers possible suggestions which include: to remove the brain; display the brain meat; to attach an ornament to the head for display purposes; or as a special way of carving the head for consumption (Gidney 1993: 7). One chicken spur had cut marks which may have been used as a method to remove the spur. Similar cut marks was also noted on a chicken from Castle Mall, although this example had multiple cut marks and the tip of the spur was removed. The reason for this practice is presently unknown (Albarella *et al.* 2009: 86). A few wild birds such as woodcock, gull, grey partridge and swan had cut marks on the distal and proximal articulations of the long bones. A sternum of a small charadiiform had been cut straight down the middle of the keel (figure 1.44).

Figure 1.44: Sternum of a small charadiiform with a chopped mark through the keel

Pathology and non-metric traits

Pathological evidence on animals from Chester's Roman Amphitheatre only accounted for 2.9% of the total amount of hand-collected, post-cranial bones. Unsurprisingly, most of these lesions were exhibited on cattle bones (1.8%). This is generally the case as they tend to live longer than other domestic mammals; as a result, there is more time for pathologies to develop on the skeleton. The most common pathology on cattle bones was periostosis, which occurs as a result of a localised or systemic inflammation/infection. However, as the majority of the pathological specimens were disarticulated, this prevented the opportunity to undertake a differential diagnosis to understand the underlying causing. Periostosis was noted on 31 elements including: the axis, calcaneum, femur, humerus, thoracic vertebra, lumber vertebra, pelvis, radius, sacrum, scapula and tibia. Some elements had osteophytes, which consists of bony outgrowths or protuberance as a result of degeneration around joint margins (Vann and Thomas 2008). Evidence for this was seen around the centrum of a lumber vertebra and sacrum and around the articular surfaces of a cuneiform, cuboid and the pelvis. Another cuneiform had a roughened surface and slight pitting on the dorsal side, which could be indicative of infectious arthritis. A total of four cattle pelves exhibited eburnation on the acetabulum; two of which were identified as female, one was male and the other was indeterminate. Eburnation is characteristic of osteoarthritis, which is a degenerative joint disease that manifests during the destruction of the articular cartilage and subchondral bone. Osteoarthritis can also develop as a result of hereditary, developmental, metabolic or biomechanical factors. In order to assess the extent that cattle were exploited for traction, Pathological Index values (after Bartosiewicz *et al.* 1997) were calculated for complete cattle autopodia for each phase (figure 1.46). The mid-late 16th - early 17th century had the lowest mean PI value (0.015) and the early-mid 17th century had the highest mean PI value (0.084). The high PI value from the early-mid 17th century is interesting because this context had a high proportion of young animals. As PI values are strongly

influenced by age, the use of old animals for traction is less likely to be the cause of this high result. The mean PI value for the whole site was 0.045, which is comparable with post-medieval cattle from Wigmore Castle (0.04) (Thomas and Vann 2015). Overall, as the PI value for the site was low it would suggest that cattle were not commonly used for traction or they were not subjected to excessive stress that would have caused traction related pathologies to develop (Thomas and Vann 2015).

Developmental anomalies were also present in a number of the cattle specimens. One thoracic vertebra had a bifid spinous process and one pelvis had a notch in the acetabulum. Two cattle skulls had occipital perforations (see figure 1.47), which are caused by a genetic and/or developmental defect (Fabiš and Thomas 2011). It has been hypothesised that these perforations occurs in domestic mammals with a large sinus frontalis, developing during the pneumatisation of the frontal, parietal and occipital bones (Fabiš and Thomas 2011). Three third molars had a missing hypoconulid (the posterior cusp on the third molar). This is a congenital trait that is dominant within a particular gene pool (Davis 1997: 425; Thomas 2005b: 74). Dental calculus was also noted on the first and second molar in one cattle mandible.

Pathologies on post-cranial sheep/goat bones largely consisted of periostosis, which was recorded on 22 bones including the femur, humerus, metacarpus, metatarsus, pelvis, radius, scapula, tibia and ulna. Osteophytes were identified on the proximal articulations of two sheep/goat radii. One metatarsus had an ossified haematoma on the anterior side, close to the proximal articulation. Ossified haematoma occur as a result of a traumatic injury, causing bleeding into the sub-periosteal area, which then eventually ossifies (Baker and Brothwell 1980: 83). The distal end of a sheep/goat first phalanx had a remodelled callus, which was functioning as an articular surface (figure 1.48). This may have resulted from a traumatic injury. A sheep/goat metatarsus also had a visible buttress on the anterior surface. There have been a number of explanations for the formation of buttresses in sheep including: penning on hard surfaces for a long duration, nutrition deficiencies and hobbling (Thomas and Grimm 2011: 121). A recent investigation of Gotlandic sheep metatarsals reveal that the formation of buttresses correlates with age and occurs more frequently in rams (Thomas and Grimm 2011). As for cranial pathologies, periosteal infection was also recorded on a sheep/goat mandible and dental calculus was noted on the third and fourth premolar of two individuals.

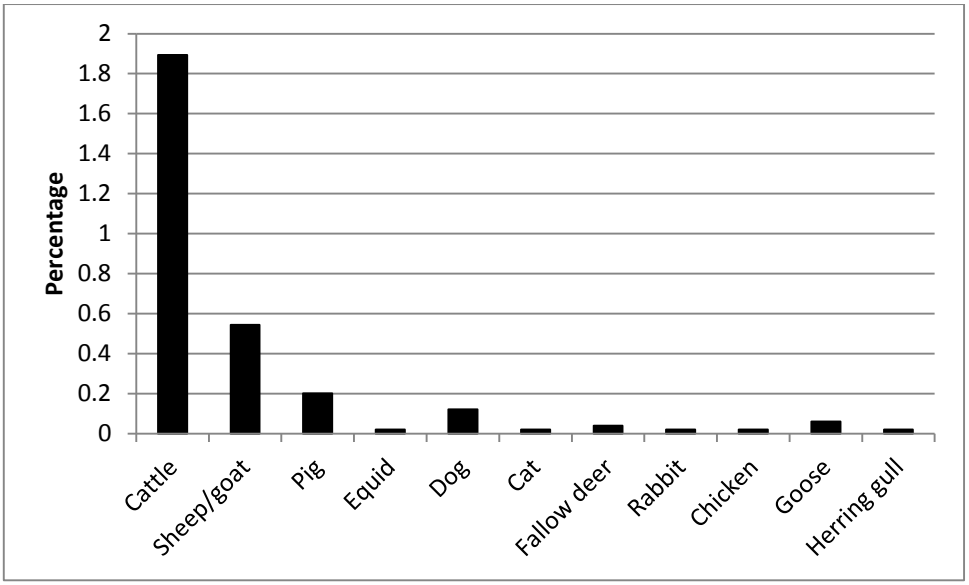

Figure 1.45: Proportion of hand-collected, identifiable post-cranial bones with pathologies from Chester's Roman Amphitheatre.

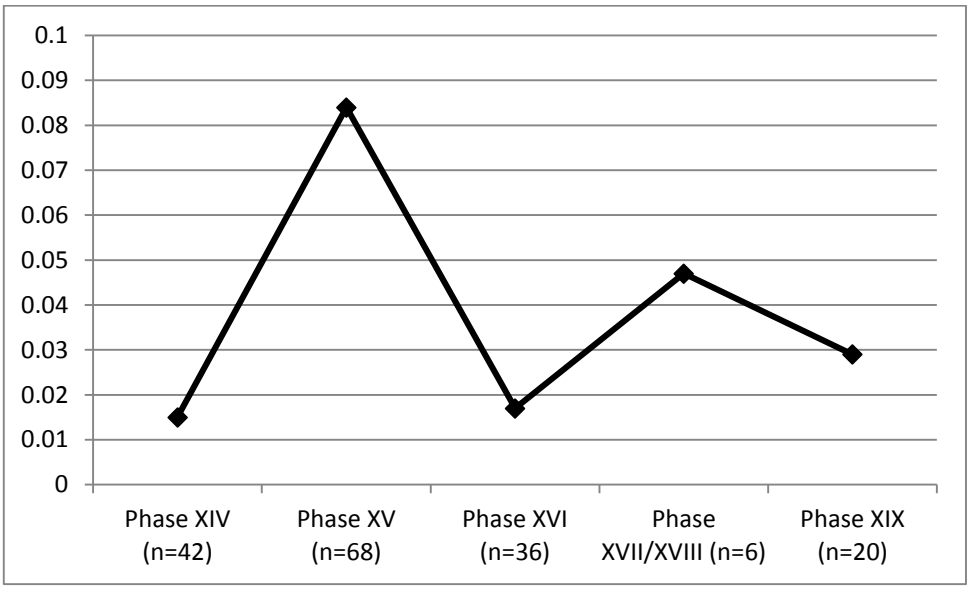

Figure 1.46: Frequency of PI values for cattle from Chester's Roman Amphitheatre. Key: XIV- mid-late 16th -early 17th; XV - early-mid 17th; XVI - late 17th-early 18th; XVII - mid-late 18th; XVIII – 18th demolition; XIX - 19th

Pig pathologies mainly comprised of periosteal new bone formation, which was noted on eight specimens on the humerus, tibia, ulna, scapula and radius. A first and second phalanx, from the same specimen, had ankylosed with the second phalanx which had rotated at an angle. One unfused lateral metapodial also had evidence of healed fracture. Cranial elements with pathologies included a pig mandible with periosteal infection and one pig third molar with linear enamel hypoplasia. The

latter is caused by physiological stress as a result of nutritional deficiency or infection (Dobney 2000: 597).

Figure 1.47: Occipital perforation on cattle skull from Chester's Roman Amphitheatre

Figure 1.48: Sheep/goat first phalanx with a remodelled callus on the distal articular surface

Pathologies were also observed on a horse second phalanx and a fallow deer humerus and tibia with periostosis. Osteophytes were observed around the joint margins of a dog humerus, radius and two lumber vertebrae. A dog ulna and humerus (from one individual) had osteoarthritis. The complete

mandibles of an adult dog (late 16th - early 17th century) have evidence of alveolar recession, which causes reduction of the bone where the tooth socket is located (figure 1.49). As a result the P_2, P_4 and M_3 in the right mandible and the P_4 and M_3 on the left mandible are absent. This could be an indication of periodontal disease. This is an inflammation of the tissue surrounding the teeth, which eventually leads to tooth loss (Jones *et al*. 1997: 1044). A survey of pathologies identified in Roman dogs revealed that conditions like pre-mortem tooth loss and osteoarthritis were a common and provided insight into the health and welfare of Roman dogs and human treatment towards these animals (MacKinnon 2010). The presence of these pathologies on dog remains from Chester could also provide evidence for human treatment and care towards animals. Two cat tibiae exhibited a healed fracture and a rabbit and hare lumber vertebra and rabbit distal femur had osteophytes.

Most of the pathologies exhibited on birds were observed in chickens; all of which derived from the 16th-century feasting pit. Osteophytes were the most common lesion and were recorded on a total of 14 bones. Most were on the cotyla scapularis of the coracoid (n=4) and on the proximal articulation of the scapula (n=6). The remaining four were seen on a tibiotarsus, two tarsometatarsi and a femur. Enthesophytes were recorded on a total of four tibiotarsi and one tarsometatarsus. They develop due to the ossification of the tendinous or ligamentous attachment and are common in old birds (Vann and Thomas 2006). On the shaft of two tarsometatarsi there was evidence of periostosis. On the distal articulation of a femur a small cavity was located above the medial condyle, however the cause of this in unknown (figure 1.50).

Figure 1.49: Dog mandible (right) with pre-mortem tooth loss

A cloaca was recorded on the mid-shaft of a tarsometatarsus (figure 1.51), which a cavity that forms to allow pus to drain out of the marrow cavity due to infection (Vann and Thomas 2006). An oblique fracture was observed on the distal end of a chicken carpometacarpus, which was confirmed following radiographic analysis (figure 1.52). One tarsometatarsus had a small round, protruding nodule on the medial side, situated close to the proximal end. This bone formation could have resulted from a number of possibilities such as an infection, physical trauma and a tumour (Fothergill pers. comm) (figure 1.53). Necrotic bone destruction had resulted in the loss of the distal medial condyle of a chicken tarsometatarsus as well as deposition of new bone on and around the shaft (figure 1.54). On the underside of a chicken pelvis there were three small abnormal growths which resembled circular, honeycombed bone deposits (figure 1.55). The cause of these growths is uncertain however, a neoplastic origin seems most likely (Fothergill pers. com). On the synsacrum of a chicken there were two distinctive growth bones that resemble spicules of neoplastic bone (figure 1.56). Similar bone deposits have been identified on chicken synsacra at other medieval and post-medieval sites including: Lion Walk, Colchester (medieval), the Barbican Well, Norwich (mid/late 15th- to early 16th-century) and at site in Germany (Roman to early modern period) (Luff 1993: 117; García 2009: 125; Teegen 2008: 70; Teegen 2011: 40). Teegen notes these lesions appear more frequently in medieval to the early modern contexts in Germany (2011: 40). Although these examples are similar to the Chester specimen, it is important to note that they have a honeycombed, rather than a spiculated appearance. One diagnosis suggested in Baker and Brothwell is that the outgrowths are a myeloma; a tumour of the bone marrow (Baker and Brothwell 1980: 104-105). However, more recent observations suggest that these bone deposits could be associated with a problem in the kidneys (Teegan 2008: 70; Fothergill pers. comm). There are a number of tumours that may have caused these growths in the Chester specimen; however, the most probable diagnosis is an osteosarcoma (Campbell 1969: 36-38). Sarcomas are rare in chickens and there is a limited amount of literature, making it difficult to diagnose the lesion. One chicken sternum had a slightly crooked keel. This could be caused by a number of factors such as perching behaviour, metabolic bone disease or a congenital defect (Thomas pers. comm).

An articulating tibiotarsus and tarsometatarsus displayed pathological modifications, which resulted in their reduced length and greater corpus width. Each element underwent a differential diagnosis, which confirmed that the specimen exhibited lesions consistent with the skeletal disorder chondrodystrophy (Gordon *et al.* 2015). The aetiology of chondrodystrophy is complicated: it can be caused by nutritional deficiencies, mycoplasma infections, and inherited as an autosomal recessive gene or occur spontaneously. These lesions are characteristic of chickens with the 'creeper' mutation (see Gordon *et al.* 2015). The 'creeper' gene causes a delay in skeletal growth during the

developmental process (Landauer 1935: 133). This results in the wings and other long bones being considerably shorter; therefore hindering the bird's ability to walk (Cutler 1925).

Seven first phalanges and a second phalanx belonging to galliformes had either osteophytes or periostosis. Osteophytes were located around the articular margins and periosteal infections were observed on the anterior and lateral sides of the phalanges. One first phalanx had osteophytes as well as eburnation on the articular surface. The periosteal infection in the phalanges may have been caused by inflammation of the ligaments surrounding the phalanges.

Only three goose bones displayed pathologies. One was a goose humerus that had a displaced fracture, which was most likely active around the time of the death (figure 1.57). Another was a carpometacarpus with osteophytes on the processus extensiorus and the distal phalanx of the major wing digit with periosteal infection. Lastly, one herring gull had a circular patch of extra bone growth on the furcula, which had a spongy appearance. This may have been caused by an infection of the soft tissue.

Figure 1.50: Chicken femur with cloaca around the distal articulation

Figure 1.51: Lateral view of a tarsometatarsus with a cloaca

Figure 1.52: X-ray of chicken carpometacarpus with an oblique fracture.

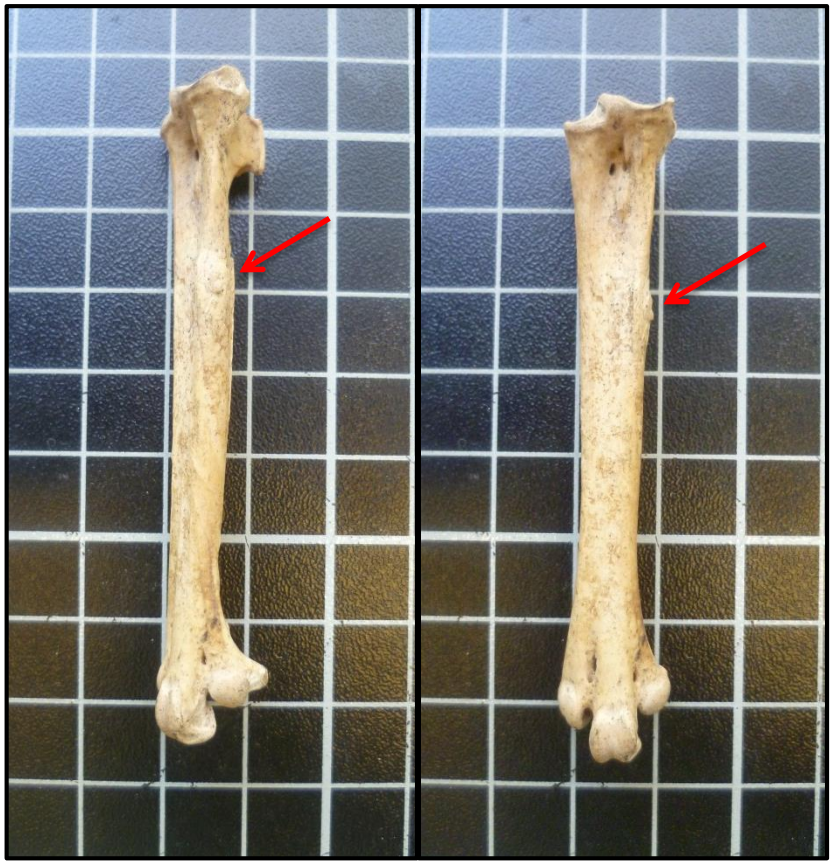

Figure 1.53: Medial and anterior view of a tarsometatarsus with a small round nodule

Figure 1.54: Anterior and posterior view of a chicken tarsometatarsus with necrotic bone destruction

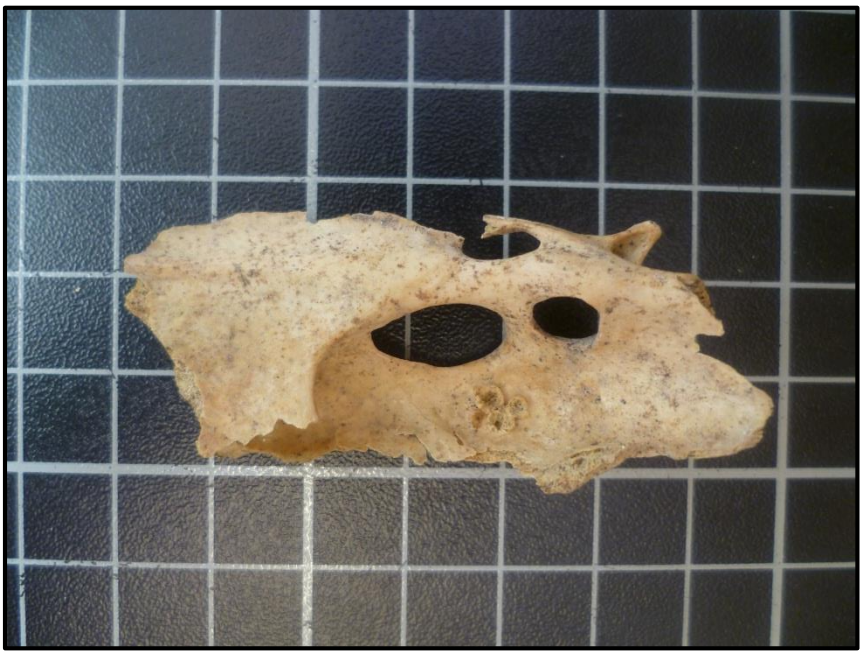

Figure 1.55: Chicken pelvis with a possible tumour(?)

Figure 1.56: Chicken synsacrum with a possible sarcoma

Figure 1.57: Photo and x-ray of a fractured goose humerus

1.2 12 Hamilton Place

Taphonomy

The overall condition of post-cranial bones from 12 Hamilton Place was 'good' with bones from the late 18th - early 19th century appearing to be in better condition (figure 1.58). This may be because a large number of these bones came from fills and deposits and therefore were disposed of more rapidly rather than left out and exposed to the elements. Although the preservation was slightly worst in the mid-19th - mid-20th century in comparison to the late 17th - early 18th century, this was only marginal. None of the post-cranial bones were in excellent condition.

The percentage of gnawed post-cranial bones on site was very low with the highest proportion just slightly over 1 % (figure 1.59), which is lower than the post-medieval bones at Chester's Roman Amphitheatre. This suggests that waste disposal on site was efficient and that bones were thrown away after butchery and/or consumption. All the bones that exhibited gnawing were produced by carnivores; there was no evidence of rodent gnawing. Only a small number of identifiable post-cranial bones showed evidence of burning; seven fragments were calcined and only one was burnt and singed. Out of the unidentifiable fragments, 63 were calcined and nine were burnt. It is unlikely that burning made a significant contribution to the site's taphonomic profile.

An analysis of the ratio of loose teeth to mandibles/maxillae suggests that site fragmentation was high as only a small percentage of teeth were located within the mandible (figure 1.60; table 1.17). In the mid-19th -mid-20th century, all of the teeth for the three domesticates were loose. In the earlier phases it appears that site fragmentation was slightly better. However the sample size for sheep/goat and pig was low, therefore the results are not completely reliable. The average number of zones per bone could only be calculated for cattle and sheep/goat which averaged at two for cattle and two/three for sheep/goat. This supports the loose teeth to mandibles ratio by showing that site fragmentation was high; however, the number of zones is also be affected by butchery practices (see butchery).

Although sieving did take place, none of the sieved bones were included in the analysis because of the selective recording strategy that was adopted for the site. Therefore, the following results will be based on hand-collected bones only. This will mean that larger mammals and birds will be better represented.

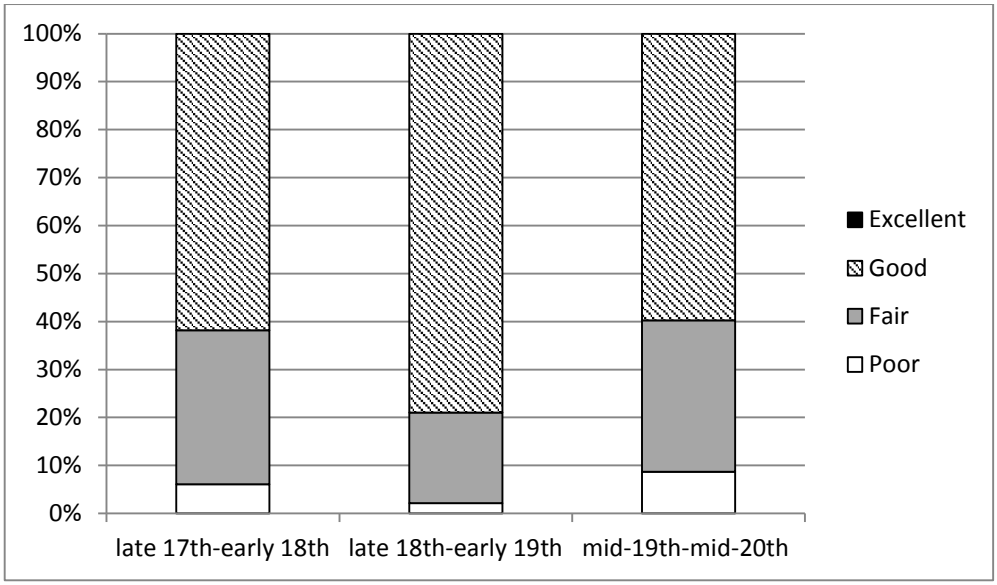

Figure 1.58: Preservation stages for identifiable, hand-collected post-cranial bones from Hamilton Place (after Harland *et al.* 2003)

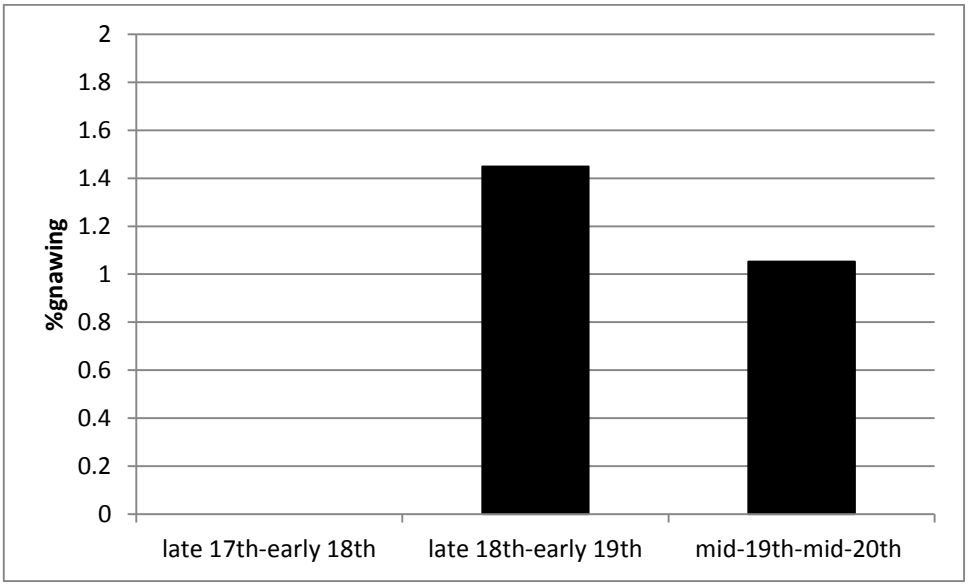

Figure 1.59: Percentage of gnawing marks on identifiable, hand-collected post-cranial bones from Hamilton Place

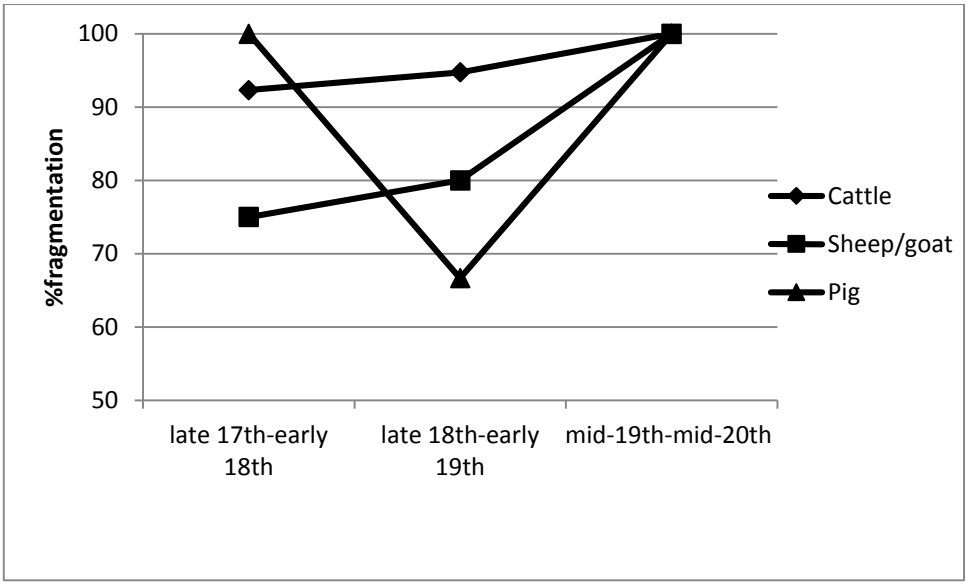

Figure 1.60: Percentage of loose teeth out of the total number of loose teeth and mandibles/maxillae

	IV	V	VI
Cattle	13 (12)	19 (18)	26 (26)
Sheep/goat	4 (3)	5 (4)	12 (12)
Pig	2 (2)	3 (2)	13 (13)

Table 1.17: The total number of mandibles/maxillae and loose teeth from Hamilton Place. The total number of loose teeth is presented in the brackets. Key: IV - late 17th-early 18th; V - late 18th-early 19th; VI - mid-19th-mid-20th

Species representation

Domestic mammals and birds

12 Hamilton Place mainly consisted of domestic mammals with cattle (*Bos taurus*), sheep/goat (*Ovis/Capra*) and pig (*Sus scrofa*) dominating the assemblage (figure 1.61, table 1.18). Cattle were the most common domesticate, followed by sheep/goat and pig. The proportion of cattle increased steadily throughout time from 55% to 70% by the mid-19th to mid-20th century and the proportion of pig increased over time at the expense of sheep/goat. There were no elements that were identified as goat which is not unusual as there was a decline in the proportion of goats in the post-medieval period (Albarella 1999). Horse was represented by a partial skeleton of a foal (which may have been a natural mortality) and a small number of isolated elements. Only a few bones came

from cat (*Felis catus*) and dog (*Canis familaris*); none of which appeared to have derived from articulated skeletons.

The assemblage contained few domestic birds of which chicken (*Gallus gallus*) was the most abundant followed by goose (*Anser* sp.) and duck (*Anas* sp.). Turkey (*Meleagris gallopavo*) was present in the 19th and 20th century phases. This was a time when turkeys began to be mass produced and became more accessible to people from all classes (Thirsk 1997: 189-195; Fothergill 2012: 45).

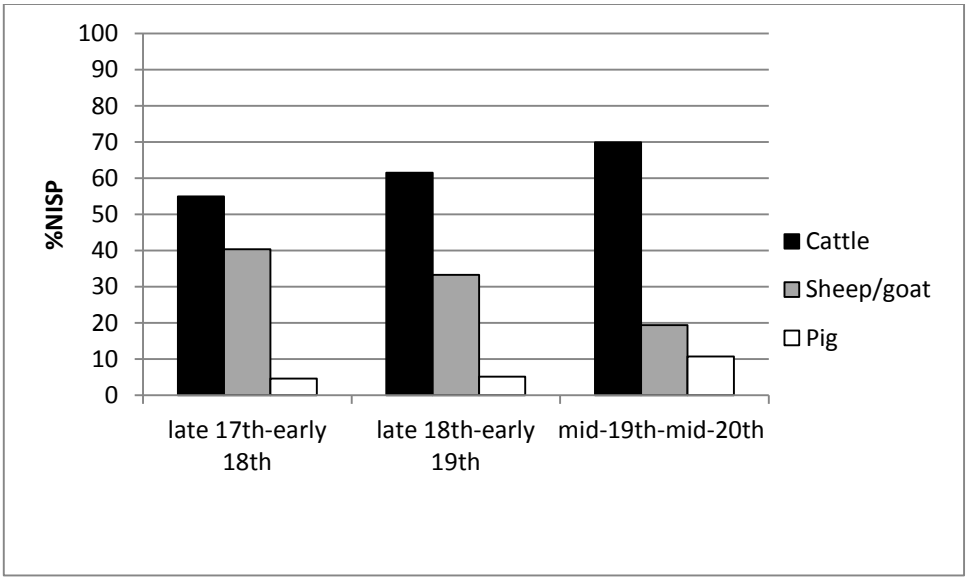

Figure 1.61: Relative proportion of hand-collected cattle, sheep/goat and pig from Hamilton Place. Total NISP in brackets: late 17th - early 18th (NISP=151); late 18th-early 19th (NISP= 156); mid-19th - mid-20th (NISP=299)

Wild mammal and birds

The wild mammals on site were rabbit (*Oryctolagus cuniculus*), hare (*Lepus europaeus*) and deer *Cervid* sp. which was represented by a single antler fragment. Out of the rabbit bones none appeared to have represented burrowing animals as all of the bones were disarticulated and skeletally mature. One rabbit pelvis also had a cut mark which suggests they were eaten. All the wild birds were corvids which most likely arrived on site as commensal species.

Species	IV	V	VI
Cattle (*Bos taurus*)	83	96	209
Sheep/goat (*Ovis/Capra)*	58	50	56
Sheep (*Ovis aries*)	3	2	2
Pig (*Sus scrofa*)	7	8	32
Horse* (*Equus caballus*)			150
Equid (*Equus* sp.)		2	2
Dog (*Canis familaris*)	1	8	11
Cat (*Felis catus)*	2	2	5
Rabbit (*Oryctolagus cuniculus*)		3	14
Hare (*Lepus europaeus*)	1	1	9
Chicken (*Gallus gallus*)	1	3	10
Turkey (*Meleagris gallopavo*)			3
Goose (*Anser* sp.)	2	3	2
Duck (*Anas* sp.)		2	1
Raven (*Corvus corax*)			1
Crow (*Corvus corone*)	1		1
Corvid		1	
TOTAL NISP	**159**	**181**	**508**
Unidentifiable large mammal	114	116	825
Unidentifiable medium mammal	92	66	114
Unidentifable small mammal	1		13
Unidentifiable large bird	1		2
Unidentifable medium bird			3
Unidentifiable bird	2	1	6
Unidentifiable fish			3
Unidentifiable	2		16
TOTAL UNIDENTIFIABLE	**212**	**183**	**982**

Table 1.18: Number of identifiable hand-collected specimens present (NSP) from Hamilton Place. Antler fragments not included. Key: IV - late 17th-early 18th; V - late 18th-early 19th; VI - mid-19th-mid-20th

Body parts represented

Due to the small sample size for cattle and sheep/goat the body parts in each phase was combined to allow a broad assessment of the elements present (figure 1.62-1.63). For pigs, however, there were too few remains to pursue this analysis.

For cattle, most of the body parts were present which suggests that the whole animal was brought to site as dressed/undressed carcasses or meat joints. Overall, there appears to be a higher proportion of bones that have less meat like the astragalus, calcaneum and phalanges. However,

these bones are dense and therefore more resistant to taphonomic factors (see Lyman 1994, table 7.6). The distal humerus is also a bone that has a high mineral density therefore its high frequency is unsurprising. There are, however, other bones with a high mineral density that are poorly represented such as the distal tibia. This may be the result of primary butchery, during which the distal end is chopped through or the purchasing of selected meat joints from the urban market. Nevertheless, it is also worth considering whether the paucity of meat-bearing bones is indicative of the social-status of the inhabitants.

The body parts represented for sheep/goat show they too were probably bought from the market as butchered joints. There seems to be a higher occurrence of major meat-bearing bones (e.g. humerus, radius and tibia) compared to cattle. Phalanges are less abundant for sheep/goat although this is most likely attributed to hand-collection biases. There are differences in the proportion of elements that have a high mineral density for sheep/goat and cattle such as the distal tibia. It is possible that this reflects the consumption of different body parts for these species.

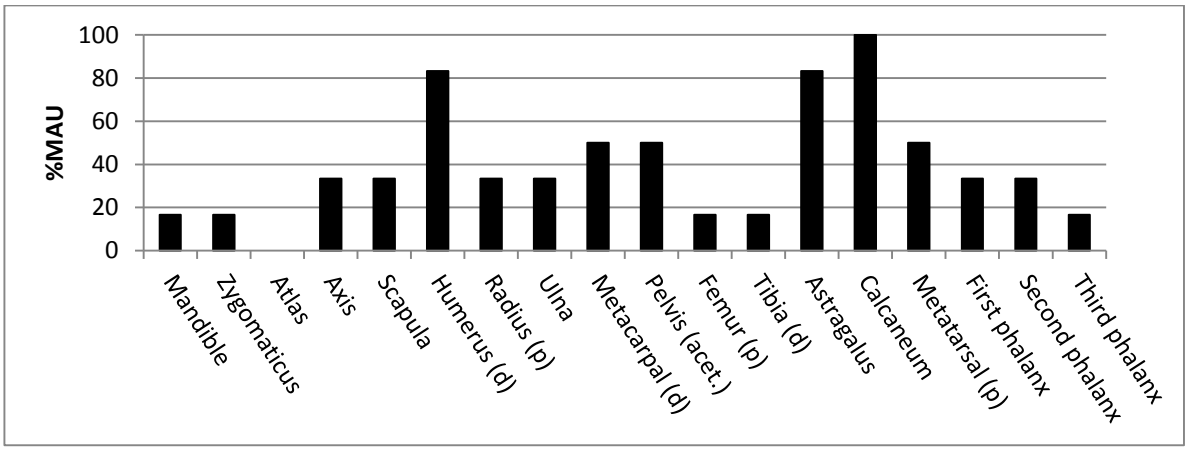

Figure 1.62: Percentage body part representation for hand-collected cattle bones from all phases. (Total NISP=206; MAU=6)

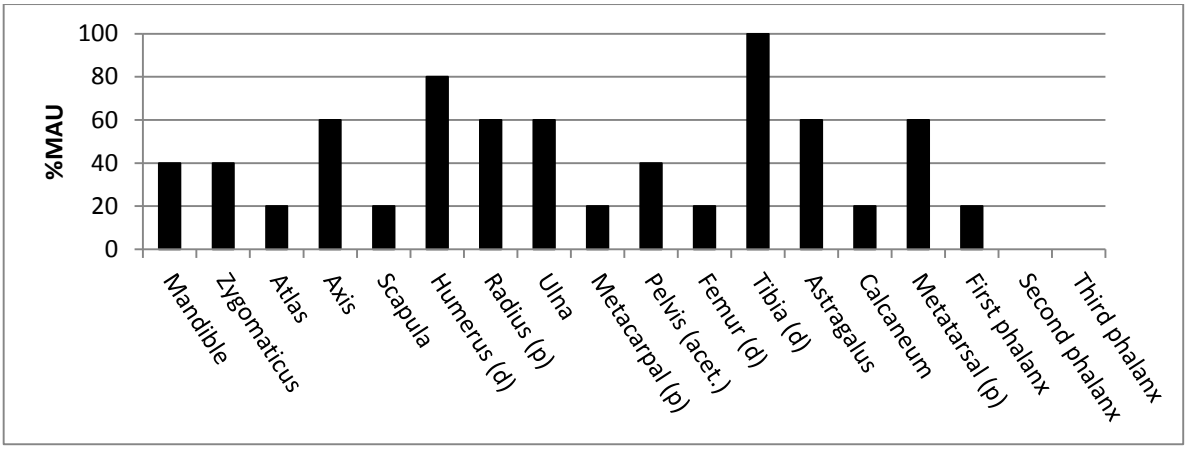

Figure 1.63: Percentage body part representation for hand-collected sheep/goat bones for all phases. (Total NISP 108; max MAU 5)

Mortality profiles

Because of the small sample size cattle and sheep/goat epiphyseal fusion data had to be combined to produce a larger sample. Unfortunately for pig there were insufficient data to do this. Furthermore, due to the lack of mandibular teeth only general statements about husbandry practices and consumption habits could be made for cattle.

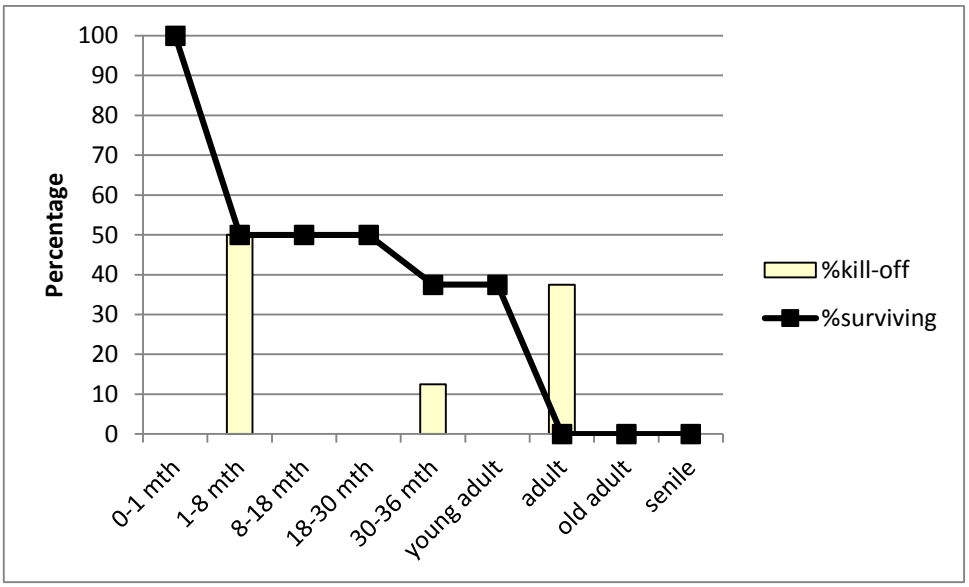

Figure 1.64: Tooth wear data for cattle mandibles (n=8) for all phases. Age categories follow Halstead (1985).

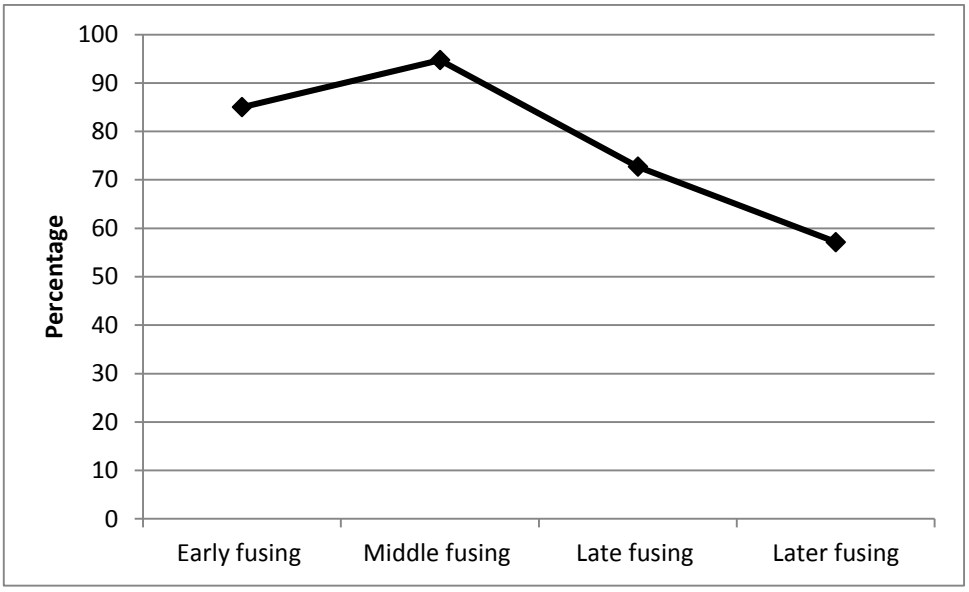

Figure 1.65: Epiphyseal fusion data for cattle (n=84) for Hamilton Place for all phases. This graph was produced following the an adapted version of fusion categories by Reitz and Wing (2008)

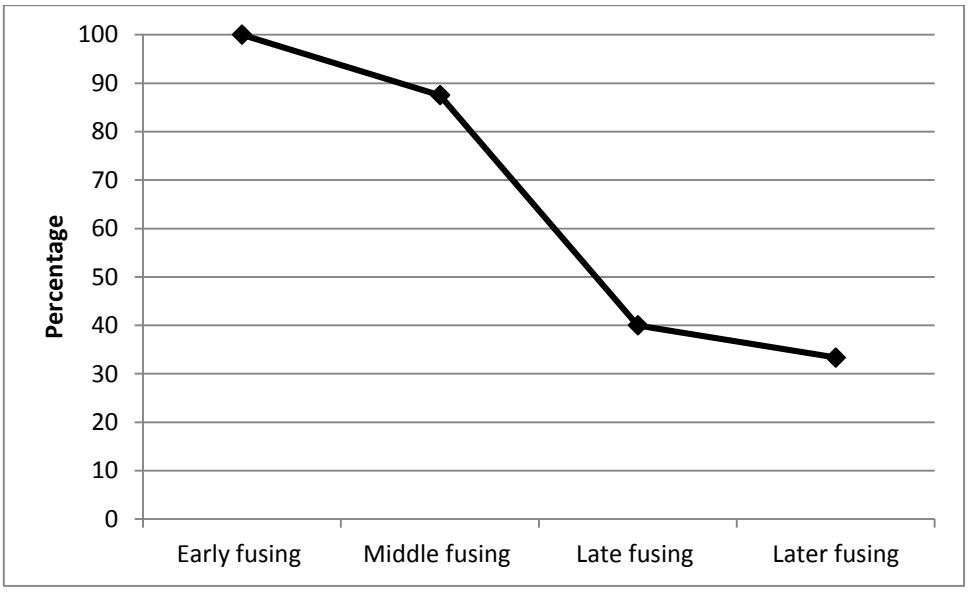

Figure 1.66: Epiphyseal fusion data for sheep/goat (n=52) for all phases. This graph was produced following the an adapted version of fusion categories by Reitz and Wing (2008)

The tooth wear data for cattle broadly shows that there was a mix of young and old animals probably representing calves and older cattle kept for their secondary products (figure 1.64). The presence of calves on site could be reflective of the growing dairy and allied veal industry in the post-medieval period. The tooth wear data is loosely supported by the fusion data which also shows

the presence of younger and older cattle. When compared to the epiphyseal fusion data from Chester's Roman Amphitheatre, cattle from Hamilton Place are older. Ninety-five percent of middle fusing bones and 73% of late fusing bones were fused, which was higher than some of the phases from Chester's Roman Amphitheatre. It would seem that most of the meat consumed on site consisted of beef and a small amount of veal.

For sheep/goat, only four teeth could be assigned an age category; one was 2-3 years and 3-4 years and two were 4-6 years. The fusion data for sheep/goat shows that none were younger than one year of age; however a few were culled between the ages of one to three years. The majority were three years of age or older when they were slaughtered which suggests that mutton was consumed regularly. The majority of these animals were probably reared for their wool before being slaughtered; a pattern which is consistent with contemporary sites (Albarella *et al.* 2009; Thomas 2007).

None of the pig teeth could be aged and out of the pig elements that were recorded; three out of four early fusing bones were fused, one middle fusing bones was fused and one out of the five late fusing bones were fused.

Sexing

Two pig canines could be sexed one was male and the other was female.

Biometry

The number of measurements for domestic mammals was insufficient to conduct an intra-site analysis of the biometrical data. However, the results will be included as part of the Chester inter-site analysis (see Chapter Three, Volume I).

Butchery

Fifteen percent of the post-cranial bones exhibited butchery marks; late 18th - early 19th century had the most butchered bones followed by mid-19th - mid-20th century and late 17th - early 18th century. Most of the bones displayed butchery marks inflicted either by a knife, axe or cleaver and in the late 18th - early 19th century and mid-19th - mid-20th century three bones had been sawn.

Cattle bones had the highest proportion of butchery marks; the majority of which were chop marks associated with disarticulation and dismemberment (figure 1.67). Examples of butchery practices included cut and/or chop marks on the shaft and articular surfaces of long bones as well as tarsal bones; which are typical of primary and secondary butchery. Cut marks were also present on the phalanges which are indicative of skinning. Two cranial bones with butchery marks were noted on a skull and mandible which could also be associated with skinning. Vertebrae were commonly chopped down the centre indicating carcasses hung for butchery and one thoracic vertebra was chopped transversely. Two humeri, one femur and a pelvis appeared to have been butchered into very small portions figure 1.68). This is reminiscence of tertiary butchery where the bone is reduced so it can fit into a cooking pot (Rixson 1988: 49). It is probable that this butchery pattern is a reflection of the social-status of the inhabitants on site. An unusual butchery pattern was noted on three large mammal rib fragments (probably cattle) which were sawn so they formed a triangular shape (figure 1.69).

After cattle, sheep/goat exhibited the most butchery. Most of these were cut marks which were characteristic of primary and secondary butchery. These comprised of cut marks on the shaft and distal ends of long bones such as the humerus, femur and tibia and chop marks on the axis and atlas. The vertebrae were also split sagittally. One sheep pelvis was sawn through the ilium which probably was carried out to divide the carcass into joints. The two pig bones that bore butchery marks had cut marks on the shaft of the femur and lateral metatarsal.

Other species with butchery marks included rabbit, dog, horse and chicken. Chop marks were on the mid-shaft of two foal tibiae and a cut mark was on the cervical vertebra of a dogs. A cut mark was also recorded on the pelvis of a rabbit and on the proximal articulation of a chicken humerus.

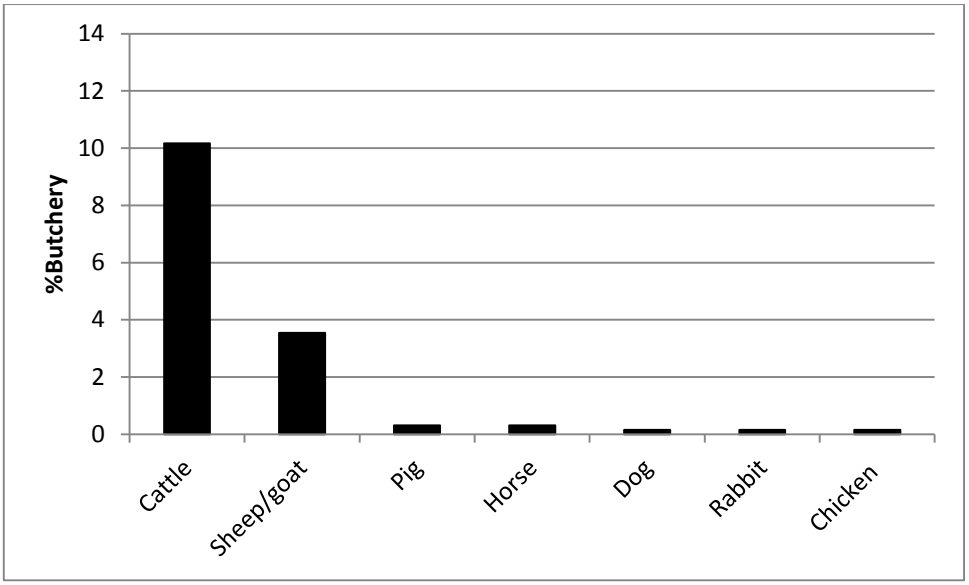

Figure 1.67: Proportion of hand-collected, identifiable post-cranial bones with butchery from Hamilton Place

Figure 1.68: Example of a butchered cattle humerus

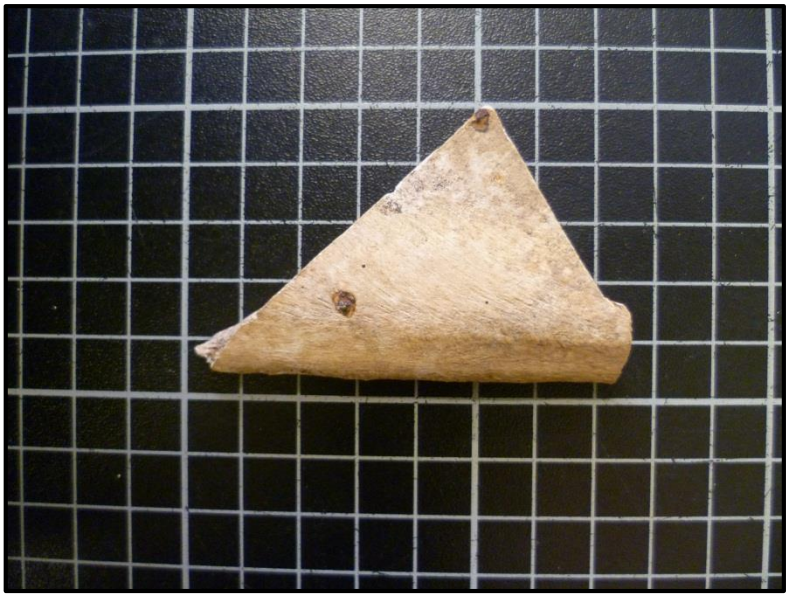

Figure 1.69: Example of sawn, triangular shaped large mammal rib fragment

Pathology

Disease and injury in the Hamilton Place assemblage was scarce with only 2% of the identifiable post-cranial bones showing signs of pathology. Cattle exhibited most of the lesions which is not surprising as they tend to be kept for longer before being slaughtered allowing time for them to develop.

Pathologies identified on cattle were mainly those associated with degenerative joint diseases and articular lesions. Two cattle femora had eburnation on the femoral head, which most likely developed as a result of over-rotation in the acetabulum (Groot 2005: 55). This is characteristic of osteoarthritis, which can be caused by stress in the joints which can develop in traction animals or in aged animals. Various lesions in the form of shallow and pinprick depressions and narrow slits were noted on the articular surfaces of two first phalanges, one second phalanx and on the glenoid cavity of three scapulae. These lesions are believed to be caused by osteochondrosis and/or form on the bone during the developmental process; although the aetiology is yet to be fully understood (Thomas and Johannsen 2011). To assess the extent that cattle were exploited for traction, PI values (Pathological Index) were calculated for complete cattle autopodia, which gave a value of zero, meaning that there was no pathological change. Lesions were, however, noted on two incomplete phalanges. Nonetheless, the virtual absence of these lesions suggests that cattle were not used for traction. A cattle first phalanx and mandible had evidence of periostosis which can be caused by a localised or systemic inflammation; however, with disarticulated material it is impossible to undertake a differential diagnosis. One cattle skull had cranial perforations which recent evidence

suggests is likely to be the cause of a genetic and/or developmental defect (Fabiš and Thomas 2011). It has been hypothesised that this defect occurs in domestic mammals with a large *sinus frontalis* during the pneumatisation of the frontal, parietal and occipital bones (Fabiš and Thomas 2011).

Other domestic mammals that showed signs of pathology were sheep/goat and dog. One sheep/goat humerus and metacarpal had periostosis on the diaphysis. One complete fused dog metatarsal had osteophytes and eburnation around and on the distal articulation which could be attributed to old age. One dog scapula had a depression on the glenoid cavity similar to the pinprick depressions observed on cattle scapulae. Lastly, one crow carpometacarpus had a healed fracture around the intermetacarpal process.

1.3 Nicholas Street Mews

Taphonomy

The majority of the bones from Nicholas Street Mews were in 'good' condition, showing little variation between phases (figure 1.70). An assessment of the preservation condition of bones from pits and layers showed hardly any difference, suggesting that bone preservation on site was homogenous, regardless of the period or depositional context. The proportion of gnawed bones on site was low (figure 1.71). Most of the gnawing marks were inflicted by carnivores; however, four bones exhibited rodent gnawing. One duck coracoid and chicken humerus had gnawing marks that were typical of cat gnawing (Moran and O'Connor 1993). The proportion of gnawing increased over time from 2% to 5%, which is low, compared to other contemporary sites (e.g. see Thomas 2005a and Thomas and Vann 2015).

Only a small number of bones were burnt, which suggests that burning played a minor role in the site's taphonomic profile. The number of identifiable post-cranial bones with evidence of burning only totalled to four calcined/burnt bones. Only nineteen unidentifiable fragments had evidence of burning. The majority were calcined, two were burnt and one was singed.

The ratio of loose teeth to mandibles/maxillae revealed a high level of fragmentation, as the majority of the teeth were loose (figure 1.72). However, it is important to note that the frequency of mandibles and maxillae were scarce, so the sample size was low for all phases (table 1.19). The average number of zones per bone for cattle averaged at two for each phase. For sheep/goat the average was three, except for the 18th-19th century which was two. Pig averaged at four in 14th-16th century, three in 16th-17th and 17th-18th century and two in the 18th-19th century. The number of zones for chicken was generally high with the highest average at six in the 16th-17th century, five in the 18th-19th century and four in the 14th-16th century and the 17th-18th century. These results are likely to be attributed to a combination of taphonomic and butchery factors. Large bones are also more prone to higher levels of fragmentation; hence the average number of zones per bone for large animals will be smaller.

There were samples taken for the site but none came from the late medieval and post-medieval contexts. The site was excavated at a time when sampling and sieving in Chester was still relatively new; therefore, the animal bones were mostly retrieved via hand-collection (Smith 2012: 146). As a consequent, the bones of smaller mammals, birds and fish will be under-represented.

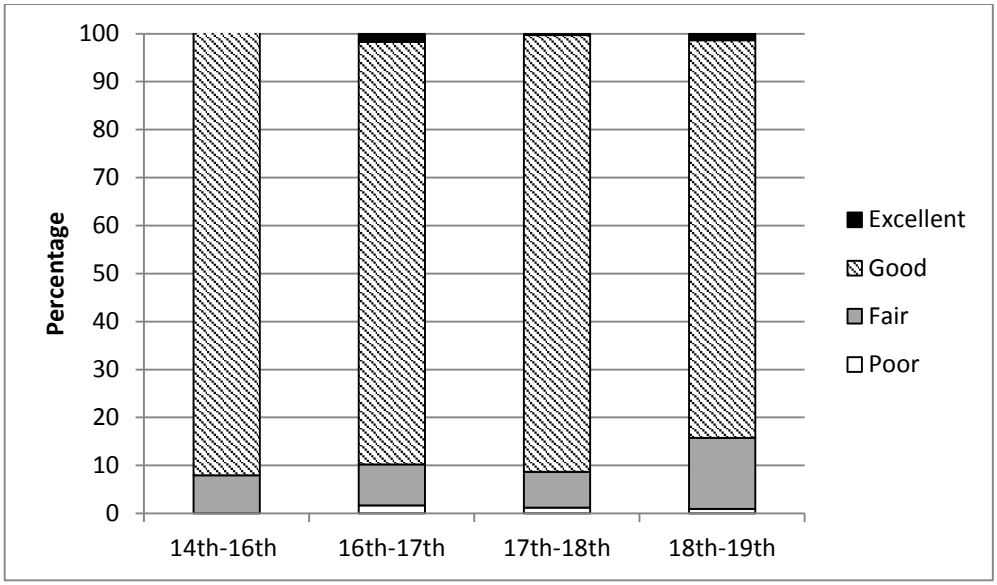

Figure 1.70: Preservation stages for identifiable, hand-collected post-cranial bones for Nicholas Street Mews

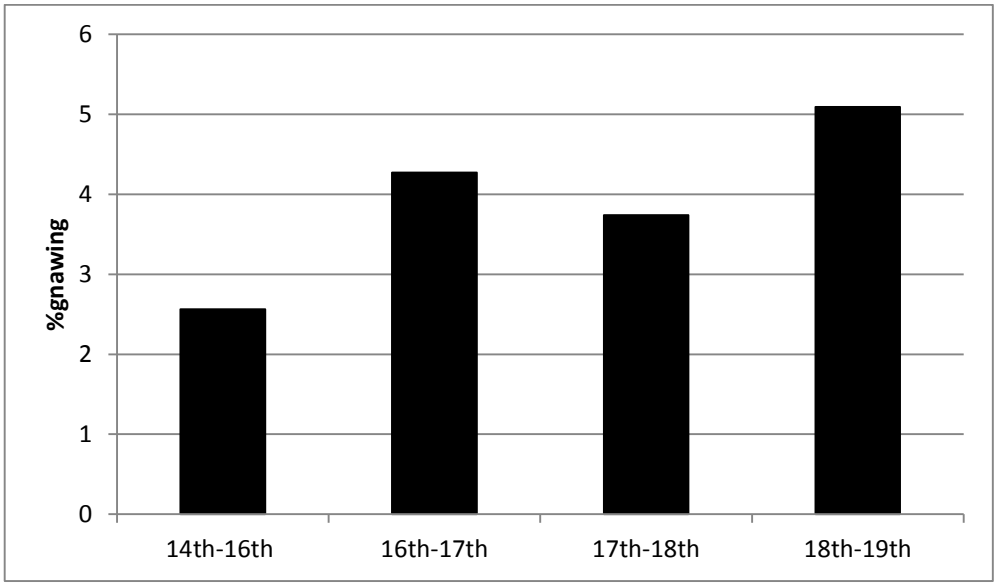

Figure 1.71: Percentage of gnawing marks on identifiable, hand-collected post-cranial bones for Nicholas Street Mews

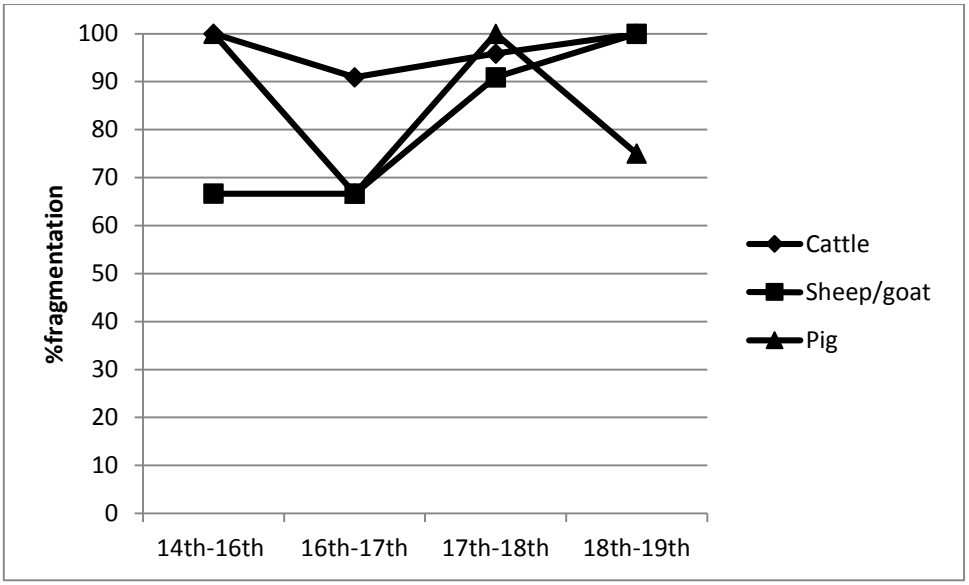

Figure 1.72: Percentage of loose teeth out of the total number of loose teeth and mandibles/maxillae

	I	II	III	IV
Cattle	5 (5)	11 (10)	24 (23)	28 (28)
Sheep/goat	3 (2)	3 (2)	11 (10)	14 (14)
Pig	1 (1)	3 (2)	6 (6)	12 (9)

Table 1.19: The number of loose teeth and mandibles/maxillae from Nicholas Street Mews. The total number of loose teeth is presented in the brackets. Key: I – 14th-16th; II – 16th-17th; III – 17th-18th; IV- 18th-19th

Species representation

Domestic and wild mammals

The site was dominated by cattle (*Bos taurus*), sheep/goat (*Ovis/Capra*) and pig (*Sus scrofa*), although their proportion differed somewhat between the phases (figure 1.73). The proportion of cattle was around 50%, which declined to 46% by the 18th-19th century. The proportion of sheep/goat varied throughout the period. The lowest percentage was at 28% in the 14th-16th century and the highest was 38% in 17th-18th century. The rise and fall in the proportion of sheep/goat occurs relative to the proportion of pigs.

The frequency of pig was the highest in the 14th-16th century (21%), which declined the 16th-17th century (13%) and 17th-18th century (12%) and increased by the 18th-19th century (19%). Nicholas Street Mews also had the highest proportion of pig in phases 14th-16th century and 18th-19th century compared to Chester's Roman Amphitheatre and Hamilton Place. One suspects that this may be related to the ecclesiastical community that occupied the site as pork was an important food source in ecclesiastical diets (Albarella 2009: 80-81).

Other domestic species were found, albeit in small numbers. Goat (*Capra hircus*), cat (*Felis catus*), dog (*Canis familaris*) and *Equus* sp. only made up a small proportion of the assemblage. There was one partial skeleton of a horse (*Equus caballus*), which was excavated from a 17th-18th century pit. The horse was skeletally mature, buried in a garden along with some other food remains. It has been suggested that the horse may have represented a family pet (Ward 1988: 13).

Wild mammals were also present in small numbers. This included red deer (*Cervus elaphus*), fallow deer (*Dama dama*), rabbit (*Oryctolagus cuniculus*) and hare (*Lepus europaeus*). One red deer phalanx was present in the 18th-19th century. Although the presence of red deer is not unusual for this time period, the preservation condition of this bone was 'fair' and appears to have been redeposited. A partial skeleton of a rat (Rattus sp.) and one bone of a brown rat (*Rattus norvegicus*) were also present.

Domestic and wild birds

Domestic birds consisted of chicken (*Gallus gallus*), goose (*Anser* sp.) and duck (*Anas* sp.). Chicken remained consistently abundant throughout time; however, the proportions of goose and duck varied (figure 1.74). The proportion of geese appeared to decline and increase relative to the proportion of duck. However, the sample size for goose and duck was small; therefore, this result should be interpreted tentatively.

There were a small number of wild species present. This included pheasant (*Phasianus colchicus*), teal/garganey (*Anas crecca/querquedula*), domestic pigeon/pigeon (*Columba cf. livia/ Columba sp*.), woodcock (*Scolopax rusticola*), golden plover (*Pluvialis cf. apricaria*), water rail (cf. *Rallus aquaticus*), herring gull (*Larus argentatus*), raven (*Corvus corax*) and jackdaw/magpie (*Corvus monedula/Pica pica*). Most of these species would have bought for consumption, some of which are considered to be high-status food (Thomas and Albarella 2002). However, there is ambiguity surrounding pigeon, jackdaw/magpie and raven, which are common commensal birds that can also be eaten.

Amphibian and fish

One amphibian bone was recovered along with several fish bones belonging to cod (cf. *Gadus morhua*), dab (cf. *Limanda limanda*), hake (*Merluccius merluccius*) and thornback ray (*Raja clavata*).

Body parts represented

Due to the limited number of elements, the body part data were amalgamated to produce a larger sample size. Therefore phases I/II and III/IV were combined together in order to identify broad trends between the late medieval to early modern period (14th - 17th century) and the early modern to modern period (17th - 19th century).

Cattle body parts from the late medieval/early modern period showed that most elements were present (figure 1.75). Both major- and non-meat bearing bones were present, however some elements were better represented than others. The most common elements were the pelvis, humerus, atlas, metacarpal and calcaneum. Their relative abundance probably reflects taphomonic factors and the selection of specific joints for consumption. Bones such as the calcaneum have little meat but have a high mineral density, which could account for their prevalence. The high frequency of metacarpals could be associated with the processing of hides nearby or primary butchery. The most common meat-bearing bones were the pelvis and humerus, which could be result of preferential selection, although the distal humerus is also a dense element, which may have contributed to its relative abundance. The presence of the atlas indicate that cattle heads were present on site, which could represent waste remains from primary butchery or evidence for the consumption of cattle heads. The body part data for cattle from the early modern/modern period (figure 1.76) is dissimilar in the sense that a greater range of elements were represented equally, suggesting there was a wider variety of meat joints that were purchased. Again, the calcaneum and axis were better represented and the astragalus and distal tibia were also present, which could reflect the deposition of primary butchery waste.

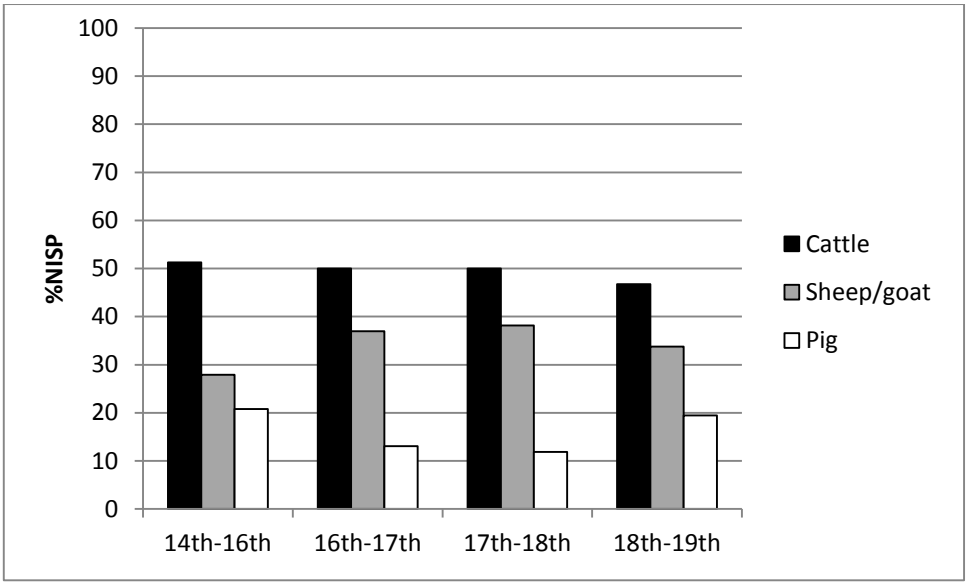

Figure 1.73: Relative proportion for hand-collected cattle, sheep/goat and pig from Nicholas Street Mews. Total NISP in brackets: 14th-16th (NISP= 154); 16th-17th (NISP= 176); 17th-18th (NISP=270); 18th-19th (NISP=231)

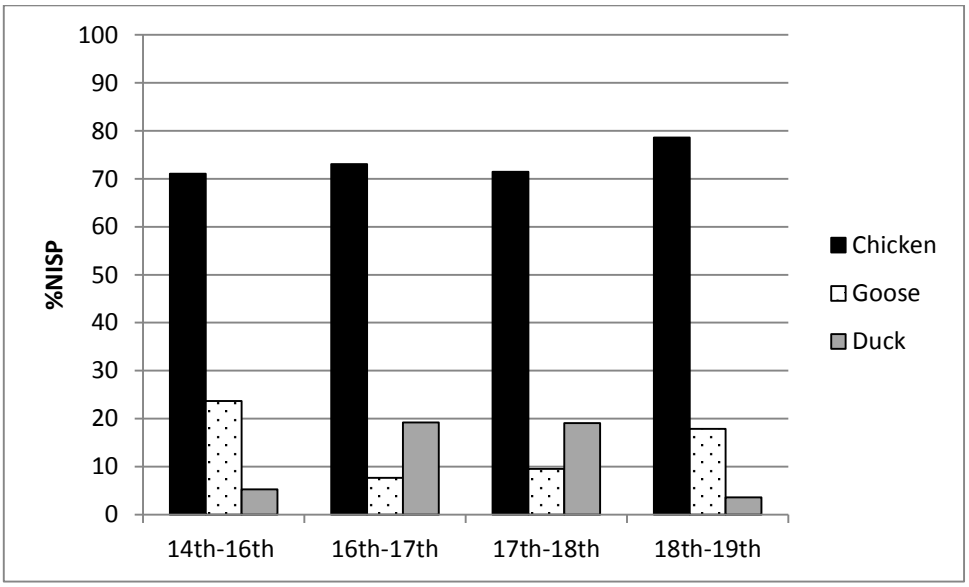

Figure 1.74: Relative proportion for hand-collected chicken, goose and duck from Nicholas Street Mews. Total NISP in brackets: 14th-16th (NISP= 38); 16th-17th (NISP=52); 17th-18th (NISP=21); 18th-19th (NISP=28)

Species	I	II	III	IV
Cattle (*Bos taurus*)	79	88	135	108
Sheep/goat (*Ovis/Capra)*	42	63	92	70
Sheep (*Ovis aries*)	1	2	11	7
Goat (*Capra hircus*)				1
Pig (*Sus scrofa*)	32	23	32	45
Horse* (*Equus caballus*)			101	
Equid (*Equus* sp.)	1	1		1
Dog (*Canis familaris*)	1	3	1	4
Dog/fox (*Canis/Vulpus*)	1			
Cat (*Felis catus)*	4			4
Red deer (*Cervus elaphus*)				1
Fallow deer (*Dama dama*)		3	6	1
Rabbit (*Oryctolagus cuniculus*)	1	3		3
Hare (*Lepus europaeus*)	1			
Brown rat (Rattus norvegicus)				1
Rat (*Rattus* sp.)*	33			
Small rodent	2	1		
Chicken (*Gallus gallus*)	27	38	15	22
Large galliform		1		2
Goose (*Anser* sp.)	9	4	2	5
Duck (*Anas* sp.)	2	10	4	1
Medium anseriform		1		
Pheasant (*Phasianus colchicus*)		1		1
Teal/Garganey (*Anas crecca/querquedula*)	3	5		
Pigeon (*Columba* sp.)		2		
Woodcock (*Scolopax rusticola*)	3	5		1
Plover (*Pluvialis* cf. *apricaria*)	1			
Water rail (cf. *Rallus aquaticus*)				1
Small charadiiform			1	
Herring gull (*Larus argentatus*)			1	
Raven (*Corvus corax*)	2			1
Corvid		2		
Small Turdid	3	3		
Amphibian	1			
Cod (cf. *Gadus morhua*)	4	4	1	
Dab (cf. *Limanda limanda*)	3			
Hake (*Merluccius merluccius*)	1			
Thornback ray (*Raja clavata)*		1		
Gadidae		2	1	
TOTAL NISP	257	266	403	280

Table 1.20: Number of hand-collected identifiable bones from Nicholas Street Mews. Antler fragments not included. *denotes the presence of partial skeletons. Key: I – 14th-16th; II – 16th-17th; III – 17th-18th; IV- 18th-19th

	I	II	III	IV
Unidentifiable large mammal	102	164	790	150
Unidentifiable medium mammal	71	75	89	109
Unidentifiable small mammal	17	2	1	5
Unidentifiable large bird	6	1		2
Unidentifable medium bird	18	11	2	6
Unidentifible small bird	3	5		3
Unidentifiable bird	10	4	4	4
Unidentifiable fish	36	38		4
Unidentifiable	10	2	1	1
TOTAL UNIDENTIFIABLE	273	302	887	284

Table 1.21: Number of unidentifiable hand-collected specimens from Nicholas Street Mews. Key: I – 14th-16th; II – 16th-17th; III – 17th-18th; IV- 18th-19th

Sheep/goat body part representation in the late medieval/early modern period was similar to cattle in that there was an emphasis on particular elements (figure 1.77). The pelvis, scapula and atlas were the most common elements. The low proportion of phalanges could reflect recovery biases, as small bones are more difficult to see during excavation. Another possibility could be that the lower limb bones were attached to skins which were transported elsewhere. This hypothesis could also account for the low proportion of metapodials. Body parts for sheep/goat in the early modern/modern period (figure 1.78) suggest that there was also a wider variety of joints consumed on site. There appeared to have been more forelimbs (e.g. humerus and scapula) compare to hindlimbs as well as a paucity of foot bones.

The body part data for pigs showed that post-cranial bones were less represented compared to cattle and sheep/goat (figure 1.79). However, this result is not wholly surprising as pig bones tend to be porous because they were slaughtered at a younger age; therefore, they are more susceptible to post-deposition destruction. The high frequency of some elements (e.g. pelvis, radius, and ulna) could suggest the purchasing of filleted meat joints. In general, there is not a great deal of variation between the late medieval/early modern period and the early modern/modern period (see figure 1.80). This may imply the availability or preference for similar meat cuts, although this interpretation should be considered tentatively due to the small sample size.

The range of chicken body parts from the late medieval/early modern period suggests that the whole carcass was present on site (figure 1.81). Most of the elements were more or less equally represented except the ulna. As the wing elements have less meat, the high abundance of the ulna

could be attributed to preservation factors as this element generally survives well (Serjeanston 2009: 164). The frequency of the tarsometatarus is low, probably because the lower leg bones were removed during primary butchery. The lack of sieving and sampling probably accounts for the absence of the skull, atlas and axis. In the later period, the proportion of chicken elements points to the consumption of the meatier elements (figure 1.82). The low proportion of the tarsometatarus and carpometacarpus is probably because these bones are removed during primary butchery.

Fallow deer was only represented by a few elements, however, most derived from the hindlimb: calcuneum (2); tibia (4); femur (3); second phalanx (1); lumber vertebra (1); humerus (1).

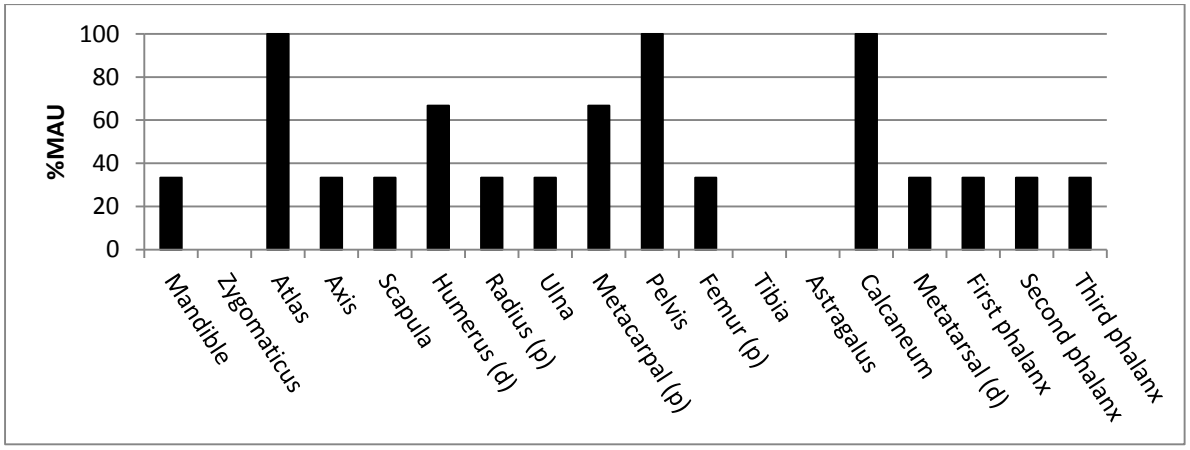

Figure 1.75: Percentage body part representation for hand-collected cattle bones from phase I and II: 14th-17th century (Total NISP 82; max MAU 3)

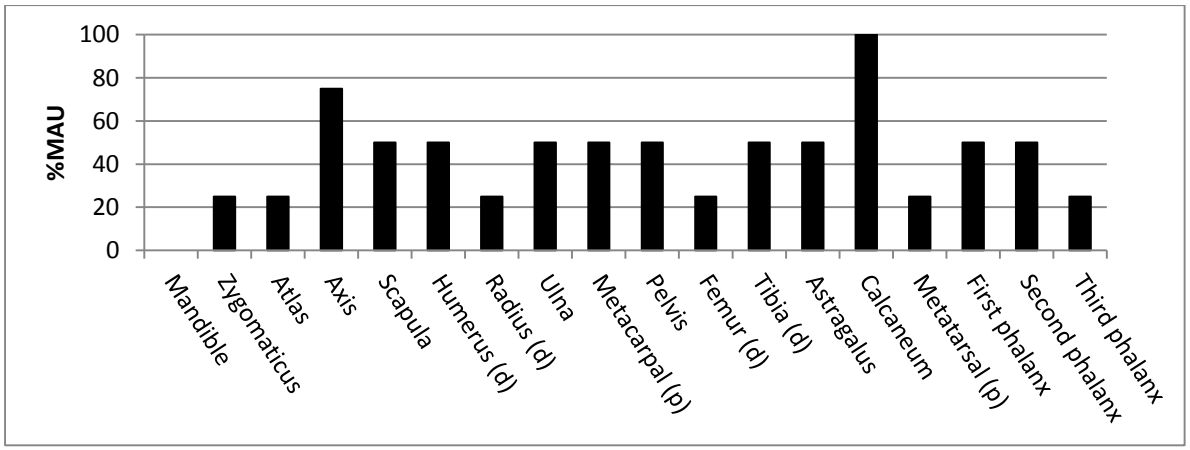

Figure 1.76: Percentage body part representation for hand-collected cattle bones from phase III and IV: 17th-19th century (Total NISP 115; max MAU 4)

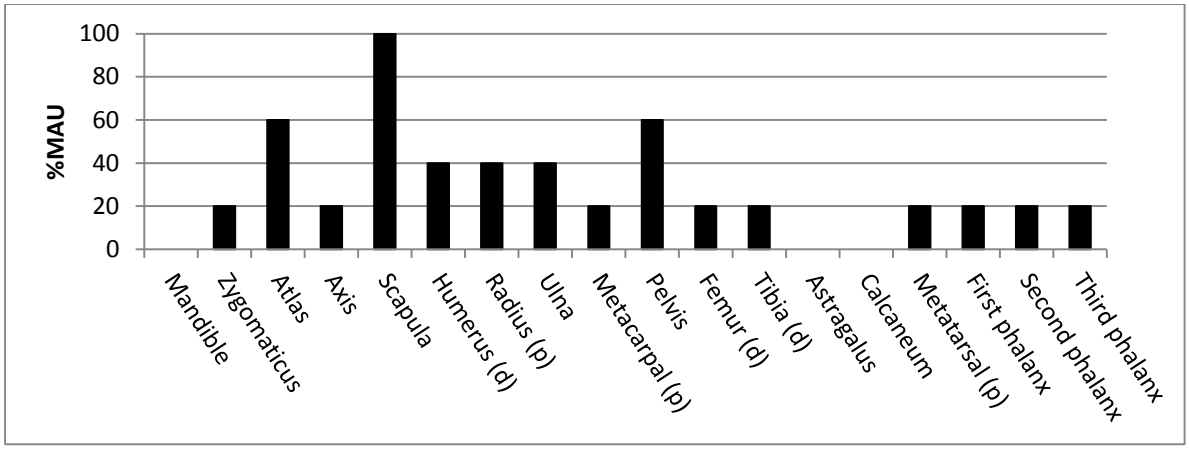

Figure 1.77: Percentage body part representation for hand-collected sheep/goat bones from phase I and II: 14th-17th century (Total NISP 75; max MAU 5)

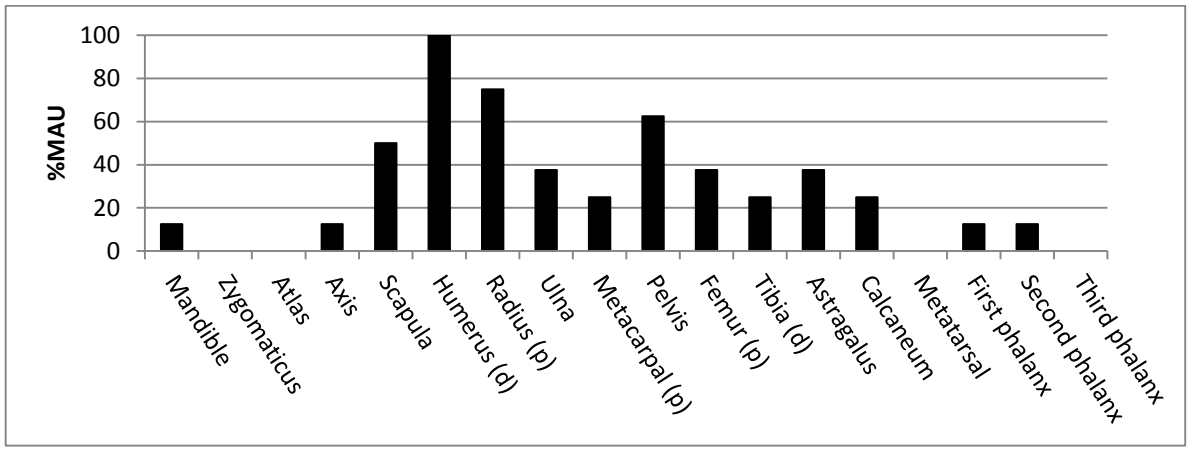

Figure 1.78: Percentage body part representation for hand-collected sheep/goat bones from phase III and IV: 17th-19th century (Total NISP 135; max MAU 8)

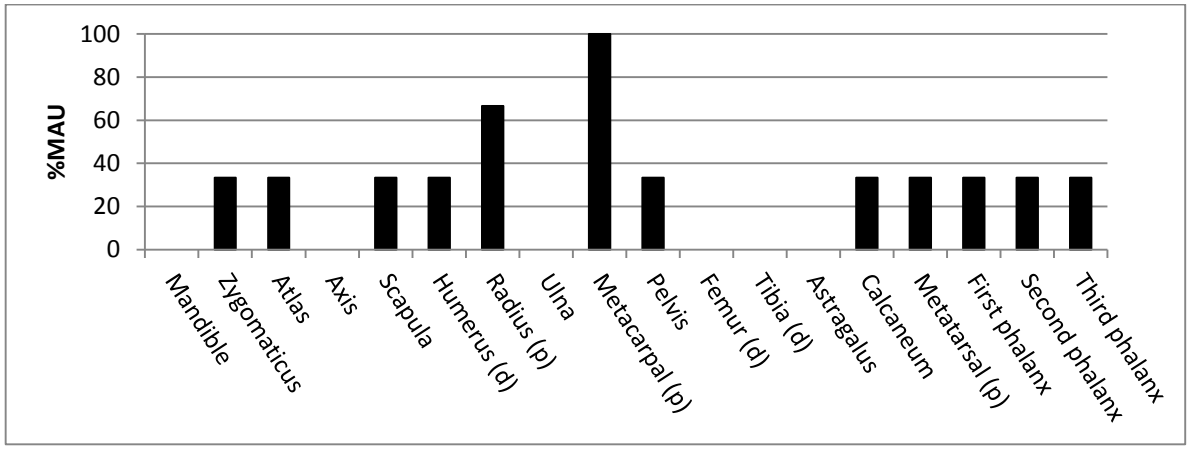

Figure 1.79: Percentage body part representation for hand-collected pig bones from phase I and II: 14th-17th century (Total NISP 35; max MAU 3)

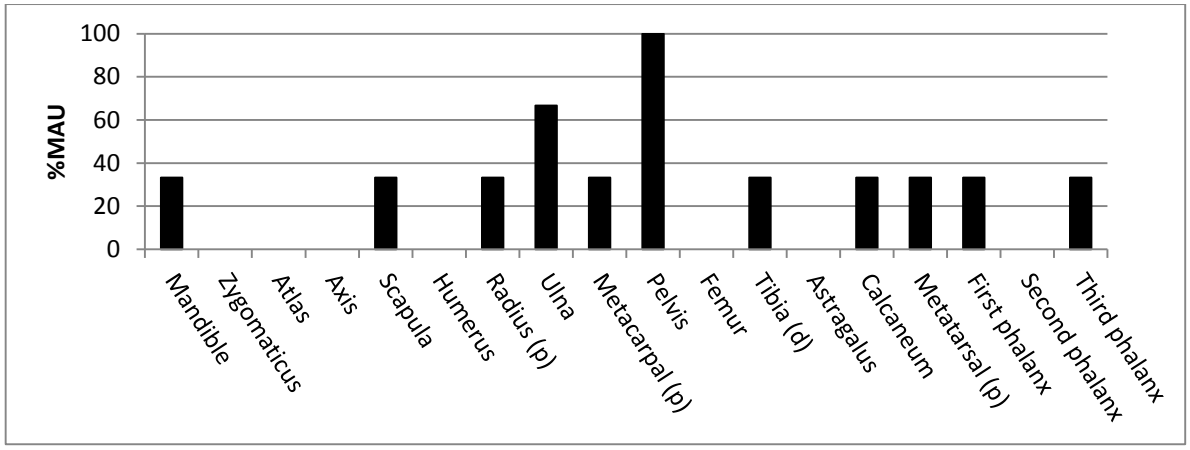

Figure 1.80: Percentage body part representation for hand-collected pig bones from phase III and IV: 17th-19th century (Total NISP 36; max MAU 3)

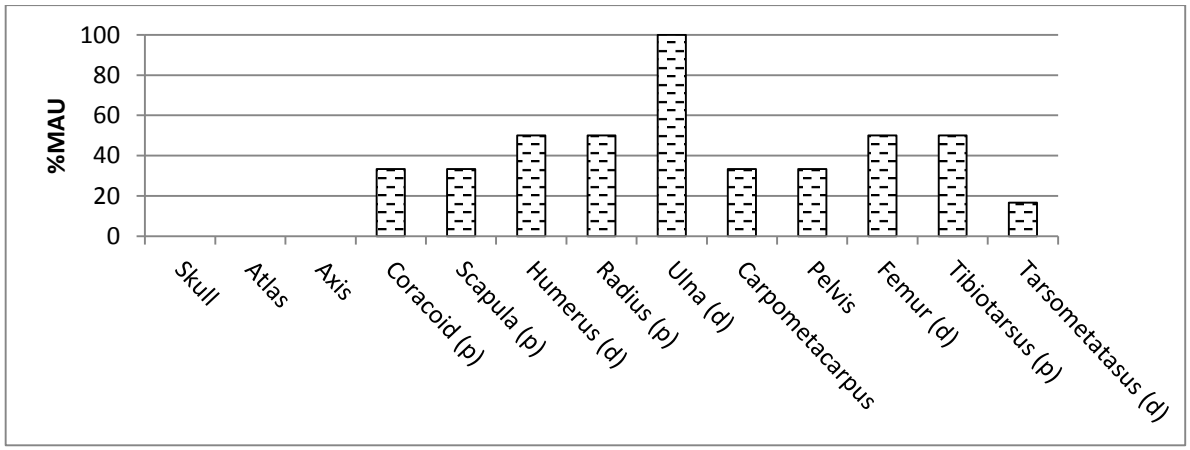

Figure 1.81: Percentage body part representation for hand-collected chicken bones from phase I and II: 14th-17th century (Total NISP 58; max MAU 6)

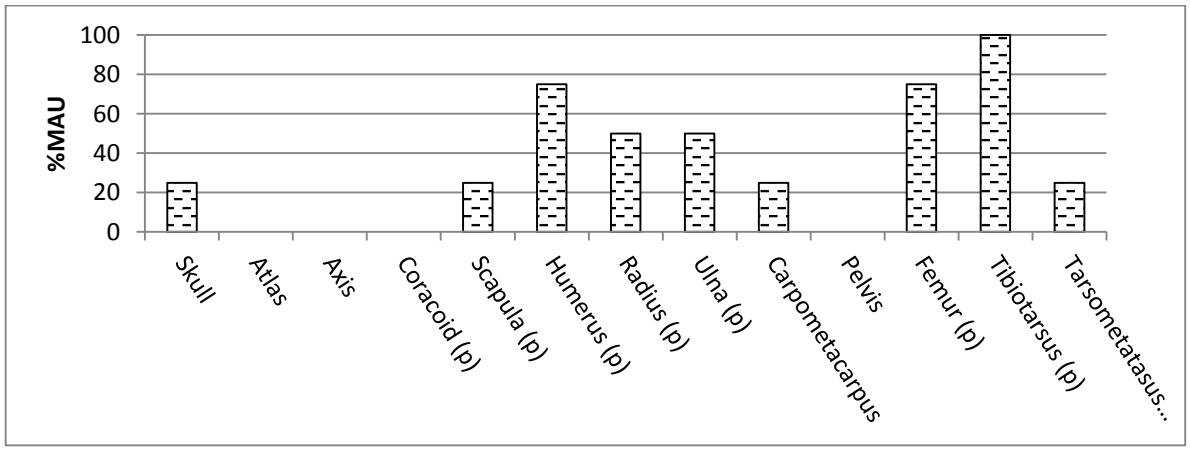

Figure 1.82: Percentage body part representation for hand-collected chicken bones from phase III and IV: 17th-19th century (Total NISP 36; max MAU 4)

Mortality Profiles

Nicholas Street Mews had very few teeth that could be aged; therefore, no tooth wear graphs could be produced. The total number of cattle teeth that could be assigned to an age category was six. These ranged between 1 to 8 months and senile and came from the 14th-16th, 17th-18th and 18th-19th century. A total of three sheep/goat teeth from the 17th-18th and 18th-19th century were aged at 2 to 6 months, 2 to 3 years and 3 to 4 years. In the 18th-19th century, one pig was aged at 14 to 21 months.

After breaking down the fusion data by phase there was a limited dataset. For that reason, data from each phase was amalgamated to form two broad chronological groups: late medieval/early modern period (14th-17th century) and the early modern/modern period (17th-19th century). Despite this, the sample size was still small; therefore, the results should be considered cautiously.

Cattle (n=38) from the late medieval/early modern period appeared to have been dominated by adults. The percentage of fused, early fusing bones was 87%, and 50% of the late fusing bones were fused. This suggests a mix of prime meat and old animals (figure 1.83). Sheep/goat (n=46) fusion data showed that none were culled around 1½ years or younger (figure 1.84). The majority of animals would have been reared for meat and wool; therefore, a mixture of prime meat and mutton was probably consumed. The fusion data for pig (n=30) was small; however, it was possible to discern that most were juvenile.

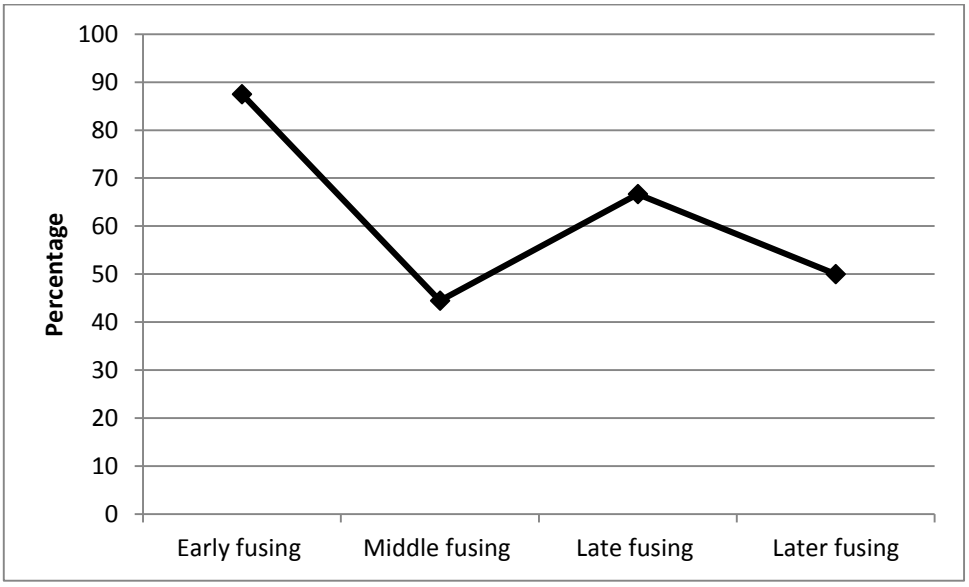

Figure 1.83: Epiphyseal fusion data for cattle (n=38) from the 14th-17th century. This graph was produced following the fusion categories of Reitz and Wing (2008)

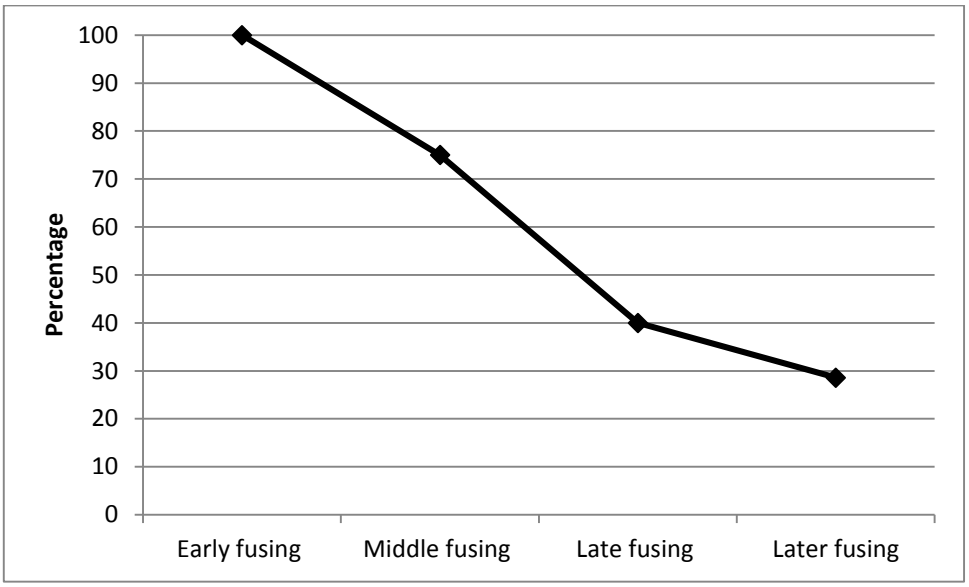

Figure 1.84: Epiphyseal fusion data for sheep/goat (n=46) from the 14th-17th century. This graph was produced following the fusion categories of Reitz and Wing (2008)

Cattle (n=59) data from the early modern/modern period were slaughtered at a comparable time to the earlier period, although there may have been an increase in the proportion of adults (figure 1.85). The result for sheep/goat (n=72) also appeared to be similar to the earlier period. The sample size for pig was too small and therefore cannot be determined (figure 1.86).

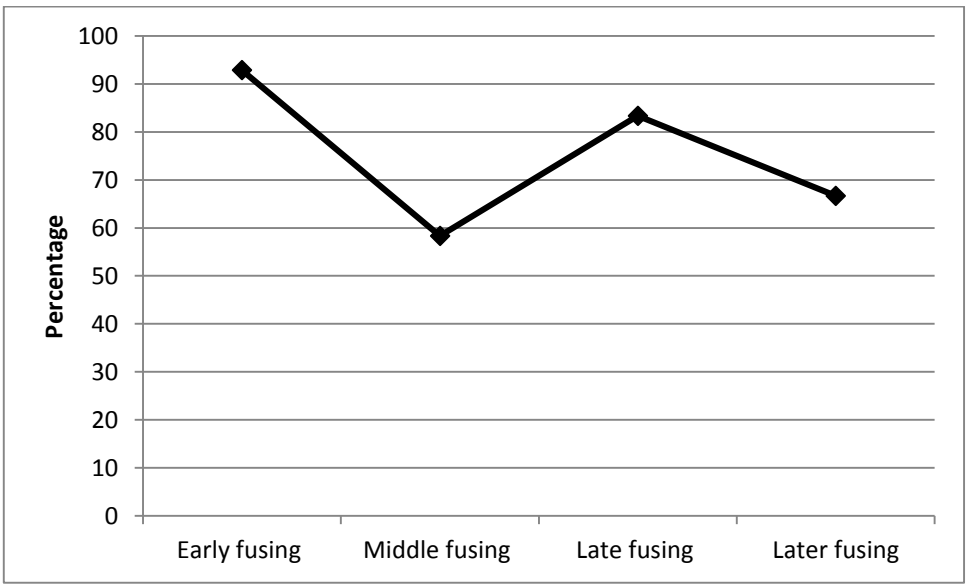

Figure 1.85: Epiphyseal fusion data for cattle (n=59) from the 17th-19th century. This graph was produced following the fusion categories of Reitz and Wing (2008)

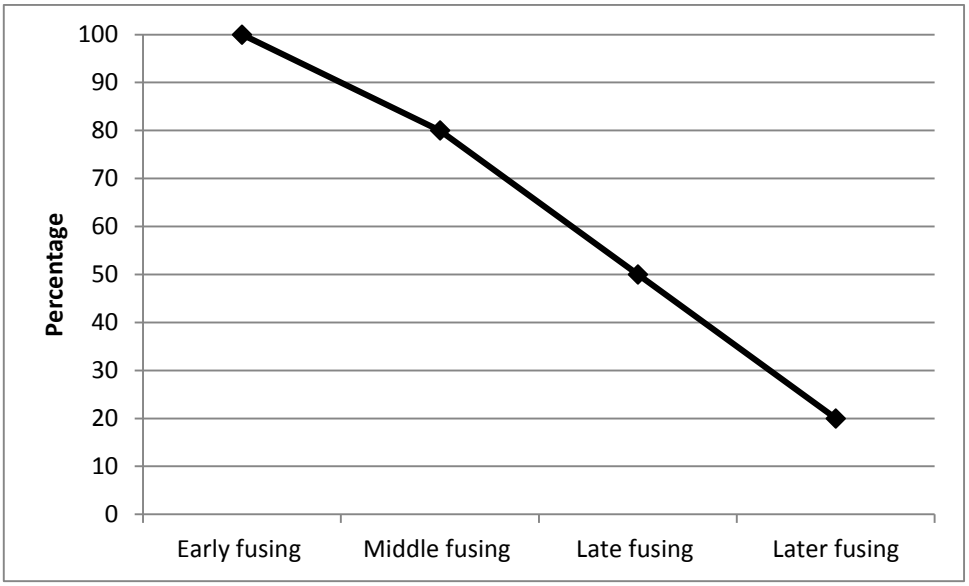

Figure 1.86: Epiphyseal fusion data for sheep/goat (n=72) from the 17th-19th century. This graph was produced following the fusion categories of Reitz and Wing (2008)

The percentage of juvenile chicken bones could only be calculated for the 14th-16th century (23%) and the 16th-17th century (44%). The proportion of juveniles at Nicholas Street Mews is higher than other contemporary post-medieval sites including Chester's Roman Amphitheatre (see Dudley Castle, Thomas 2005a, figure 145; Wigmore Castle, Thomas and Vann 2015; and Stafford Castle, Thomas 2003). The presence of juveniles suggests that on-site breeding was taking place or it could also be an indication of high-status consumption (Thomas and Vann 2015).

The second and third molar of the horse partial skeleton was aged following the criteria of Levine (1982) which estimated age to be 10-14 years.

Sexing

Only a few post-cranial bones and teeth belonging to cattle, sheep/goat, pig, horse and chicken could be sexed.

One cattle pelvis was identified as male. Two sheep/goat pelves were female and another was male. Five mandibular/maxillae pig canines could be sexed, four of which were female and one was male. There was one loose horse canine that was identified as male and an assessment of the horse

skeleton's pelvis identified it as female. As for chicken, one tarsometatarus had a spur scar and one tibiotarsus had medullary bone.

Biometry

There was an insufficient amount of data to compare the size and shape of cattle, pig and chicken from each phase. Sheep/goat, on the other hand, produced a reasonable number of breadth measurements to compare phases I/II and III/IV (figure 1.87). The metrical data shows that there was an increase in the mean size by the later phases; however, this was not statistically significant (U=103.5; P=0.092).

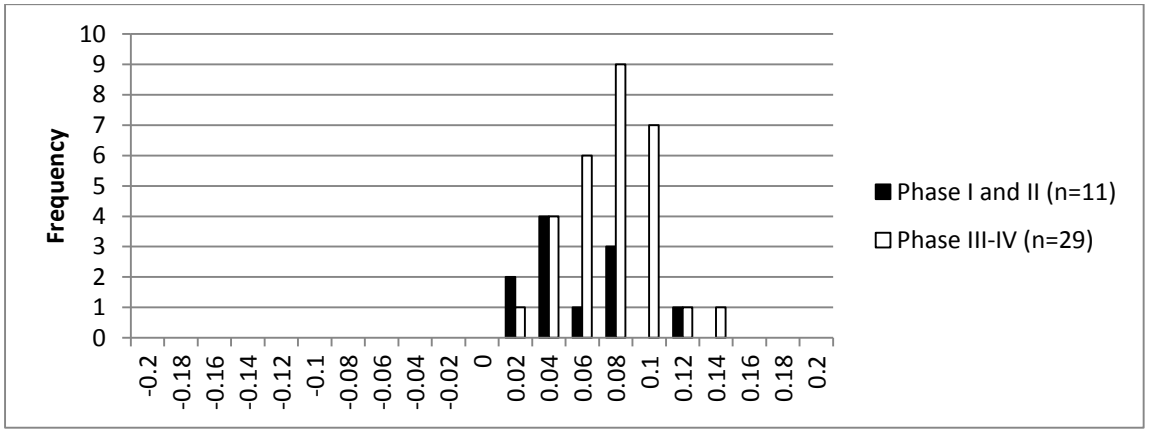

Figure 1.87: Log-scaled of sheep/goat post-cranial bone breadth measurements from Nicholas Street Mews. Key: I – 14th-16th; II – 16th-17th; III – 17th-18th; IV- 18th-19th

Butchery

Ten percent of the post-cranial bones at Nicholas Street Mews displayed butchery marks, which was less than Hamilton Place and the Roman Amphitheatre. Overall, cattle exhibited most of the butchery, followed by sheep/goat and pig (figure 1.88). The majority of cattle had chop marks whereas cut marks were more common on sheep/goat. Only a few pig elements (n=8) had butchery marks, six of which were cut marks.

Cattle butchery demonstrated sagittal splitting of the carcass through the cervical, thoracic, lumbar and sacral vertebrae. Chop marks were noted on the articulating surfaces such as the glenoid cavity, proximal ulna and distal humerus. This is characteristic of disarticulation during primary and secondary butchery. One humerus had been chopped through the middle of the trochlea, either for

the extraction of marrow or to fit in a cooking pot. There was evidence for skinning as a number of phalanges had cut marks. Cranial butchery included chop marks on the skull/occipital condyles and cut marks on the zygomaticus.

Sheep/goat vertebrae had also been split sagittally. Cut and chop marks were observed on the shaft and on the distal/proximal articulation of long bones (e.g. tibia, radius and humerus). Two humeri had a circumferential cut mark around the mid-shaft from the 17th-18th and 18th-19th century and one scapula had a hook mark. Similar perforations have been seen on sheep scapulae at Lincoln and Dudley Castle (Dobney *et al.* 1996: 28; Thomas 2005a: 47). It was common when curing shoulder joints to hang the joint on a hook while it was in the smoker or brine vat (Dobney *et al.* 1996: 26). Cut and chop marks were recorded on several pelves, located either on or around the ilium and acetabulum, which probably occurred during the separation of the femur and pelvis during primary butchery. Three occipitals had chop marks and one skull had a cut mark on the dorsal side of the orbit and was chopped through the frontal. This might have been done to extract the brain for consumption.

Half of the butchery marks on pig bones were observed on the ribs, either on the corpus costae and the rib head. Cut and chop marks were also noted on the femur, pelvis and atlas.

Other species with butchery marks were fallow deer, chicken, goose and duck. Only three fallow deer elements had cut marks, located on the distal femur, proximal humerus and the transverse process of a lumber vertebra. Most of the butchery marks on birds were either on the proximal/distal articulation or the shaft. One deer antler also exhibited butchery marks which suggest that craft-working was taking place.

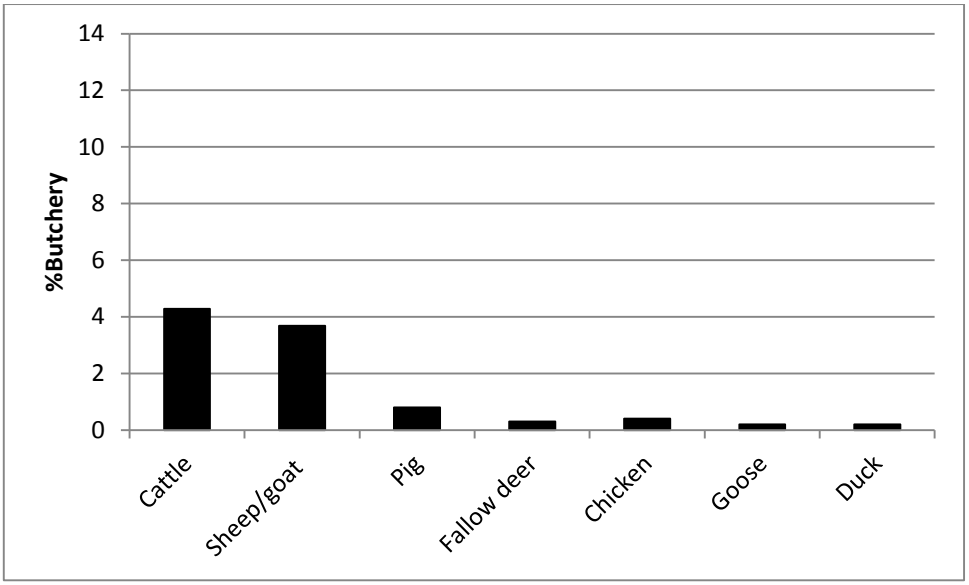

Figure 1.88: Proportion of hand-collected, identifiable post-cranial bones with butchery for all phases

Pathology and non-metric traits

The percentage of post-cranial elements exhibiting pathologies was only 3%. One percent of those pathologies were from the partial horse skeleton. Cattle and horse equally exhibited the most lesions, followed by sheep/goat, chicken, pig and goose. For cattle, the majority of the lesions were observed on the autopodia. Lesions included type 1 and lesion 2 articular depressions on a first phalanx and metapodial, as described as in Thomas and Johannsen (2011). One cattle scapula and second phalanx also had depressions similar to lesions described in Thomas and Johannsen (2011). However, these depressions were not distinct enough to classify to type. Pathological Index values were calculated for complete cattle autopodia, which gave a PI value of 0.030% for the late medieval/early modern period, and 0.015% for the early modern/modern period. The low values suggest that cattle were not extensively used for traction.

Osteophytes were observed on the centrum, spinous and articular process of the horse cervical, thoracic, lumbar and sacral vertebrae as well as on the articular surface of the phalanges and on the mandibular condyles. One first phalanx had lipping and another had lipping and eburnation, which is characteristic of osteoarthritis. Two ribs had a pseudarthrosis. This can develop as a result of movement during the healing process, which prohibits revascularisation of either, the bone, the infection or the soft tissue that separates the bone at the point of fracture (Thompson 2007: 23). In addition, the horse's scapula had a shallow, irregular circular depression on the glenoid cavity, typical to the depression noted in the cattle scapula. Cranial pathologies comprised one cattle third molar with a missing hypoconulid.

Two sheep/goat radii and one scapula had periostosis and one pig scapula had a pinprick depression similar to lesion type 4 (see Thomas and Johannsen 2011). Osteophytes were also noted on the proximal end of a chicken radius and tibia. One broken chicken femur had an infilling of thick bone in the diaphysis; however the surface of the bone was unaltered. This could be avian osteopetrosis, caused by the avian leucosis virus group, which results in the development of dense bone in the marrow cavity (Brothwell 2002). It only occurs when there is a high level of the virus which allows it to spread from hen to egg, or bird to bird. A goose tarsometatarsus had a small circular, spongy growth of bones on the shaft, located on the lateral side.

2 Appendix Two – Intra-site analysis supplementary data

Cattle	Fused	Unfused
Humerus (distal)	4	1
Scapula	3	0
Radius (proximal)	4	1
Pelvis	4	0
First phalanx	7	1
Second phalanx	5	1
Tibia (distal)	1	0
Calcaneum	1	1
Metapodial (distal)	1	3
Humerus (proximal)	2	1
Radius (distal)	2	0
Ulna (proximal)	0	0
Femur (proximal)	1	0
Femur (distal)	2	0
Tibia (proximal)	1	1
Vertebral centrum (p)	3	4
Total	41	14

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	27	4	87.09677	12.90323
Middle fusing	3	4	42.85714	57.14286
Late fusing	8	2	80	20
Later fusing	3	4	42.85714	57.14286

Table 2.1: Raw epiphyseal fusion data for cattle from Chester's Roman Amphitheatre Area B (Phase XIV)

Sheep/goat	Fused	Unfused
Humerus (distal)	10	0
Scapula	1	1
Radius (proximal)	6	0
Pelvis	7	1
First phalanx	3	0
Second phalanx	1	0
Tibia (distal)	6	1
Calcaneum	3	0
Metapodial (distal)	3	2
Humerus (proximal)	1	1
Radius (distal)	2	1
Ulna (proximal)	0	0
Femur (proximal)	2	0
Femur (distal)	0	0
Tibia (proximal)	1	3
Vertebral centrum (p)	4	7
Total	50	17

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	28	2	93.33333	6.666667
Middle fusing	12	3	80	20
Late fusing	6	5	54.54545	45.45455
Later fusing	4	7	36.36364	63.63636

Table 2.2: Raw epiphyseal fusion data for sheep/goat from Chester's Roman Amphitheatre Area B (Phase XIV)

Pig	Fused	Unfused
Humerus (distal)	1	0
Scapula	0	1
Radius (proximal)	1	1
Pelvis	1	0
First phalanx	1	0
Second phalanx	0	0
Tibia (distal)	0	0
Calcaneum	0	0
Metapodial (distal)	1	2
Humerus (proximal)	0	1
Radius (distal)	0	1
Ulna (proximal)	0	0
Femur (proximal)	0	1
Femur (distal)	0	0
Tibia (proximal)	0	0
Vertebral centrum (p)	0	2
Total	5	9

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	4	2	66.66667	33.33333
Middle fusing	1	2	33.33333	66.66667
Late fusing	0	3	0	100
Later fusing	0	2	0	100

Table 2.3: Raw epiphyseal fusion data for pig from Chester's Roman Amphitheatre Area B (Phase XIV)

Specimen	P4	dP4	M1	M2	M3	Suggested Age
Cattle		c				1-8 mth
Cattle		c	V			1-8 mth
Cattle		c				1-8 mth
Sheep/goat			9A	7A		1-2 yrs
Sheep/goat		17L				2-6 mth
Pig	b		g	e	b	21-27 mth
Pig	b		f		a	14-21 mth
Pig	c		j			7-14 mth

Table 2.4: Mandibular wear stage data for domestic mammals from Chester's Roman Amphitheatre Area B (Phase XIV). Produced following the tooth wear criteria in Grant (1982) and Payne (1973). Wear stages were converted using (Hambleton 1999)

Cattle	Fused	Unfused
Humerus (distal)	7	1
Scapula	6	4
Radius (proximal)	8	0
Pelvis	2	3
First phalanx	29	3
Second phalanx	22	0
Tibia (distal)	3	4
Calcaneum	1	4
Metapodial (distal)	14	7
Humerus (proximal)	2	3
Radius (distal)	3	3
Ulna (proximal)	4	1
Femur (proximal)	0	1
Femur (distal)	2	3
Tibia (proximal)	5	2
Vertebral centrum (d)	19	16
Total	127	55

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	74	11	87.05882	12.94118
Middle fusing	18	15	54.54545	45.45455
Late fusing	16	13	55.17241	44.82759
Later fusing	19	16	54.28571	45.71429

Table 2.5: Raw epiphyseal fusion data for cattle from Chester's Roman Amphitheatre Area B (Phase XV)

Sheep/goat	Fused	Unfused
Humerus (distal)	20	0
Scapula	10	0
Radius (proximal)	14	0
Pelvis	6	1
First phalanx	17	3
Second phalanx	6	0
Tibia (distal)	18	1
Calcaneum	5	2
Metapodial (distal)	11	2
Humerus (proximal)	1	0
Radius (distal)	10	3
Ulna (proximal)	0	0
Femur (proximal)	0	3
Femur (distal)	2	0
Tibia (proximal)	2	4
Vertebral centrum (d)	3	15
Total	125	34

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	73	4	94.80519	5.194805
Middle fusing	34	5	87.17949	12.82051
Late fusing	15	10	60	40
Later fusing	3	15	16.66667	83.33333

Table 2.6: Raw epiphyseal fusion data for sheep/goat from Chester's Roman Amphitheatre Area B (Phase XV)

Pig	Fused	Unfused
Humerus (distal)	2	1
Scapula	3	0
Radius (proximal)	0	0
Pelvis	2	3
First phalanx	1	1
Second phalanx	2	0
Tibia (distal)	1	4
Calcaneum	0	4
Metapodial (distal)	2	10
Humerus (proximal)	1	1
Radius (distal)	0	0
Ulna (proximal)	0	4
Femur (proximal)	0	0
Femur (distal)	0	1
Tibia (proximal)	0	2
Vertebral centrum (d)	0	14
Total	14	45

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	10	5	66.66667	33.33333
Middle fusing	3	18	14.28571	85.71429
Late fusing	1	8	11.11111	88.88889
Later fusing	0	14	0	100

Table 2.7: Raw epiphyseal fusion data for pig from Chester's Roman Amphitheatre Area B (Phase XV)

Specimen	P4	dP4	M1	M2	M3	Suggested Age
Cattle		c	V			1-8 mths
Cattle	h		m	l		18-30 mths
Sheep/goat	12S		12A	9A	11G	4-6 yrs
Sheep/goat			9A	9A	9G	3-4 yrs
Pig			m	j		14-21 mth
Pig	b		j	e	a	14-21 mth
Pig					a	14-21 mth

Table 2.8: Mandibular wear stage data for domestic mammals from Chester's Roman Amphitheatre Area B (Phase XV). Produced following the tooth wear criteria in Grant (1982) and Payne (1973). Wear stages were converted using (Hambleton 1999)

Cattle	Fused	Unfused
Humerus (distal)	6	2
Scapula	2	1
Radius (proximal)	8	0
Pelvis	4	1
First phalanx	23	2
Second phalanx	16	0
Tibia (distal)	2	0
Calcaneum	2	1
Metapodial (distal)	16	5
Humerus (proximal)	0	0
Radius (distal)	2	1
Ulna (proximal)	1	1
Femur (proximal)	2	1
Femur (distal)	6	1
Tibia (proximal)	0	0
Vertebral centrum (p)	8	8
Total	98	24

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	59	6	90.76923	9.230769
Middle fusing	20	6	76.92308	23.07692
Late fusing	11	4	73.33333	26.66667
Later fusing	8	8	50	50

Table 2.9: Raw epiphyseal fusion data for cattle from Chester's Roman Amphitheatre Area B (Phase XVI)

Sheep/goat	Fused	Unfused
Humerus (distal)	15	0
Scapula	3	1
Radius (proximal)	12	0
Pelvis	7	0
First phalanx	5	2
Second phalanx	1	0
Tibia (distal)	14	4
Calcaneum	6	0
Metapodial (distal)	5	2
Humerus (proximal)	1	0
Radius (distal)	4	3
Ulna (proximal)	5	1
Femur (proximal)	3	1
Femur (distal)	7	0
Tibia (proximal)	3	3
Vertebral centrum (p)	11	6
Total	102	23

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	43	3	93.47826	6.521739
Middle fusing	25	6	80.64516	19.35484
Late fusing	23	8	74.19355	25.80645
Later fusing	11	6	64.70588	35.29412

Table 2.10: Raw epiphyseal fusion data for sheep/goat from Chester's Roman Amphitheatre Area B (Phase XVI)

Pig	Fused	Unfused
Humerus (distal)	3	1
Scapula	1	1
Radius (proximal)	2	2
Pelvis	1	1
First phalanx	1	0
Second phalanx	3	0
Tibia (distal)	0	2
Calcaneum	0	3
Metapodial (distal)	2	9
Humerus (proximal)	0	1
Radius (distal)	0	0
Ulna (proximal)	0	1
Femur (proximal)	0	0
Femur (distal)	0	0
Tibia (proximal)	0	0
Vertebral centrum (p)	0	3
Total	13	24

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	11	5	68.75	31.25
Middle fusing	2	14	12.5	87.5
Late fusing	0	2	0	100
Later fusing	0	3	0	100

Table 2.11: Raw epiphyseal fusion data for pig from Chester's Roman Amphitheatre Area B (Phase XVI)

Specimen	dP4	M1	M2	M3	Suggested Age
1	j				1-8 mths
2		m	l		18-30 mths
3			k	h	Old adult
4				g	Adult
5	c				1-8 mths
6	c				1-8 mths
7	c				1-8 mths
8				g	Adult
9				b	30-36 mths
10	c				1-8 mths

Table 2.12: Mandibular wear stage data for cattle from Chester's Roman Amphitheatre Area B (Phase XVI). Produced following the tooth wear criteria in Grant (1982). Wear stages were converted using (Hambleton 1999).

Specimen	P4	dP4	M1	M2	M3	Suggested Age
1			11B	9A	11G	4-6 yrs
2					11G	4-6 yrs
3	9A		9A		11G	4-6 yrs
4		13L				2-6 mths
5					4B	2-3 yrs
6					11G	4-6 yrs
7			9A	8B	6A	2-3 yrs
8					11G	4-6 yrs
9		11L	4C			6-12 mths

Table 2.13: Mandibular wear stage data for sheep/goat from Chester's Roman Amphitheatre Area B (Phase XVI). Produced following the tooth wear criteria in Payne (1973). Wear stages were converted using (Hambleton 1999).

Specimen	P4	dP4	M1	M2	M3	Suggested Age
1	Present		Present	Present	E	14-21 mths
2					a	14-21 mths

Table 2.14: Mandibular wear stage data for pig from Chester's Roman Amphitheatre Area B (Phase XVI). Produced following the tooth wear criteria in Grant (1982). Wear stages were converted using (Hambleton 1999)

Cattle	Fused	Unfused
Humerus (distal)	1	1
Scapula	0	0
Radius (proximal)	3	0
Pelvis	1	0
First phalanx	8	0
Second phalanx	7	0
Tibia (distal)	0	1
Calcaneum	0	0
Metapodial (distal)	0	0
Humerus (proximal)	0	1
Radius (distal)	1	0
Ulna (proximal)	1	0
Femur (proximal)	0	1
Femur (distal)	0	0
Tibia (proximal)	0	0
Vertebral centrum (p)	1	2
Total	23	6

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	20	1	95.2381	4.761905
Middle fusing	0	1	0	100
Late fusing	2	2	50	50
Later fusing	1	2	33.33333	66.66667

Table 2.15: Raw epiphyseal fusion data for cattle from Chester's Roman Amphitheatre Area B (Phase XVII)

Sheep/goat	Fused	Unfused
Humerus (distal)	7	1
Scapula	1	0
Radius (proximal)	1	0
Pelvis	0	0
First phalanx	2	0
Second phalanx	1	0
Tibia (distal)	5	1
Calcaneum	0	1
Metapodial (distal)	1	0
Humerus (proximal)	0	0
Radius (distal)	1	1
Ulna (proximal)	0	0
Femur (proximal)	0	0
Femur (distal)	0	0
Tibia (proximal)	0	0
Vertebral centrum (p)	3	2
Total	22	6

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	12	1	92.30769	7.692308
Middle fusing	6	2	75	25
Late fusing	1	1	50	50
Later fusing	3	2	60	40

Table 2.16: Raw epiphyseal fusion data for sheep/goat from Chester's Roman Amphitheatre Area B (Phase XVII)

Specimen	dP4	M1	M2	M3	Suggested Age
Cattle				j	Old adult
Cattle	b				1-8 mths
Cattle	b				1-8 mths
Sheep/goat	13L	V			2-6 mths
Pig		j	e	V	14-21 mths

Table 2.17: Mandibular wear stage data for domestic mammals from Chester's Roman Amphitheatre Area B (Phase XVII). Produced following the tooth wear criteria in Grant (1982) and Payne (1973). Wear stages were converted using (Hambleton 1999)

Cattle	Fused	Unfused
Humerus (distal)	0	0
Scapula	0	0
Radius (proximal)	1	0
Pelvis	0	1
First phalanx	1	0
Second phalanx	1	1
Tibia (distal)	0	0
Calcaneum	1	0
Metapodial (distal)	1	0
Humerus (proximal)	0	0
Radius (distal)	1	0
Ulna (proximal)	0	0
Femur (proximal)	1	2
Femur (distal)	0	2
Tibia (proximal)	0	0
Vertebral centrum (d)	2	1
Total	9	7

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	3	2	60	40
Middle fusing	2	0	100	0
Late fusing	2	4	33.33333	66.66667
Later fusing	2	1	66.66667	33.33333

Table 2.18: Raw epiphyseal fusion data for cattle from Chester's Roman Amphitheatre Area B (Phase XVIII)

Specimen	dP4	M1	M2	M3	Suggested Age
Cattle		k	k		18-30 mths
Cattle	c	E			1-8 mths
Cattle	> n				1-8 mths
Cattle				k	Senile
Cattle				a	18-30 mths
Sheep/goat				11G	4-6 yrs
Sheep/goat				11G	4-6 yrs
Pig				a	14-21 mths

Table 2.19: Mandibular wear stage data for domestic mammals from Chester's Roman Amphitheatre Area B (Phase XVIII). Produced following the tooth wear criteria in Grant (1982) and Payne (1973). Wear stages were converted using (Hambleton 1999)

Cattle	Fused	Unfused
Humerus (distal)	4	3
Scapula	1	2
Radius (proximal)	7	0
Pelvis	4	0
First phalanx	20	2
Second phalanx	15	0
Tibia (distal)	0	1
Calcaneum	3	2
Metapodial (distal)	12	1
Humerus (proximal)	0	1
Radius (distal)	2	2
Ulna (proximal)	2	1
Femur (proximal)	1	1
Femur (distal)	3	0
Tibia (proximal)	0	2
Vertebral centrum (p)	6	6
Total	80	24

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	51	7	87.93103	12.06897
Middle fusing	15	4	78.94737	21.05263
Late fusing	8	7	53.33333	46.66667
Later fusing	6	6	50	50

Table 2.20: Raw epiphyseal fusion data for cattle from Chester's Roman Amphitheatre Area B (Phase XIX)

Sheep/goat	Fused	Unfused
Humerus (distal)	14	0
Scapula	3	0
Radius (proximal)	14	0
Pelvis	5	0
First phalanx	5	0
Second phalanx	3	0
Tibia (distal)	21	2
Calcaneum	4	2
Metapodial (distal)	6	1
Humerus (proximal)	1	4
Radius (distal)	5	4
Ulna (proximal)	2	0
Femur (proximal)	2	2
Femur (distal)	2	1
Tibia (proximal)	5	2
Vertebral centrum (p)	3	2
Total	95	20

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	44	0	100	0
Middle fusing	31	5	86.11111	13.88889
Late fusing	17	13	56.66667	43.33333
Later fusing	3	2	60	40

Table 2.21: Raw epiphyseal fusion data for sheep/goat from Chester's Roman Amphitheatre Area B (Phase XIX)

Pig	Fused	Unfused
Humerus (distal)	3	0
Scapula	1	0
Radius (proximal)	3	2
Pelvis	1	0
First phalanx	0	0
Second phalanx	2	0
Tibia (distal)	0	1
Calcaneum	0	0
Metapodial (distal)	0	0
Humerus (proximal)	1	1
Radius (distal)	0	1
Ulna (proximal)	0	0
Femur (proximal)	0	0
Femur (distal)	0	0
Tibia (proximal)	0	1
Vertebral centrum (p)	0	8
Total	11	14

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	10	2	83.33333	16.66667
Middle fusing	0	1	0	100
Late fusing	1	3	25	75
Later fusing	0	8	0	100

Table 2.22: Raw epiphyseal fusion data for pig from Chester's Roman Amphitheatre Area B (Phase XIX)

Specimen	dP4	M1	M2	M3	Suggested Age
1				b	30-36 mths
2	c				1-8 mths
3				j	Old adult
4				j	Old adult
5	b				1-8 mths
6				a	18-30 mths
7	c				1-8 mths

Table 2.23: Mandibular wear stage data for cattle from Chester's Roman Amphitheatre Area B (Phase XIX). Produced following the tooth wear criteria in Grant (1982). Wear stages were converted using (Hambleton 1999).

Specimen	P4	dP4	M1	M2	M3	Suggested Age
1				9A	11G	4-6 yrs
2	9A		9A	9A		1-2 yrs
3					11G	4-6 yrs

Table 2.24: Mandibular wear stage data for sheep/goat from Chester's Roman Amphitheatre Area B (Phase XIX). Produced following the tooth wear criteria in Payne (1973). Wear stages were converted using (Hambleton 1999)

Cattle	Fused	Unfused
Humerus (distal)	11	0
Scapula	5	3
Radius (proximal)	5	0
Pelvis	3	4
First phalanx	18	3
Second phalanx	15	1
Tibia (distal)	7	1
Calcaneum	10	1
Metapodial (distal)	8	1
Humerus (proximal)	3	2
Radius (distal)	2	0
Ulna (proximal)	1	1
Femur (proximal)	4	1
Femur (distal)	6	2
Tibia (proximal)	10	0
Vertebral centrum (p)	26	8
Total	134	28

	Total Fused	Total unfused	%	CUMULATIVE
Early fusing	57	11	83.82353	16.17647059
Middle fusing	25	3	89.28571	10.71428571
Late fusing	26	6	81.25	18.75
Later fusing	26	8	76.47059	23.52941176

Table 2.25: Raw epiphyseal fusion data for cattle from Chester's Roman Amphitheatre Area C (Phase XIV)

Specimen	P4	dP4	M1	M2	M3	Suggested Age
1	h		g	g	Broken	18-30 mth
2		c				1-8 mth
3		c				1-8 mth
4			c	C		8-18 mth
5		c				1-8 mth
6	g		m	k	k	Senile
7		h	E			1-8 mth
8		c	C			1-8 mth
9		d	C			1-8 mth
10		c	E			1-8 mth
11		b	C			1-8 mth
12		b	C			1-8 mth

Table 2.26: Mandibular wear stage data for cattle from Chester's Roman Amphitheatre Area C (Phase XIV). Produced following the tooth wear criteria in Grant (1982). Wear stages were converted using (Hambleton 1999).

Sheep/goat	Fused	Unfused
Humerus (distal)	25	1
Scapula	10	0
Radius (proximal)	29	1
Pelvis	4	0
First phalanx	10	0
Second phalanx	1	0
Tibia (distal)	15	2
Calcaneum	6	1
Metapodial (distal)	11	2
Humerus (proximal)	1	2
Radius (distal)	5	7
Ulna (proximal)	3	2
Femur (proximal)	1	2
Femur (distal)	1	3
Tibia (proximal)	4	2
Vertebral centrum (p)	16	17
Total	142	42

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	79	2	97.53086	2.469136
Middle fusing	32	5	86.48649	13.51351
Late fusing	15	18	45.45455	54.54545
Later fusing	16	17	48.48485	51.51515

Table 2.27: Raw epiphyseal fusion data for sheep/goat from Chester's Roman Amphitheatre Area C (Phase XIV)

Specimen	**P4**	**M1**	**M2**	**M3**	**Suggested Age**
Sheep	5S	9A	9A	6A	2-3 yrs
Sheep/goat	5A	9A	8B	5A	2-3 yrs

Table 2.28: Mandibular wear stage data for sheep/goat from Chester's Roman Amphitheatre Area C (Phase XIV). Produced following the tooth wear criteria in Payne (1973). Wear stages were converted using (Hambleton 1999).

Pig	**Fused**	**Unfused**
Humerus (distal)	8	8
Scapula	1	2
Radius (proximal)	3	4
Pelvis	2	14
First phalanx	1	41
Second phalanx	5	22
Tibia (distal)	2	4
Calcaneum	0	2
Metapodial (distal)	1	7
Humerus (proximal)	0	5
Radius (distal)	1	3
Ulna (proximal)	0	5
Femur (proximal)	0	6
Femur (distal)	0	4
Tibia (proximal)	0	5
Vertebral centrum (p)	0	45
Total	24	177

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	20	91	18.01802	81.98198
Middle fusing	3	13	18.75	81.25
Late fusing	1	28	3.448276	96.55172
Later fusing	0	45	0	100

Table 2.29: Raw epiphyseal fusion data for pig from Chester's Roman Amphitheatre Area C (Phase XIV)

Specimen	**P4**	**dP4**	**M1**	**M2**	**M3**	**Suggested Age**
1	d		h	e	V	14-21 mth
2		g	b	V		7-14 mth
3		a				0-2 mth
4		a				0-2 mth
5		a				0-2 mth
6	b		j		V	14-21 mth
7		a				0-2 mth

Table 2.30: Mandibular wear stage data for pig from Chester's Roman Amphitheatre Area C (Phase XIV). Produced following the tooth wear criteria in Grant (1982). Wear stages were converted using (Hambleton 1999)

Cattle	**Fused**	**Unfused**
Humerus (distal)	2	0
Scapula	3	1
Radius (proximal)	2	0
Pelvis	2	0
First phalanx	11	0
Second phalanx	8	0
Tibia (distal)	6	0
Calcaneum	2	1
Metapodial (distal)	8	0
Humerus (proximal)	0	1
Radius (distal)	2	0
Ulna (proximal)	1	1
Femur (proximal)	1	1
Femur (distal)	0	1
Tibia (proximal)	1	0
Vertebral centrum (d)	2	8
Total	51	14

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	28	1	96.55172	3.448276
Middle fusing	16	1	94.11765	5.882353
Late fusing	5	4	55.55556	44.44444
Later fusing	2	8	20	80

Table 2.31: Raw epiphyseal fusion data for cattle from Chester's Roman Amphitheatre Area C (Phase XV)

Sheep/goat	**Fused**	**Unfused**
Humerus (distal)	6	0
Scapula	0	0
Radius (proximal)	5	0
Pelvis	0	0
First phalanx	1	0
Second phalanx	1	0
Tibia (distal)	3	0
Calcaneum	1	1
Metapodial (distal)	3	2
Humerus (proximal)	1	0
Radius (distal)	2	3
Ulna (proximal)	0	0
Femur (proximal)	0	1
Femur (distal)	1	1
Tibia (proximal)	0	2
Vertebral centrum (p)	2	3
Total	26	13

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	13	0	100	0
Middle fusing	7	3	70	30
Late fusing	4	7	36.36364	63.63636
Later fusing	2	3	40	60

Table 2.32: Raw epiphyseal fusion data for sheep/goat from Chester's Roman Amphitheatre Area C (Phase XV)

Taxon	M3	Suggested Age
OVA	11G	4-8 yrs
O	8G	3-4 yrs

Table 2.33: Mandibular wear stage data for loose sheep/goat M3. Produced following the tooth wear criteria in Payne (1973). Wear stages were converted using (Hambleton 1999).

Pig	Fused	Unfused
Humerus (distal)	0	1
Scapula	0	0
Radius (proximal)	2	0
Pelvis	0	0
First phalanx	0	0
Second phalanx	0	0
Tibia (distal)	1	1
Calcaneum	1	1
Metapodial (distal)	0	2
Humerus (proximal)	0	0
Radius (distal)	0	0
Ulna (proximal)	0	1
Femur (proximal)	0	0
Femur (distal)	0	0
Tibia (proximal)	0	0
Vertebral centrum (p)	0	1
Total	4	7

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	2	1	66.66667	33.33333
Middle fusing	2	4	33.33333	66.66667
Late fusing	0	1	0	100
Later fusing	0	1	0	100

Table 2.34: Raw epiphyseal fusion data for pig from Chester's Roman Amphitheatre Area C (Phase XV)

Cattle	Fused	Unfused
Humerus (distal)	1	0
Scapula	1	0
Radius (proximal)	0	0
Pelvis	0	0
First phalanx	4	0
Second phalanx	1	0
Tibia (distal)	0	1
Calcaneum	0	0
Metapodial (distal)	1	1
Humerus (proximal)	0	0
Radius (distal)	0	0
Ulna (proximal)	0	0
Femur (proximal)	1	0
Femur (distal)	0	0
Tibia (proximal)	0	0
Vertebral centrum (p)	1	1
Total	10	3

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	7	0	100	0
Middle fusing	1	2	33.33333	66.66667
Late fusing	1	0	100	0
Later fusing	1	1	50	50

Table 2.35: Raw epiphyseal fusion data for cattle from Chester's Roman Amphitheatre Area C (Phase XVI)

Sheep/goat	Fused	Unfused
Humerus (distal)	7	0
Scapula	2	0
Radius (proximal)	2	0
Pelvis	0	0
First phalanx	1	0
Second phalanx	0	0
Tibia (distal)	1	1
Calcaneum	0	0
Metapodial (distal)	1	0
Humerus (proximal)	2	0
Radius (distal)	0	0
Ulna (proximal)	0	0
Femur (proximal)	0	0
Femur (distal)	0	0
Tibia (proximal)	0	0
Vertebral centrum (d)	0	3
Total	16	4

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	12	0	100	0
Middle fusing	2	1	66.66667	33.33333
Late fusing	2	0	100	0
Later fusing	0	3	0	100

Table 2.36: Raw epiphyseal fusion data for sheep/goat from Chester's Roman Amphitheatre Area C (Phase XVI)

Cattle	Fused	Unfused
Humerus (distal)	8	1
Scapula	1	1
Radius (proximal)	4	1
Pelvis	0	3
First phalanx	11	0
Second phalanx	10	0
Tibia (distal)	4	0
Calcaneum	5	1
Metapodial (distal)	9	0
Humerus (proximal)	0	0
Radius (distal)	1	0
Ulna (proximal)	1	1
Femur (proximal)	3	1
Femur (distal)	2	0
Tibia (proximal)	1	1
Vertebral centrum (p)	8	6
Total	68	16

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	34	6	85	15
Middle fusing	18	1	94.736842	5.263157895
Late fusing	8	3	72.727273	27.27272727
Later fusing	8	6	57.142857	42.85714286

Table 2.37: Raw epiphyseal fusion data for cattle from 12 Hamilton Place all phases

Sheep/goat	Fused	Unfused
Humerus (distal)	7	0
Scapula	1	0
Radius (proximal)	6	0
Pelvis	1	0
First phalanx	5	0
Second phalanx	0	0
Tibia (distal)	9	1
Calcaneum	0	0
Metapodial (distal)	5	1
Humerus (proximal)	0	1
Radius (distal)	4	1
Ulna (proximal)	0	0
Femur (proximal)	0	1
Femur (distal)	0	2
Tibia (proximal)	0	1
Vertebral centrum (d)	2	4
Total	40	12

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	20	0	100	0
Middle fusing	14	2	87.5	12.5
Late fusing	4	6	40	60
Later fusing	2	4	33.333333	66.66666667

Table 2.38: Raw epiphyseal fusion data for sheep/goat from 12 Hamilton Place all phases

Pig	Fused	Unfused
Humerus (distal)	0	1
Scapula	0	0
Radius (proximal)	2	0
Pelvis	0	0
First phalanx	0	0
Second phalanx	1	0
Tibia (distal)	1	0
Calcaneum	0	0
Metapodial (distal)	0	0
Humerus (proximal)	1	0
Radius (distal)	0	0
Ulna (proximal)	0	0
Femur (proximal)	0	1
Femur (distal)	0	1
Tibia (proximal)	0	1
Vertebral centrum (p)	0	1
Total	5	5

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	3	1	75	25
Middle fusing	1	0	100	0
Late fusing	1	3	25	75
Later fusing	0	1	0	100

Table 2.39: Raw epiphyseal fusion data for pig from 12 Hamilton Place all phases

Specimen	P4	dP4	M1	M2	M3	Suggested Age
1					g	Adult
2		c				1-8 mth
3		b				1-8 mth
4		c				1-8 mth
5		c				1-8 mth
6					g	Adult
7					d	30-36 mth
8					g	Adult

Table 2.40: Mandibular wear stage data for cattle from Hamilton Place (all phases). Produced following the tooth wear criteria in Grant (1982). Wear stages were converted using (Hambleton 1999).

Specimen	P4	dP4	M1	M2	M3	Suggested Age
1			9A	9A	11G	4-6 yrs
2					5A	2-3 yrs
3					9G	3-4 yrs
4					11G	4-6 yrs

Table 2.41: Mandibular wear stage data for sheep/goat from Hamilton Place (all phases) Produced following the tooth wear criteria in Payne (1973). Wear stages were converted using (Hambleton 1999).

Cattle	Fused	Unfused
Humerus (distal)	3	0
Scapula	0	1
Radius (proximal)	2	0
Pelvis	2	1
First phalanx	5	0
Second phalanx	2	0
Tibia (distal)	0	1
Calcaneum	1	1
Metapodial (distal)	3	3
Humerus (proximal)	0	0
Radius (distal)	0	1
Ulna (proximal)	0	0
Femur (proximal)	2	0
Femur (distal)	0	0
Tibia (proximal)	0	0
Vertebral centrum (d)	5	5
Total	25	13

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	14	2	87.5	12.5
Middle fusing	4	5	44.44444444	55.55556
Late fusing	2	1	66.66666667	33.33333
Later fusing	5	5	50	50

Table 2.42: Raw epiphyseal fusion data for cattle from Nicholas Street Mews from phase I and II

Humerus (distal)	3	0
Scapula	6	0
Radius (proximal)	4	0
Pelvis	3	0
First phalanx	4	0
Second phalanx	3	0
Tibia (distal)	1	0
Calcaneum	0	0
Metapodial (distal)	2	1
Humerus (proximal)	0	2
Radius (distal)	2	2
Ulna (proximal)	3	1
Femur (proximal)	0	0
Femur (distal)	1	1
Tibia (proximal)	0	0
Vertebral centrum (p)	2	5
Total	34	12

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	23	0	100	0
Middle fusing	3	1	75	25
Late fusing	4	6	40	60
Later fusing	2	5	28.57142857	71.42857

Table 2.43: Raw epiphyseal fusion data for sheep/goat from Nicholas Street Mews from phase I and II

Cattle	Fused	Unfused
Humerus (distal)	4	0
Scapula	0	0
Radius (proximal)	1	0
Pelvis	0	2
First phalanx	11	0
Second phalanx	10	0
Tibia (distal)	1	1
Calcaneum	1	1
Metapodial (distal)	5	3
Humerus (proximal)	2	0
Radius (distal)	1	0
Ulna (proximal)	0	0
Femur (proximal)	1	1
Femur (distal)	1	0
Tibia (proximal)	1	0
Vertebral centrum (d)	8	4
Total	47	12

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	26	2	92.85714	7.142857143
Middle fusing	7	5	58.33333	41.66666667
Late fusing	5	1	83.33333	16.66666667
Later fusing	8	4	66.66667	33.33333333

Table 2.44: Raw epiphyseal fusion data for cattle from Nicholas Street Mews from phase III and IV

Sheep/goat	Fused	Unfused
Humerus (distal)	10	0
Scapula	2	0
Radius (proximal)	13	0
Pelvis	5	0
First phalanx	3	0
Second phalanx	2	0
Tibia (distal)	1	0
Calcaneum	0	0
Metapodial (distal)	3	1
Humerus (proximal)	0	2
Radius (distal)	4	2
Ulna (proximal)	1	2
Femur (proximal)	4	2
Femur (distal)	4	1
Tibia (proximal)	0	0
Vertebral centrum (d)	2	8
Total	54	18

	Total fused	Total unfused	%	CUMULATIVE
Early fusing	35	0	100	0
Middle fusing	4	1	80	20
Late fusing	9	9	50	50
Later fusing	2	8	20	80

Table 2.45: Raw epiphyseal fusion data for sheep/goat from Nicholas Street Mews from phase III and IV

Phase	Specimen	dP4	M2	M3	Suggested age
I	Cattle	k			Senile
III	Cattle			b	30-36mth
III	Cattle			g	adult
III	Cattle			l	Senile
IV	Cattle	b			1-8mth
IV	Cattle			b	30-36mth
III	Sheep	4B			2-6mth
IV	Sheep/goat			9G	3-4 years
IV	Sheep/goat			4B	2-3 years
IV	Pig		c	E	14-21mth

Table 2.46: Mandibular wear stage data for domestic mammals from Nicholas Street Mews (all phases). Produced following the tooth wear criteria in Grant (1982) and Payne (1973). Wear stages were converted using (Hambleton 1999)

3 Appendix Three – Inter-site analysis supplementary data

Table 3.1: Species representation of hand-collected NISP from Chester sites grouped by chronological phase

Sites	Cattle	Sheep/goat	Sheep	Goat	Pig	Horse	Equid	Dog
14th - 16th C								
3-15 Eastgate street (late 15th/mid-17th-century)	56	176			37			4
25 Bridge Street (late 15th - mid-17th C)	647	286	76	4	145			8
Nicholas Street Mews (14th - 16th C)	79	42	1		32		1	1
Total NISP	**135**	**218**	**1**	**0**	**69**	**0**	**1**	**5**
16th - 17th C								
3-15 Eastgate street (late 17th/mid-18th-century)	51	27			50			
Chester's Roman Amphitheatre (mid-late 16th - mid-17th C)	1465	846	74	1	324	5	19	102
Nicholas Street Mews (16th - 17th C)	88	63	2		23		1	3
Total NISP	**1604**	**936**	**76**	**1**	**397**	**5**	**20**	**105**
17th - 18th C								
25 Bridge Street (mid-late 17th - early 18th C)	1426	381	83	3	253		6	76
Chester's Roman Amphitheatre (late 17th - early 18th C)	562	362	18	4	104	3	7	13
Hamilton Place (late 17th/early 18th C)	83	58	3		7			1
Nicholas Street Mews (17th - 18th C)	135	92	11		32	101		1
Total NISP	**2206**	**893**	**115**	**7**	**396**	**104**	**13**	**91**

Sites	Cattle	Sheep/goat	Sheep	Goat	Pig	Horse	Equid	Dog
18th - 19th C								
25 Bridge Street (early 18th - early 19th C)	761	300	85	5	159		6	34
Chester's Roman Amphitheatre (mid-late 18th C)	234	150	4		44		2	6
Hamilton Place (late 18th/early 19th-century)	96	50	2		8			8
Nicholas Street Mews (18th/19th C)	108	70	7	1	45		1	4
Canal side/Witter Place (18th - 19th C)	109	8			8	20		6
Total NISP	**1308**	**578**	**98**	**6**	**264**	**20**	**9**	**58**
19th - 20th C								
25 Bridge Street (early 19th century)	466	300	68	3	135		1	266
Chester's Roman Amphitheatre (19th C)	439	277	27	1	79		5	66
Hamilton Place (mid-19th/mid-20th C)	209	56	2		32	150	2	11
Total NISP	1114	633	97	4	246	150	8	343
17th - 19th C								
City Road (17th - 19th C)	2134	27			5	1091	1	
Commonhall (17th - 19th)	63	15	7	1	17			
Total NISP	**2197**	**42**	**7**	**1**	**22**	**1091**	**1**	**0**
TOTAL NISP for Chester Sites	**8564**	**3300**	**394**	**19**	**1394**	**1370**	**52**	**602**

Sites									
	Fox	Dog/fox	Cat	Red deer	Fallow deer	Roe deer	Deer	Rabbit	Hare
14th - 16th C									
3-15 Eastgate street (late 15th/mid-17th-century)			3				2	8	
25 Bridge Street (late 15th - mid-17th C)	244	50	1	12	11	21	21	225	79
Nicholas Street Mews (14th - 16th C)		1						1	1
Total NISP	**0**	**1**	**3**	**0**	**0**	**0**	**2**	**9**	**1**
16th - 17th C									
3-15 Eastgate street (late 17th/mid-18th-century)							1	1	
Chester's Roman Amphitheatre (mid-late 16th - mid-17th C)			12	3	56			22	3
Nicholas Street Mews (16th - 17th C)					3			3	
Total NISP	**0**	**0**	**12**	**3**	**59**	**0**	**1**	**26**	**3**
17th - 18th C									
25 Bridge Street (mid-late 17th - early 18th C)	1		370	3	11		13	55	12
Chester's Roman Amphitheatre (late 17th - early 18th C)			13		8	3		5	3
Hamilton Place (late 17th/early 18th C)			2						1
Nicholas Street Mews (17th - 18th C)					6				
Total NISP	**1**	**0**	**385**	**3**	**25**	**3**	**13**	**60**	**16**

Sites									
	Fox	Dog/fox	Cat	Red deer	Fallow deer	Roe deer	Deer	Rabbit	Hare
18th - 19th C									
25 Bridge Street (early 18th - early 19th C)	3		83		9	3	6	35	10
Chester's Roman Amphitheatre (mid-late 18th C)			4		2			2	1
Hamilton Place (late 18th/early 19th-century)			2						
Nicholas Street Mews (18th/19th C)			4	1	1			3	
Canal side/Witter Place (18th - 19th C)									
Total NISP	**3**	**0**	**93**	**1**	**12**	**3**	**6**	**40**	**11**
19th - 20th C									
25 Bridge Street (early 19th century)			77	2	5	1	5	45	10
Chester's Roman Amphitheatre (19th C)			277		1			6	5
Hamilton Place (mid-19th/mid-20th C)			5					14	9
Total NISP	0	0	359	2	6	1	5	65	24
17th - 19th C									
City Road (17th - 19th C)	25			1				3	2
Commonhall (17th - 19th)	3	2	1			9	1	22	5
Total NISP	**28**	**2**	**1**	**1**	**0**	**9**	**1**	**25**	**7**
TOTAL NISP for Chester Sites	**32**	**3**	**853**	**10**	**102**	**16**	**28**	**225**	**62**

Sites	Chicken	Goose	Duck	Other wild mammals	Wild bird	Fish
14th - 16th C						
3-15 Eastgate street (late 15th/mid-17th-century)	14	10			1	
25 Bridge Street (late 15th - mid-17th C)	12	1	45			
Nicholas Street Mews (14th - 16th C)	27	9	2		12	8
Total NISP	**41**	**19**	**2**	**0**	**13**	**8**
16th - 17th C						
3-15 Eastgate street (late 17th/mid-18th-century)	1	1			1	
Chester's Roman Amphitheatre (mid-late 16th - mid-17th C)	127	34	12		41	1
Nicholas Street Mews (16th - 17th C)	38	4	10		18	7
Total NISP	**166**	**39**	**22**	**0**	**60**	**8**
17th - 18th C						
25 Bridge Street (mid-late 17th - early 18th C)	236	133	12	5	38	
Chester's Roman Amphitheatre (late 17th - early 18th C)	24	18	1		11	
Hamilton Place (late 17th/early 18th C)	1	2			1	
Nicholas Street Mews (17th - 18th C)	15	2	4		2	
Total NISP	**276**	**155**	**17**	**5**	**52**	**0**

Sites	Chicken	Goose	Duck	Other wild mammals	Wild bird	Fish
18th - 19th C						
25 Bridge Street (early 18th - early 19th C)	75	46	6	5	10	
Chester's Roman Amphitheatre (mid-late 18th C)	9	7	1		2	
Hamilton Place (late 18th/early 19th-century)					1	
Nicholas Street Mews (18th/19th C)	22	5	1		4	
Canal side/Witter Place (18th - 19th C)	6	1				
Total NISP	**112**	**59**	**8**	**5**	**17**	**0**
19th - 20th C						
25 Bridge Street (early 19th century)	77	50	4		24	
Chester's Roman Amphitheatre (19th C)	17	12			6	
Hamilton Place (mid-19th/mid-20th C)	10	2	1		5	
Total NISP	104	64	5	0	35	0
17th - 19th C						
City Road (17th - 19th C)			2			
Commonhall (17th - 19th)	2					
Total NISP	**2**	**0**	**2**	**0**	**0**	**0**
TOTAL NISP for Chester Sites	**701**	**336**	**56**	**10**	**177**	**16**

Table 3.2: Species representation of sieved NISP from Chester sites grouped by chronological phase

Site	Cattle	Sheep/goat	Sheep	Goat	Pig	Horse	Equid	Dog
15th - 17th C								
25 Bridge Street (late 15th - mid-17th C)	18	23			57			4
Total NISP	**18**	**23**	**0**	**0**	**57**	**0**	**0**	**4**
16th - 17th C								
Chester's Roman Amphitheatre (mid-late 16th - mid-17th C)	258	200	21	1	495			2
Total NISP	**258**	**200**	**21**	**1**	**495**	**0**	**0**	**2**
17th - 18th C								
25 Bridge Street (mid-late 17th - early 18th C)	317	11	3		50			3
Chester's Roman Amphitheatre (late 17th - early 18th C)	3	2						1
Total NISP	**320**	**13**	**3**	**0**	**50**	**0**	**0**	**4**

Site	Cattle	Sheep/goat	Sheep	Goat	Pig	Horse	Equid	Dog
18th - 19th C								
25 Bridge Street (early 18th - early 19th C)	41	8	1		17			6
Chester's Roman Amphitheatre (mid-late 18th C)	7	5			4			
Total NISP	**48**	**13**	**1**	**0**	**21**	**0**	**0**	**6**
19th - 20th C								
25 Bridge Street (early 19th century)	3	5	1	1	16			5
Chester's Roman Amphitheatre (19th C)	9	12			7			3
Total NISP	**12**	**17**	**1**	**1**	**23**	**0**	**0**	**8**
17th - 19th								
City Road (17th - 19th C)	**11**	**2**			**1**		**23**	
Total NISP	**11**	**2**	**0**	**0**	**1**	**0**	**23**	**0**
TOTAL NISP for Chester Sites	**667**	**268**	**26**	**2**	**647**	**0**	**23**	**24**

Site									
	Fox	Dog/fox	Cat	Red deer	Fallow deer	Roe deer	Deer	Rabbit	Hare
15th - 17th C									
25 Bridge Street (late 15th - mid-17th C)			111					11	2
Total NISP	**0**	**0**	**111**	**0**	**0**	**0**	**0**	**11**	**2**
16th - 17th C									
Chester's Roman Amphitheatre (mid-late 16th - mid-17th C)			100		5			160	117
Total NISP	**0**	**0**	**100**	**0**	**5**	**0**	**0**	**160**	**117**
17th - 18th C									
25 Bridge Street (mid-late 17th - early 18th C)			105					5	3
Chester's Roman Amphitheatre (late 17th - early 18th C)									
Total NISP	**0**	**0**	**105**	**0**	**0**	**0**	**0**	**5**	**3**

Site									
	Fox	Dog/fox	Cat	Red deer	Fallow deer	Roe deer	Deer	Rabbit	Hare
18th - 19th C									
25 Bridge Street (early 18th - early 19th C)			75					33	2
Chester's Roman Amphitheatre (mid-late 18th C)					1			2	
Total NISP	**0**	**0**	**75**	**0**	**1**	**0**	**0**	**35**	**2**
19th - 20th C									
25 Bridge Street (early 19th century)			116					7	1
Chester's Roman Amphitheatre (19th C)			104					1	1
Total NISP	**0**	**0**	**220**	**0**	**0**	**0**	**0**	**8**	**2**
17th - 19th									
City Road (17th - 19th C)									
Total NISP	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL NISP for Chester Sites	**0**	**0**	**611**	**0**	**6**	**0**	**0**	**219**	**126**

Site	Chicken	Goose	Duck	Other wild mammals	Wild bird	Fish
15th - 17th C						
25 Bridge Street (late 15th - mid-17th C)	130	3			6	
Total NISP	**130**	**3**	**0**	**0**	**6**	**0**
16th - 17th C						
Chester's Roman Amphitheatre (mid-late 16th - mid-17th C)	617	21	6		521	
Total NISP	**617**	**21**	**6**	**0**	**521**	**0**
17th - 18th C						
25 Bridge Street (mid-late 17th - early 18th C)	15	6	1		19	
Chester's Roman Amphitheatre (late 17th - early 18th C)					2	
Total NISP	**15**	**6**	**1**	**0**	**21**	**0**

Site	Chicken	Goose	Duck	Other wild mammals	Wild bird	Fish
18th - 19th C						
25 Bridge Street (early 18th - early 19th C)	6	1	1		6	
Chester's Roman Amphitheatre (mid-late 18th C)					2	
Total NISP	**6**	**1**	**1**	**0**	**8**	**0**
19th - 20th C						
25 Bridge Street (early 19th century)	3				7	
Chester's Roman Amphitheatre (19th C)	1	1			3	
Total NISP	**4**	**1**	**0**	**0**	**10**	**0**
17th - 19th						
City Road (17th - 19th C)						**8**
Total NISP	**0**	**0**	**0**	**0**	**0**	**8**
TOTAL NISP for Chester Sites	**772**	**32**	**8**	**0**	**566**	**8**

4 Appendix Four – Regional site comparisons supplementary data and figures

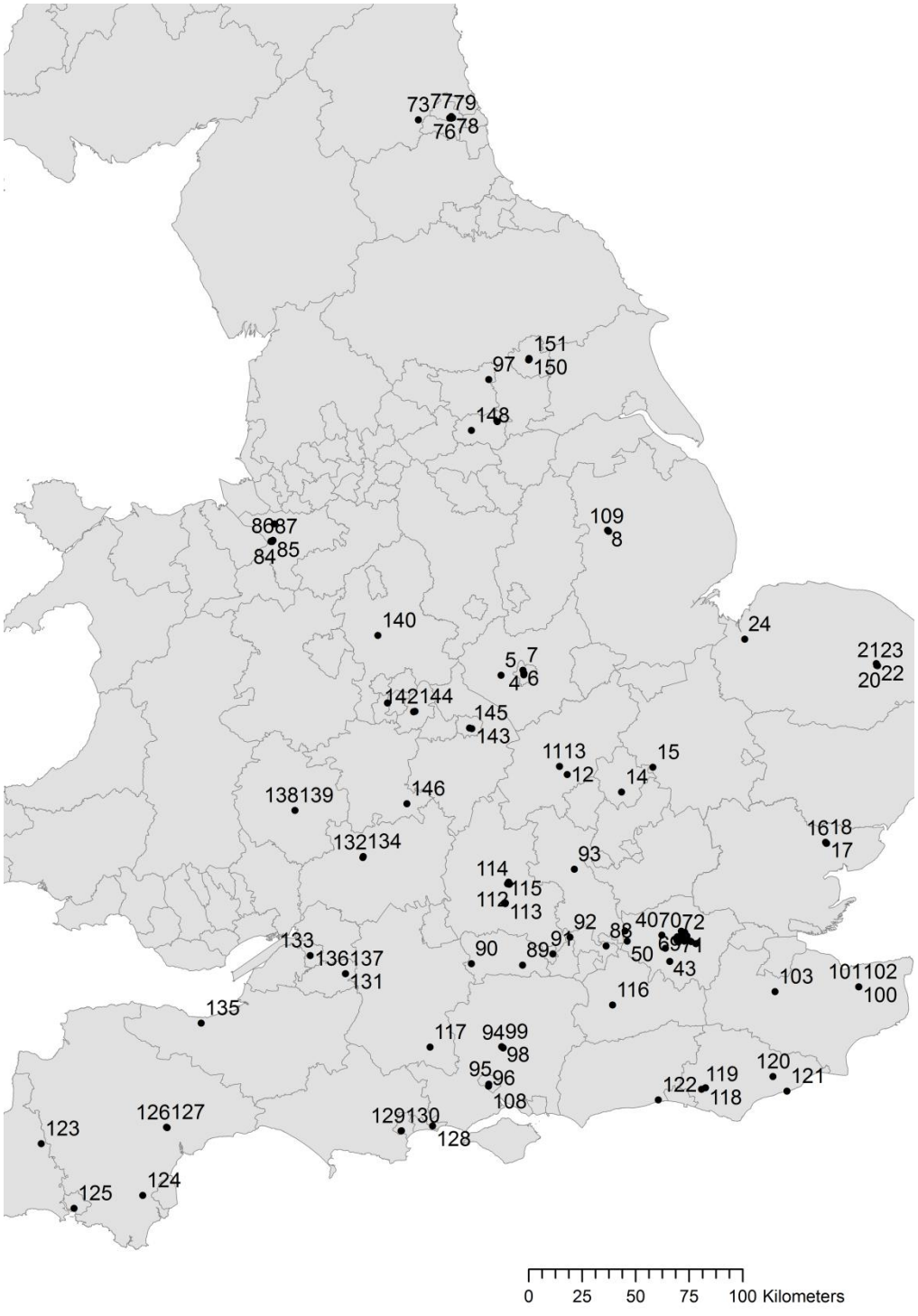

Figure 4.1: Location of post-medieval urban sites. See table 4.1 for site descriptions

Table 4.1: List of post-medieval sites as shown on figure 4.1. * Some sites will be duplicated on the table because excavations for the same site took place in different locations

Site number	Site name*	County	Region
1	Bonners Lane, Leicester	Leicestershire	East Midlands
2	Causeway Lane 80-91, Leicester	Leicestershire	East Midlands
3	DMU, Leicester	Leicestershire	East Midlands
4	Freeschool Lane, Leicester	Leicestershire	East Midlands
5	Little Lane, Leicester	Leicestershire	East Midlands
6	St Nicholas Place, Leicester	Leicestershire	East Midlands
7	St Peters Lane, Leicester	Leicestershire	East Midlands
8	Lincoln	Lincolnshire	East Midlands
9	St Marys Guildhall 82-3, Lincoln	Lincolnshire	East Midlands
10	St Marys Guildhall, Lincoln	Lincolnshire	East Midlands
11	St Peters St, Northampton	Northamptonshire	East Midlands
12	The Green, Northampton	Northamptonshire	East Midlands
13	The Riding, Northampton	Northamptonshire	East Midlands
14	St John's Street, Bedford	Bedfordshire	East of England
15	Huntingdon Street, St. Neots	Cambridgeshire	East of England
16	Lion Walk, Colchester	Essex	East of England
17	Long Wyre Street	Essex	East of England
18	Middleborough	Essex	East of England
19	Alms Ln 76, Norwich	Norfolk	East of England
20	Castle Mall Barbican Well, Norwich	Norfolk	East of England
21	Castle Mall, Norwich	Norfolk	East of England
22	Dragon Hall, King Street, Norwich	Norfolk	East of England
23	Golden Ball Street, Norwich	Norfolk	East of England
24	King's Lynn	Norfolk	East of England
25	Keeley House, London	London (Camden)	London
26	St Giles Court, London	London (Camden)	London

Site number	Site name	County	Region
27	67 Upper Thames Street, London	London (City)	London
29	Aldersgate, London	London (City)	London
30	Broadgate, London	London (City)	London
31	Eagle House (Cannon Street), London	London (City)	London
32	Finsbury Avenue Square, London	London (City)	London
33	Mariner House, London	London (City)	London
34	New Street Square, London	London (City)	London
35	East London Line: Holywell Priory, London	London (Hackney)	London
36	Fulham Pottery	London (Hammersmith and Fulham)	London
37	20-26 Cowcross Street, London	London (Islington)	London
38	20-26 Cowcross Street, London	London (Islington)	London
39	Finsbury Pavement, London	London (Islington)	London
40	Lowndes House, London	London (Islington)	London
41	St Bartholomews Hospital, London	London (Islington)	London
42	St John Clerkenwell, London	London (Islington)	London
43	Merton Priory, London	London (Merton)	London
44	129 Lambeth Road, London	London (Middlesex)	London
45	Aldgate, 1974, London	London (Middlesex)	London
46	Arundel House, London	London (Middlesex)	London
47	Broad Sanctuary, London	London (Middlesex)	London
48	Creedy's Yard, Greenwich	London (Middlesex)	London
49	Gardiner's Corner, London	London (Middlesex)	London
50	Gatehouse Nurseries, West Drayton	London (Middlesex)	London
51	High Street, Uxbridge, London	London (Middlesex)	London
52	Mark Browns Wharf, London	London (Middlesex)	London
53	Rainbow Quay, Rotherhithe	London (Middlesex)	London
54	Upper Thames St, London	London (Middlesex)	London
55	Winchester Palace, Southwark	London (Middlesex)	London

Site number	Site name	County	Region
56	East London Line, London	London (Multi)	London
57	Battle Bridge Lane, Southwark	London (Southwark)	London
58	Bermondsey Abbey, London	London (Southwark)	London
59	Holland Street, London	London (Southwark)	London
60	London Bridge City, London	London (Southwark)	London
61	Southbridge House (Rose Theatre), London	London (Southwark)	London
62	Southbridge House (Rose Theatre), London	London (Southwark)	London
63	St Saviour, Bermondsey	London (Southwark)	London
64	The Globe Theatre, London	London (Southwark)	London
65	The Rose Theatre, London	London (Southwark)	London
66	250 Bishopgate, London	London (Tower Hamlet)	London
67	Royal London Hospital, London	London (Tower Hamlet)	London
68	Spitalfields Market (former), London	London (Tower Hamlet)	London
69	Spitalfields Market (Lamb Street), London	London (Tower Hamlet)	London
70	St Mary Spital, London	London (Tower Hamlet)	London
71	Palace of Westminster, London	London (Westminster)	London
72	Saxon Lundenwic, London	London (Westminster)	London
73	Prudhoe Castle, Prudnoe	Northumberland	North East
74	Black Friars, Newcastle Upon Tyne	Tyne and Wear	North East
75	Castle Bastion, Newcastle-Upon-Tyne	Tyne and Wear	North East
76	Castle Ditch, Newcastle Upon Tyne	Tyne and Wear	North East
77	Closegate I & II, Newcastle Upon Tyne	Tyne and Wear	North East
78	Crown Court, Newcastle Upon Tyne	Tyne and Wear	North East
79	Westgate Road, Newcastle Upon Tyne	Tyne and Wear	North East
80	10 Commonhall Street, Chester	Cheshire	North West
81	25 Bridge Street, Chester	Cheshire	North West
82	3-15 Eastgate street	Cheshire	North West
83	Canalside/Witter Place	Cheshire	North West

Site number	Site name	County	Region
84	Chester's Roman Amphitheatre	Cheshire	North West
85	City Road, Chester	Cheshire	North West
86	Hamilton Place	Cheshire	North West
87	Nicholas Street Mews	Cheshire	North West
88	29 Thames St, Windsor	Berkshire	South East
89	Abbey Wharf, Reading	Berkshire	South East
90	Bridge St East	Berkshire	South East
91	Crane Wharf, Reading	Berkshire	South East
92	Reading Abbey Stables	Berkshire	South East
93	County Museum, Aylesbury	Buckinghamshire	South East
94	Chester Road, Winchester	Hampshire	South East
95	Quilter's Vault, Southampton	Hampshire	South East
96	SOU 29, Southampton	Hampshire	South East
97	Southampton Excavations 1966-9	Hampshire	South East
98	St John's Street, Winchester	Hampshire	South East
99	Victoria Road, Winchester	Hampshire	South East
100	Canterbury Defences	Kent	South East
101	Linacre Garden, Canterbury	Kent	South East
102	St Gregory's Priory, Canterbury	Kent	South East
103	St Peters Street, Maidstone	Kent	South East
104	67-69 St Thomas' St, Oxford	Oxfordshire	South East
105	Ashmolean Museum Forecourt, Oxford	Oxfordshire	South East
106	Classics Centre, Oxford	Oxfordshire	South East
107	Elizabeth House, Oxford	Oxfordshire	South East
108	Hinxey Hall, Oxford	Oxfordshire	South East
109	Lincoln College, Oxford	Oxfordshire	South East

Site number	Site name	County	Region
110	Merton College, Oxford	Oxfordshire	South East
111	Old Clothing Factory, Abingdon	Oxfordshire	South East
112	St Frideswide's Cloister, Oxford	Oxfordshire	South East
113	Stert St, Oxford	Oxfordshire	South East
114	West Gate, Oxford Castle	Oxfordshire	South East
115	West St Helen St, Abingdon	Oxfordshire	South East
116	16 Tunsgate, Guildford	Surrey	South East
117	High St, Guildford	Surrey	South East
118	Cliffe, Lewes	Sussex	South East
119	Lewes Castle	Sussex	South East
120	Mount St, Battle	Sussex	South East
121	Phoenix Brewery, Hastings	Sussex	South East
122	Ropetackle, Shoreham by Sea	Sussex	South East
123	Launceston Castle	Cornwall	South West
124	39 Fore St, Totnes	Devon	South West
125	Dung Quay, Plymouth	Devon	South West
126	Exeter	Devon	South West
127	Tudor St, Exeter	Devon	South West
128	Christchurch 1969-80	Dorset	South West
129	Poole	Dorset	South West
130	The Foundry, Poole	Dorset	South West
131	Citizen House, Bath	Gloucestershire	South West
132	East Gate, Gloucester	Gloucestershire	South West
133	Narrow Quay, Bristol	Gloucestershire	South West
134	Tanner's Hall, Gloucester	Gloucestershire	South West
135	5-8 Fore St, Taunton	Somerset	South West

Site number	Site name	County	Region
136	Bath 1984-1989	Somerset	South West
137	Southgate Redevelopment, Bath	Somerset	South West
138	16 - 18 Harrison Street, Hereford	Herefordshire	West Midlands
139	St Peters School, Gaol Street, Hereford	Herefordshire	West Midlands
140	Stafford Castle	Staffordshire	West Midlands
141	Dudley Castle	West Midlands	West Midlands
142	Edgbaston Street, Birmingham	West Midlands	West Midlands
143	Free Grammar School, Coventry	West Midlands	West Midlands
144	Park Street, Birmingham	West Midlands	West Midlands
145	Town Wall 76-8, Coventry	West Midlands	West Midlands
146	Evesham Abbey 87-8	Worcestershire	West Midlands
147	Pontefract Castle, Wakefield	West Yorkshire	Yorkshire/Humber
148	Sandal Castle, Wakefield	West Yorkshire	Yorkshire/Humber
149	46-54 Fishergate	Yorkshire	Yorkshire/Humber
150	Block E: Hungate, York	Yorkshire	Yorkshire/Humber
151	Walmgate, York	Yorkshire	Yorkshire/Humber

Table 4.2: List of post-medieval sites included in the regional comparison from all phases. * Some sites will be duplicated on the table because excavation for the same site took place in different locations

Site name	Region	Site type	Dates	Reference
Bonners Lane, Leicester	East Midlands	Not defined	16th - 17th century	Baxter 1993
DMU, Leicester a	East Midlands	Industrial	1600 - 1650	Browning 2010
DMU, Leicester b	East Midlands	Industrial	1650 - 1750	Browning 2010
Freeschool Lane, Leicester	East Midlands	Mixed	1500-1650	Browning 2009
Lincoln a	East Midlands	Mixed	pre-Civil War	Dobney *et al.* 1996
Lincoln b	East Midlands	Mixed	Civil War period	Dobney *et al.* 1996
Little Lane, Leicester a	East Midlands	Domestic	16th	Gidney 1991
Little Lane, Leicester b	East Midlands	Domestic	17th	Gidney 1991
St Marys Guildhall 82-3, Lincoln	East Midlands	Industrial	16th	O'Connor 1991b
St Marys Guildhall, Lincoln	East Midlands	Industrial	16th	Scott 1986
St Nicholas Place, Leicester a	East Midlands	Domestic	1550-1775	Browning 2009
St Nicholas Place, Leicester b	East Midlands	Domestic	1750+	Browning 2009
St Peters Lane, Leicester a	East Midlands	Not defined	16th - 17th century	Gidney 1992
St Peters Lane, Leicester b	East Midlands	Not defined	18th	Gidney 1992
St Peters St, Northampton	East Midlands	Not defined	16th - 17th century	Harman 1979
The Green, Northampton a	East Midlands	Industrial	1500 - 1700	Harman 1996
The Green, Northampton b	East Midlands	Industrial	1700 to present	Harman 1996
The Riding, Northampton	East Midlands	Domestic	17th - 18th	Harman 1984
Alms Ln 76, Norwich a	East of England	Domestic	1500 - 1575	Cartledge 1985; Harman *et al.*1985; Jones and Scott 1985
Alms Ln 76, Norwich b	East of England	Domestic	1575 - 1675	Cartledge 1985; Harman *et al.*1985; Jones and Scott 1985
Alms Ln 76, Norwich c	East of England	Domestic	1675 - 1750	Cartledge 1985; Harman *et al.*1985; Jones and Scott 1985
Alms Ln 76, Norwich d	East of England	Domestic	1750 - 1800	Cartledge 1985; Harman *et al.*1985; Jones and Scott 1985
Castle Mall Barbican Well, Norwich	East of England	Mixed	mid/late 15th to early 16th C	Garcia 2009
Castle Mall, Norwich a	East of England	Mixed	late 16th - 18th	Albarella *et al.* 2009
Castle Mall, Norwich b	East of England	Mixed	1800 - 1900	Locker 2009

Site name	Region	Site type	Dates	Reference
Dragon Hall, King Street, Norwich a	East of England	Domestic	early 15th to mid-16th century	Murray and Albarella *et al.* 2005
Dragon Hall, King Street, Norwich b	East of England	Domestic	mid-16th to late 17th century	Murray and Albarella *et al.* 2005
Dragon Hall, King Street, Norwich c	East of England	Domestic	late 17th to mid-19th century	Murray and Albarella *et al.* 2005
Golden Ball Street, Norwich	East of England	Domestic	late 16th - 18th	Curl 2009
Huntingdon Street, St. Neots	East of England	Domestic	early 20th century	Rajkovača 2013
King's Lynn	East of England	Mixed	16th - mid 18th	Noddle 1977; Bramwell 1977
Lion Walk, Colchester a	East of England	Mixed	15th - 17th	Luff 1993
Lion Walk, Colchester b	East of England	Mixed	17th - 18th	Luff 1993
Long Wyre Street	East of England	Mixed	16th - 17th century	Luff 1993
Middleborough	East of England	Mixed	16th	Luff 1993
St John's Street, Bedford	East of England	Domestic	16th - 18th	Duke 1979
129 Lambeth Road, London a	London	Domestic	1480 - 1620	Locker 1996
129 Lambeth Road, London b	London	Domestic	1620 - 1680	Locker 1996
129 Lambeth Road, London c	London	Domestic	1680 - 1800	Locker 1996
20-26 Cowcross Street, London	London	Ecclesiastical	1570 - 1700	Sidell 1996
250 Bishopgate, London	London	Mixed	1570 - 1770	Ainsley 1997
67 Upper Thames Street, London	London	Mixed	1600 - 1800	Rielly 1998c
8-22 Smithfield Street, London	London	Mixed	1575 - 1640	Pipe 2004
Aldersgate, London a	London	Mixed	16th	Armitage 2001
Aldersgate, London b	London	Mixed	17th	Armitage 2001
Aldersgate, London c	London	Mixed	1612 - 1615	Armitage 2001
Aldgate, 1974, London a	London	Domestic	17th	Armitage *et al*. 1984
Aldgate, 1974, London b	London	Domestic	1700 - 1720	Armitage *et al*. 1984
Arundel House, London a	London	Palace	15th to mid-16th century	Clutton-Brock 1975
Arundel House, London b	London	Palace	15th to mid-16th century	Cowles 1975
Arundel House, London c	London	Palace	15th to mid-16th century	Wheeler 1975

Site name	Region	Site type	Dates	Reference
Battle Bridge Lane, Southwark	London	Mixed	late 16th - early 17th century	Rielly 2000b
Bermondsey Abbey, London a	London	Ecclesiastical	1580 - 1700	Pipe 2011
Bermondsey Abbey, London b	London	Ecclesiastical	1700 - 1800	Pipe 2011
Broad Sanctuary, London	London	Mixed	16th	Locker 1982
Broadgate, London	London	Mixed	1580 - 1780	Liddle 2000a
Creedy's Yard, Greenwich	London	Mixed	16th - early 18th century	Hamilton-Dyer 2002
Eagle House (Cannon Street), London	London	Domestic	18th	Gordon 2010
East London Line, London a	London	Mixed	1580 - 1740	Pipe 2009b
East London Line, London b	London	Mixed	1660 - 1800	Pipe 2009b
East London Line, London c	London	Mixed	1700 - 1820	Pipe 2009b
East London Line, London d	London	Mixed	1800 - 1895	Pipe 2009b
East London Line: Holywell Priory, London a	London	Domestic	1580 - 1710	Pipe 2009c
East London Line: Holywell Priory, London b	London	Domestic	1700 - 1900	Pipe 2009c
Finsbury Avenue Square, London	London	Domestic	1570 - 1750	Rielly 2004a
Finsbury Pavement, London	London	Domestic	16th	Locker 1997
Fulham Pottery	London	Industrial	17th	Armitage 1999
Gardiner's Corner, London	London	Mixed	16th	Locker 1984
Gatehouse Nurseries, West Drayton	London	Manor	Late 15th to early 16th century	Locker 1985
High Street, Uxbridge, London a	London	Mixed	1580 - 1700	Liddle 2000b
High Street, Uxbridge, London b	London	Mixed	1700 - 1800	Liddle 2000b
Holland Street, London a	London	Domestic	1580 - 1750	Pipe 2010a
Holland Street, London b	London	Domestic	1700 - 1840	Pipe 2010a
Keeley House, London	London	Domestic	1807 - 1900	Rielly 2004b
London Bridge City, London a	London	Mixed	1580 - 1700	Rielly 2000a
London Bridge City, London b	London	Mixed	1700 - 1760	Rielly 2000a
Lowndes House, London	London	Domestic	1580 - 1630	Pipe 2009d

Site name	Region	Site type	Dates	Reference
Mariner House, London	London	Domestic	1650 - 1700	Morris 2011
Mark Browns Wharf, London	London	Domestic	1645-1800	Locker 1996
Merton Priory, London	London	Ecclesiastical	1700 - 1900	Pipe *et al*. 1999
New Street Square, London a	London	Domestic	1580 - 1600	Pipe 2010b
New Street Square, London b	London	Domestic	1600 - 1700	Pipe 2010b
Palace of Westminster, London	London	Palace	1680 - 1800	Pipe 2006
Rainbow Quay, Rotherhithe	London	Mixed	18th - early 19th century	Rielly 1999
Royal London Hospital, London	London	Hospital	1700 - 1900	Morris 2010
Saxon Lundenwic, London	London	Not defined	1670 - 1900	Rielly 1997
Southbridge House (Rose Theatre), London a	London	Mixed	1580 - 1650	Rielly 2005
Southbridge House (Rose Theatre), London b	London	Mixed	1600 - 1710	Rielly 2005
Southbridge House (Rose Theatre), London c	London	Mixed	1700 - 1900	Rielly 2005
Spitalfields Market (former), London	London	Domestic	1580 - 1730	Rielly 1998b
Spitalfields Market (Lamb Street), London a	London	Domestic	1580 - 1710	Liddle 2002
Spitalfields Market (Lamb Street), London b	London	Domestic	1700 - 1760	Liddle 2002
Spitalfields Market (Lamb Street), London c	London	Domestic	1800 - 1900	Liddle 2002
St Bartholomews Hospital, London	London	Mixed	1580 - 1710	Pipe 2008
St Giles Court, London	London	Domestic	1580 - 1740	Pipe 2009a
St John Clerkenwell, London	London	Domestic	1570 - 1780	Sidell 1996
St Mary Spital, London a	London	Domestic	1538-1620	Pipe and Locker 1997
St Mary Spital, London b	London	Domestic	1620-1700	Pipe and Locker 1997
St Mary Spital, London c	London	Domestic	1700+	Pipe and Locker 1997
St Saviour, Bermondsey a	London	Domestic	early 15th - mid 16th	Pipe *et al*. 2011
St Saviour, Bermondsey b	London	Domestic	mid-16th - mid 17th	Pipe *et al*. 2011
The Globe Theatre, London	London	Domestic	1580 - 1700	Rielly 1998a

Site name	Region	Site type	Dates	Reference
The Rose Theatre, London a	London	Mixed	1580 - 1650	Rielly 2005
The Rose Theatre, London b	London	Mixed	1610 - 1850	Rielly 2005
Upper Thames St, London	London	Domestic	16th - 1666	King 1980
Winchester Palace, Southwark	London	Domestic	1500 - 1600	Rielly and Locker 2006
Black Friars, Newcastle Upon Tyne a	North East	Mixed	16th - 17th	Rackham 1987
Black Friars, Newcastle Upon Tyne b	North East	Mixed	17th - 18th	Rackham 1987
Castle Bastion, Newcastle-Upon-Tyne	North East	Castle	17th	Rackham 1983
Castle Ditch, Newcastle Upon Tyne	North East	Castle	16th	Rackham and Allison 1981
Closegate I & II, Newcastle Upon Tyne a	North East	Domestic	15th - 16th	Davis 1991
Closegate I & II, Newcastle Upon Tyne b	North East	Domestic	17th - 18th	Davis 1991
Crown Court, Newcastle Upon Tyne	North East	Mixed	15th - 16th	Gidney 1989
Prudhoe Castle, Prudnoe a	North East	Castle	late 15th - mid 16th	Davis 1987
Prudhoe Castle, Prudnoe b	North East	Castle	mid-16th - early 17th (1630)	Davis 1987
Prudhoe Castle, Prudnoe c	North East	Castle	17th (1630 onwards)	Davis 1987
Prudhoe Castle, Prudnoe d	North East	Castle	18th	Davis 1987
Westgate Road, Newcastle Upon Tyne a	North East	Domestic	1640-1680	Gidney 1994
Westgate Road, Newcastle Upon Tyne b	North East	Domestic	mid/late 18th	Gidney 1994
Westgate Road, Newcastle Upon Tyne c	North East	Domestic	19th-20th	Gidney 1994
10 Commonhall Street, Chester	North West	Domestic	17th - 19th	Sykes and Wan
25 Bridge Street, Chester a	North West	Domestic	late 15th - mid 17th century	Smith 2008; Jacques *et al.* 2008
25 Bridge Street, Chester b	North West	Domestic	mid/late 17th - early 18th century	Smith 2008; Jacques *et al.* 2008
25 Bridge Street, Chester c	North West	Domestic	early to late 18th century	Smith 2008; Jacques *et al.* 2008
25 Bridge Street, Chester d	North West	Domestic	early 19th century - c 1900	Smith 2008; Jacques *et al.* 2008
25 Bridge Street, Chester e	North West	Domestic	20th	Jacques *et al.* 2008
3-15 Eastgate street a	North West	Mixed	late 15th - mid 17th century	Harrison 1995b
3-15 Eastgate street b	North West	Mixed	late 17th/mid 18th	Harrison 1995b

Site name	Region	Site type	Dates	Reference
Canalside/Witter Place	North West	Industrial	18th -19th	Carrott *et al.* 2001
Chester's Roman Amphitheatre a	North West	Domestic	mid-late 16th/early 17th	Gordon 2015
Chester's Roman Amphitheatre b	North West	Domestic	early/mid 17th	Gordon 2015
Chester's Roman Amphitheatre c	North West	Domestic	late 17th/early 18th	Gordon 2015
Chester's Roman Amphitheatre d	North West	Domestic	mid to late 18th	Gordon 2015
Chester's Roman Amphitheatre e	North West	Domestic	19th century	Gordon 2015
City Road, Chester	North West	Industrial	17th - 19th	Sykes *et al.* n.d.
12 Hamilton Place a	North West	Domestic	late 17th/early 18th	Gordon 2015
12 Hamilton Place b	North West	Domestic	late 18th/early 19th	Gordon 2015
12 Hamilton Place c	North West	Domestic	mid-19th/mid 20th	Gordon 2015
Nicholas Street Mews a	North West	Domestic	14th-16th	Gordon 2015
Nicholas Street Mews b	North West	Domestic	16th - 17th century	Gordon 2015
Nicholas Street Mews c	North West	Domestic	17th - 18th	Gordon 2015
Nicholas Street Mews d	North West	Domestic	18th -19th	Gordon 2015
16 Tunsgate, Guildford	South East	Domestic	1702-1710	Smith and Serjeantson 1997
29 Thames St, Windsor a	South East	Domestic	mid/late 16th century	Hamilton-Dyer 2005
29 Thames St, Windsor b	South East	Mixed	early 17th century	Hamilton-Dyer 2005
29 Thames St, Windsor c	South East	Domestic	late 17th century	Hamilton-Dyer 2005
67-69 St Thomas' St, Oxford a	South East	Mixed	late 15th to mid-16th century	Poole 2006
67-69 St Thomas' St, Oxford b	South East	Mixed	mid 16th/late 17th century	Poole 2006
67-69 St Thomas' St, Oxford c	South East	Mixed	late 17th/early 19th century	Poole 2006
Abbey Wharf, Reading a	South East	Mixed	16th - 18th	Coy 1997
Abbey Wharf, Reading b	South East	Mixed	early 18th century	Coy 1997
Abbey Wharf, Reading c	South East	Mixed	mid-18th century	Coy 1997
Abbey Wharf, Reading d	South East	Mixed	late 18th century	Coy 1997
Ashmolean Museum Forecourt, Oxford	South East	Domestic	16th - 17th century	Hamilton-Dyer 1997

Site name	Region	Site type	Dates	Reference
Bridge St East a	South East	Domestic	16th - 18th	Coy 1997
Bridge St East b	South East	Industrial	18th -19th	Coy 1997
Canterbury Defences	South East	Domestic	18th - 20th	King 1982
Chester Road, Winchester	South East	Domestic	17th	Serjeantson, D. and Smith 2009
Classics Centre, Oxford	South East	Domestic	16th - 18th	Poole; Nicholas 2008
Cliffe, Lewes	South East	Domestic	late 16th - early 18th	Stevens 1991
County Museum, Aylesbury	South East	Not defined	17th	Sadler 1998
Crane Wharf, Reading	South East	Domestic	18th -19th	Coy 1997
Elizabeth House, Oxford a	South East	Domestic	17th	Holmes 2010
Elizabeth House, Oxford b	South East	Domestic	18th	Holmes 2010
High St, Guildford	South East	Domestic	17th - 18th	Holmes 2007
Hinxey Hall, Oxford	South East	Domestic	15th - 16th	Wilson *et al*. 1983
Lewes Castle	South East	Domestic	18th	O'Shea 1992
Linacre Garden, Canterbury a	South East	Domestic	16th	Driver 1990
Linacre Garden, Canterbury b	South East	Domestic	17th	Driver 1990
Lincoln College, Oxford	South East	Domestic	16th - 18th	Charles and Ingrem 2002
Merton College, Oxford	South East	Domestic	mid-16th - mid 18th century	Worley and Evans 2006
Mount St, Battle	South East	Domestic	15th - 16th	Sibun 2008
Old Clothing Factory, Abingdon	South East	Mixed	16th - 17th	Wilson 1989
Phoenix Brewery, Hastings	South East	Domestic	late 16th - early 17th century	Clements 1993
Quilter's Vault, Southampton	South East	Domestic	17th - 18th	Boudillon 1979
Reading Abbey Stables	South East	Domestic	15th - 16th	Coy 1990
Ropetackle, Shoreham by Sea a	South East	Domestic	mid-16th/mid-18th century	Ayton and Jaques 2011
Ropetackle, Shoreham by Sea b	South East	Domestic	mid-18th/19th century	Ayton and Jaques 2011
SOU 29, Southampton	South East	Domestic	15th - 16th	Bourdillon 1986
Southampton Excavations 1966-9	South East	Domestic	1550 - 1650	Noddle 1975

Site name	Region	Site type	Dates	Reference
St Frideswide's Cloister, Oxford a	South East	Ecclesiastical	16th	Stallibrass 1990
St Frideswide's Cloister, Oxford b	South East	Ecclesiastical	17th	Stallibrass 1990
St Gregory's Priory, Canterbury	South East	Ecclesiastical	16th	Powell *et al*. 2001
St John's Street, Winchester	South East	Domestic	late 15th - 16th	Serjeantson, D. and Smith
St Peters Street, Maidstone	South East	Hospital	1850 - 1900	Morris 2007
Stert St, Oxford	South East	Domestic	18th	Wilson and Bramwell 1980
Victoria Road, Winchester	South East	Domestic	late 15th - 16th	Serjeantson, D. and Smith 2009
West Gate, Oxford Castle	South East	Domestic	16th - 18th	Wilson and Locker 2003
West St Helen St, Abingdon	South East	Domestic	19th	Wilson *et al*. 1975
39 Fore St, Totnes	South West	Domestic	1600	Bovey 1984; Colley 1984
5-8 Fore St, Taunton	South West	Domestic	16th	Adams 1988
Bath 1984-1989	South West	Domestic	18th	Barber 1999
Christchurch 1969-80	South West	Domestic	18th -19th	Coy 1983
Citizen House, Bath	South West	Domestic	17th	Grant 1979
Dung Quay, Plymouth	South West	Domestic	1645-1800	Higbee 2003
East Gate, Gloucester	South West	Domestic	16th - 17th century	Maltby 1983
Exeter a	South West	Mixed	1500 - 1600	Maltby 1979
Exeter b	South West	Mixed	1550 - 1650	Maltby 1979
Exeter c	South West	Mixed	1660 - 1700	Maltby 1979
Exeter d	South West	Mixed	1660 - 1800	Maltby 1979
Launceston Castle a	South West	Castle	16th century - 1650	Albarella and Davis 1996
Launceston Castle b	South West	Castle	1660 - 1840	Albarella and Davis 1996
Narrow Quay, Bristol	South West	Industrial	Late 16th century	Levitan 1987
Poole	South West	Domestic	16th	Coy 1985
Southgate Redevelopment, Bath a	South West	Domestic	1575 - 1725	Pipe 2011
Southgate Redevelopment, Bath b	South West	Domestic	1700 - 1910	Pipe 2011

Site name	Region	Site type	Dates	Reference
Tanner's Hall, Gloucester	South West	Industrial	16th - 17th	Sykes 2009
The Foundry, Poole a	South West	Domestic	early 16th century	Bourdillon 1994; Bullock 1994
The Foundry, Poole b	South West	Domestic	mid-16th - mid 17th	Bourdillon 1994; Bullock 1994
Tudor St, Exeter	South West	Domestic	17th	Higbee 2009
16 - 18 Harrison Street, Hereford a	West Midlands	Not defined	16th - 17th century	Baxter, in press
16 - 18 Harrison Street, Hereford b	West Midlands	Not defined	18th -19th	Baxter, in press
Dudley Castle a	West Midlands	Castle	1533 - 1647	Thomas 2005a
Dudley Castle b	West Midlands	Castle	1647 - 1750	Thomas 2005a
Edgbaston Street, Birmingham	West Midlands	Domestic	17th - 18th	Smith 2009
Evesham Abbey 87-8	West Midlands	Ecclesiastical	18th -19th	Lovett 1990
Free Grammar School, Coventry	West Midlands	Ecclesiastical	16th	Holmes 1981
Park Street, Birmingham	West Midlands	Domestic	17th - 18th	Baxter 2009
St Peters School, Gaol Street, Hereford a	West Midlands	Not defined	1500 - 1600	Baxter in press
St Peters School, Gaol Street, Hereford b	West Midlands	Not defined	1600 - 1750	Baxter in press
Stafford Castle a	West Midlands	Castle	1500 - 1600	Sadler, P. and Jones, G. 1997
Stafford Castle b	West Midlands	Castle	1600 - 1650	Sadler, P. and Jones, G. 1997
Stafford Castle c	West Midlands	Castle	1800 - 1900	Thomas 2011
Town Wall 76-8, Coventry a	West Midlands	Not defined	16th - 17th	Noddle 1986; Bramwell 1986
Town Wall 76-8, Coventry b	West Midlands	Not defined	18th	Noddle 1968; Bramwell 1986
46-54 Fishergate	Yorkshire/Humber	Ecclesiastical	1650 - 1700	O' Connor 1991a
Block E: Hungate, York a	Yorkshire/Humber	Domestic	late 17th - early 19th	Hunter-Mann 2008
Block E: Hungate, York b	Yorkshire/Humber	Domestic	mid-19th - early 20th	Hunter-Mann 2008
Pontefract Castle, Wakefield	Yorkshire/Humber	Castle	17th	Richardson 2002
Sandal Castle, Wakefield a	Yorkshire/Humber	Castle	1485-1600	Griffith *et al.*
Sandal Castle, Wakefield b	Yorkshire/Humber	Castle	1645	Griffith *et al.*
Walmgate, York	Yorkshire/Humber	Industrial	early 18th century	O'Connor 1984

Site name	Site type	NISP (total)	NISP*	Cattle	S/G	Pig	Wild mammals	Chicken	Goose	Duck	Wild birds
Castle Ditch, Newcastle Upon Tyne	Castle	13959	11708	37.97	58.46	3.57	1.1247224	1.6119	1.4758	0.0287	0.1146214
29 Thames St, Windsor a	Domestic	238	225	44.89	45.78	9.333	1.2605042	1.2605	2.9412	0	0
Finsbury Pavement, London	Domestic	1836	1836	51.03	36.6	12.36	0	0	0	0	0
Linacre Garden, Canterbury a	Domestic	1447	516	28.68	53.88	17.44	4.008293	35.798	1.0366	0.4838	7.049067
Little Lane, Leicester a	Domestic	1248	941	30.5	56.64	12.86	2.2435897	9.0545	7.2917	1.0417	0.3205128
Poole	Domestic	1353	1090	47.34	37.71	14.95	3.917221	6.4302	1.626	2.0695	0.7390983
The Foundry, Poole a	Domestic	718	663	56.11	33.79	10.11	1.9498607	4.5961	0.6964	0	0
5-8 Fore St, Taunton	Domestic	1607	1301	56.5	37.13	6.38	0.5600498	15.184	1.5557	0.9334	0.497822
Alms Ln 76, Norwich a	Domestic	1409	1141	41.81	42.24	15.95	3.2647268	8.6586	5.3229	0.5678	0
Free Grammar School, Coventry	Ecclesiastical	1691	1041	24.3	63.5	12.2	20.520402	11.059	5.204	0.0591	0.8870491
St Frideswide's Cloister, Oxford a	Ecclesiastical	264	257	43.97	52.14	3.891	2.6515152	0	0	0	0
St Gregory's Priory, Canterbury	Ecclesiastical	413	265	23.77	37.74	38.49	6.2953995	11.138	5.0847	0	0
Narrow Quay, Bristol	Industrial	5935	5620	56.41	36.09	7.509	4.6672283	0.1179	0.0505	0.0842	0.0168492
St Marys Guildhall 82-3, Lincoln	Industrial	334	331	98.19	1.813	0	0.2994012	0	0.2994	0	0
St Marys Guildhall, Lincoln	Industrial	1122	1119	99.46	0.536	0	0.0891266	0	0.0891	0	0
Aldersgate, London a	Mixed	763	700	65.57	29.29	5.143	0.9174312	2.3591	1.3106	0	0.1310616
Broad Sanctuary, London	Mixed	1151	1046	44.74	50.1	5.163	1.9113814	2.2589	0.695	0.3475	0.6081668
Gardiner's Corner, London	Mixed	185	167	49.7	23.95	26.35	0.5405405	0	0	0	0
Middleborough	Mixed	440	396	53.79	36.11	10.1	1.1363636	4.5455	2.0455	0	0

Table 4.3: Species representation for domestic and wild mammals and birds from the 16th century by site type

Site name	Site type	NISP (total)	NISP*	Cattle	S/G	Pig	Wild mammals	Chicken	Goose	Duck	Wild birds
Castle Bastion, Newcastle-Upon-Tyne	Castle	1810	1590	25.72	68.18	6.101	2.320442	2.9834	2.3204	0.1105	0.718232
Pontefract Castle, Wakefield	Castle	2149	1382	43.05	40.38	16.57	7.026524	11.54	3.3039	0.9307	3.9087948
Prudhoe Castle, Prudnoe c	Castle	159	152	56.58	38.82	4.605	3.1446541	0	0	0	0
Sandal Castle, Wakefield b	Castle	265	227	40.09	49.78	10.13	13.962264	0	0	0	0
Chester Road, Winchester	Domestic	752	676	32.25	49.41	18.34	2.5265957	2.3936	1.3298	0	0
Chester's Roman Amphitheatre b	Domestic	1774	1563	54.38	32.69	12.92	2.1984216	3.044	1.3529	0.3946	1.0710259
Citizen House, Bath	Domestic	256	251	43.03	47.81	9.163	1.5625	0	0	0	0
Elizabeth House, Oxford a	Domestic	133	122	38.52	44.26	17.21	0.7518797	3.0075	2.2556	0	0.7518797
Linacre Garden, Canterbury b	Domestic	1108	1083	40.26	54.11	5.633	0.9927798	0	0	0	0
Little Lane, Leicester b	Domestic	593	506	49.41	39.53	11.07	2.1922428	6.2395	3.7099	0.3373	0.5059022
Tudor St, Exeter	Domestic	280	274	16.06	82.48	1.46	0	0	0	0	0
Westgate Road, Newcastle Upon Tyne a	Domestic	118	106	21.7	70.75	7.547	0.8474576	0.8475	0.8475	0	0
129 Lambeth Road, London b	Domestic	360	293	28.67	59.73	11.6	10	5.2778	1.1111	0.5556	0
39 Fore St, Totnes	Domestic	269	269	62.83	29.37	7.807	0	0	0	0	0
Aldgate, 1974, London a	Domestic	233	209	17.7	80.38	1.914	3.0042918	4.2918	1.7167	1.2876	0
St Frideswide's Cloister, Oxford b	Ecclesiastical	174	165	22.42	73.94	3.636	3.4482759	0	0	0	0
Fulham Pottery	Industrial	409	370	39.73	60.27	0	0	0	0	0	0
Aldersgate, London b & c	Mixed	1041	949	65.75	29.4	4.847	0.6724304	2.7858	1.3449	0.2882	0.0960615
Lincoln b	Mixed	2531	2128	55.22	35.62	9.164	1.6989332	1.6989	0.9087	0.5531	1.066772
29 Thames St, Windsor b & c	Mixed	1388	1340	47.24	46.19	6.567	1.8011527	1.0807	0.5043	0	0
County Museum, Aylesbury	Not defined	344	328	14.63	80.49	4.878	1.1627907	1.7442	0	0	1.4534884

Table 4.4: Species representation for domestic and wild mammals and birds from the 17th century by site type

Site name	Site type	NISP (total)	NISP*	Cattle	S/G	Pig	Wild mammals	Chicken	Goose	Duck	Wild birds
Prudhoe Castle, Prudnoe d	Castle	132	122	45.9	50	4.098	6.8181818	0	0	0	0
16 Tunsgate, Guildford	Domestic	314	194	42.78	40.21	17.01	1.2738854	12.42	15.605	0	4.4585987
Bath 1984-1989	Domestic	215	191	32.98	46.07	20.94	0.4651163	8.8372	0.4651	0	0
Chester's Roman Amphitheatre d	Domestic	469	432	54.17	35.65	10.19	1.2793177	1.919	1.4925	0.2132	0.4264392
Eagle House (Cannon Street), London	Domestic	1025	705	40.43	49.36	10.21	9.8536585	13.659	1.7561	1.0732	0.3902439
Elizabeth House, Oxford b	Domestic	115	108	36.11	45.37	18.52	2.6086957	2.6087	0	0	0
Lewes Castle	Domestic	1033	982	11.61	67.31	21.08	3.9690223	0	0	0	0
St Mary Spital, London c	Domestic	20295	19726	60.6	33.49	5.911	0.5863513	0.2611	0.404	0.0049	0.0246366
Westgate Road, Newcastle Upon Tyne b	Domestic	616	545	36.51	47.89	15.6	3.8961039	1.1364	0.8117	0.974	0.487013
Aldgate, 1974, London b	Domestic	1528	1449	36.09	57.97	5.935	0.9162304	1.0471	0.3927	0.1309	0.3926702
Stert St, Oxford	Domestic	282	263	37.26	53.23	9.506	0.7092199	1.773	0	0	3.5460993
Walmgate, York	Industrial	26106	26078	0.69	99.23	0.077	0.0268138	0.0192	0.0115	0.0038	0.0191527
London Bridge City, London b	Mixed	1490	411	46.72	42.82	10.46	0.1342282	0.4027	0	0	0
Abbey Wharf, Reading b - d	Mixed	1380	1379	70.63	23.64	5.729	0	0	0	0	0.0724638
St Peters Lane, Leicester b	Not defined	240	199	51.76	39.2	9.045	7.0833333	2.9167	1.6667	1.25	1.25
Town Wall 76-8, Coventry b	Not defined	189	150	58.67	32	9.333	4.7619048	4.7619	6.3492	0	1.5873016

Table 4.5: Species representation for domestic and wild mammals and birds from the 18th century by site type

Site name	Site type	NISP (total)	NISP*	Cattle	S/G	Pig	Wild mammals	Chicken	Goose	Duck	Wild birds
Chester's Roman Amphitheatre e	Domestic	1218	823	53.34	37.06	9.599	0.9852217	1.3957	0.9852	0	0.4926108
West St Helen St, Abingdon	Domestic	134	118	49.15	33.9	16.95	0.7462687	4.4776	4.4776	0.7463	0
East London Line, London d	Mixed	597	453	27.59	58.72	13.69	1.6750419	3.3501	0	0.1675	0

Table 4.6: Species representation for domestic and wild mammals and birds from the 19th century by site type

Site name	Site type	NISP (total)	NISP*	Cattle	S/G	Pig	Wild mammals	Chicken	Goose	Duck	Wild birds
Castle Mall Barbican Well, Norwich	Mixed	6770	3396	36.93	36.81	26.27	2.1418021	8.3013	14.963	0.8272	0.7237814
Prudhoe Castle, Prudnoe a	Castle	152	145	63.45	31.72	4.828	4.6052632				
Sandal Castle, Wakefield a	Castle	1438	1132	52.39	36.04	11.57	19.749652				
Dragon Hall, King Street, Norwich a	Domestic	147	101	26.73	47.52	25.74	9.5238095	10.884	5.4422	1.3605	2.7210884
129 Lambeth Road, London a	Domestic	178	147	38.1	55.78	6.122	3.9325843	7.3034	1.1236	1.1236	
St Saviour, Bermondsey a	Domestic	1529	494	28.14	36.03	35.83	13.603663	35.71	6.9326	2.4199	6.8672335
Closegate I & II, Newcastle Upon Tyne a	Domestic	1003	950	31.47	61.58	6.947	0.8973081	0.1994	0.6979		
25 Bridge Street, Chester a	Domestic	1888	1158	55.87	31.61	12.52	3.5487288	11.917	4.1843	0.6356	2.3834746
Nicholas Street Mews a	Domestic	209	154	51.3	27.92	20.78	1.4354067	12.919	4.3062	0.9569	3.8277512
Hinxey Hall, Oxford	Domestic	309	187	9.626	73.8	16.58	23.624595	13.592	0.6472		1.618123
Mount St, Battle	Domestic	113	106	65.09	23.58	11.32		0.885			
Reading Abbey Stables	Domestic	413	381	59.06	25.98	14.96	3.6319613	2.1792	0.9685	0.2421	0.2421308
SOU 29, Southampton	Domestic	1983	1828	56.07	34.35	9.573	2.269289	1.9667	1.059	0.353	0.4034291
St John's Street, Winchester	Domestic	1031	807	33.09	46.96	19.95	8.0504365	7.3715	4.8497	0.582	0.6789525
Victoria Road, Winchester	Domestic	987	890	30	46.63	23.37	1.5197568	4.6606	1.1145		1.3171226
67-69 St Thomas' St, Oxford a	Mixed	269	239	38.08	54.39	7.531	3.7174721	2.974	1.487	2.6022	
Gatehouse Nurseries, West Drayton	Manor	1103	1068	64.98	18.16	16.85	1.1786038	0.0907	0.1813	0.0907	
Lincoln a	Mixed	399	369	10.3	85.64	4.065	0.2506266	1.7544	2.005	0.2506	0.2506266
Lion Walk, Colchester a	Mixed	4046	3101	46.28	45.21	8.513	1.9525457	9.7874	2.2491	0.9639	
Crown Court, Newcastle Upon Tyne	Mixed	2267	2116	53.97	37.67	8.365	0.2205558	1.0587	1.1028		0.0441112
3-15 Eastgate street a	Mixed	311	269	20.82	65.43	13.75	3.2154341	4.5016	3.2154		0.3215434
Arundel House, London a	Palace	651	637	52.75	37.21	10.05	1.9969278				

Table 4.7: Species representation for domestic and wild mammals and birds from the 15th-17th century by site type

Site name	Site type	NISP (total)	NISP*	Cattle	S/G	Pig	Wild mammals	Chicken	Goose	Duck	Wild birds
Dudley Castle a	Castle	2096	1132	46.47	33.75	19.79	25.811069	8.1107	1.1927	1.2405	7.6335878
Launceston Castle a	Castle	1497	1191	48.36	38.46	13.18	4.8764195	2.672	0.8016	0.0668	1.0688043
Prudhoe Castle, Prudnoe b	Castle	502	474	44.09	48.95	6.962	5.1792829	0	0	0	0
Stafford Castle a & b	Castle	1765	1094	39.4	18.46	42.14	18.130312	10.538	1.9263	1.1898	3.6827195
Chester's Roman Amphitheatre a	Domestic	1376	1147	53.62	35.75	10.64	3.2703488	5.3052	0.7267	0.5814	1.6715116
Dragon Hall, King Street, Norwich b	Domestic	296	223	46.19	43.05	10.76	5.7432432	11.824	4.0541	1.3514	0.6756757
Lowndes House, London	Domestic	224	142	46.48	41.55	11.97	8.0357143	16.964	2.2321	2.6786	6.25
Nicholas Street Mews b	Domestic	256	176	50	36.93	13.07	2.34375	14.844	1.5625	3.9063	7.03125
Southampton Excavations 1966-9	Domestic	193	113	41.59	47.79	10.62	11.398964	0	0	0	0
St Mary Spital, London a	Domestic	24394	23233	71.36	22.39	6.245	0	0	0.5124	0.0082	0.0573912
St Saviour, Bermondsey b	Domestic	407	341	49.85	31.38	18.77	3.6855037	6.3882	1.7199	1.4742	0.982801
The Foundry, Poole b	Domestic	679	643	60.96	32.35	6.687	2.5036819	1.9146	0	0	0
Upper Thames St, London	Domestic	125	116	42.24	43.97	13.79	4.8	0	0	0	0
Winchester Palace, Southwark	Domestic	482	369	45.53	32.79	21.68	3.9419087	8.7137	5.8091	2.6971	1.4522822
New Street Square, London a	Domestic	121	115	50.43	34.78	14.78	1.6528926	0.8264	0	0	0
Alms Ln 76, Norwich b	Domestic	1906	1601	49.53	38.35	12.12	3.1479538	6.5582	3.9874	0.8919	0.4197272
Ashmolean Museum Forecourt, Oxford	Domestic	139	138	68.84	26.81	4.348	0	0.7194	0	0	0
East Gate, Gloucester	Domestic	4262	3791	47.22	39.99	12.79	0.9854528	4.0591	1.4547	0.0469	1.1027687

Table 4.8: Species representation for domestic and wild mammals and birds from the 16th-17th century by site type

Site name	Site type	NISP (total)	NISP*	Cattle	S/G	Pig	Wild mammals	Chicken	Goose	Duck	Wild birds
Phoenix Brewery, Hastings	Domestic	142	132	61.36	35.61	3.03	2.1126761	1.4085	0	0	0
Black Friars, Newcastle Upon Tyne a	Ecclesiastical	574	501	23.75	72.65	3.593	0.5226481	8.0139	2.439	0	0
Tanner's Hall, Gloucester	Industrial	404	403	97.27	2.73	0	0	0	0	0	0
8-22 Smithfield Street, London	Mixed	113	106	9.434	89.62	0.943	0	4.4248	0	0	0
67-69 St Thomas' St, Oxford b	Mixed	129	118	57.63	38.14	4.237	0.7751938	5.4264	0.7752	0.7752	0
Battle Bridge Lane, Southwark	Mixed	453	435	43.45	47.82	8.736	1.1037528	0.883	0.4415	1.1038	0.2207506
Exeter a & b	Mixed	5348	3360	38.42	50.21	11.37	4.1884817	17.016	1.4959	1.7203	2.2251309
Freeschool Lane, Leicester	Mixed	409	317	52.05	32.49	15.46	2.4449878	7.5795	8.802	0	0.9779951
Long Wyre Street	Mixed	201	195	43.08	37.95	18.97	0.9950249	0	0	0	0
Old Clothing Factory, Abingdon	Mixed	816	735	28.16	58.23	13.61	1.9607843	1.9608	2.2059	0.3676	0.4901961
Southbridge House (Rose Theatre), London a	Mixed	330	263	25.48	66.92	7.605	1.5151515	0.6061	0.6061	0.6061	0.3030303
The Rose Theatre, London a	Mixed	199	178	27.53	62.92	9.551	2.0100503	2.5126	0.5025	0	0
16 - 18 Harrison Street, Hereford a	Not defined	249	223	67.71	17.94	14.35	0.4016064	1.2048	2.008	0	0.8032129
Bonners Lane, Leicester	Not defined	355	295	39.66	47.46	12.88	1.6901408	4.7887	6.7606	0.8451	0
Causeway Lane 80-91, Leicester	Not defined	533	428	36.45	46.26	17.29	0	8.818	8.6304	0	0.3752345
St Peters Lane, Leicester a	Not defined	1926	1445	38.62	47.89	13.49	4.517134	10.073	5.9709	0.675	0.674974
St Peters School, Gaol Street, Hereford a	Not defined	373	244	51.64	23.77	24.59	0	25.737	6.4343	1.3405	0.2680965
St Peters St, Northampton	Not defined	176	170	34.12	58.82	7.059	0.5681818	0	0	0	0
Town Wall 76-8, Coventry a	Not defined	2889	2429	51.83	32.56	15.6	2.4229837	7.6843	3.0807	0.4846	0.4499827

Table 4.8 (Cont): Species representation for domestic and wild mammals and birds from the 16th-17th century by site type

Site name	Site type	NISP (total)	NISP*	Cattle	S/G	Pig	Wild mammals	Chicken	Goose	Duck	Wild birds
Dudley Castle b	Castle	626	175	62.29	26.86	10.86	8.3067093	2.8754	0.3195	0.1597	0.6389776
25 Bridge Street, Chester b	Domestic	3118	2146	66.45	21.76	11.79	3.2392559	7.569	4.2656	0.3849	1.21873
Chester's Roman Amphitheatre c	Domestic	1174	1065	52.77	36.06	11.17	1.6183986	2.0443	1.5332	0.0852	0.9369676
Closegate I & II, Newcastle Upon Tyne b	Domestic	188	173	25.43	69.94	4.624	3.1914894	0	0	0.5319	1.0638298
Edgbaston Street, Birmingham	Domestic	162	125	59.2	37.6	3.2	0	0	0	0	0
Hamilton Place a	Domestic	159	151	54.97	40.4	4.636	0.6289308	0.6289	1.2579	0	0.6289308
High St, Guildford	Domestic	320	300	42.33	43.67	14	0.3125	0.625	0	0	0
Mariner House, London	Domestic	151	115	46.09	47.83	6.087	1.3245033	7.2848	0.6623	1.9868	2.6490066
Nicholas Street Mews c	Domestic	401	270	50	38.15	11.85	1.4962594	3.7406	0.4988	0.9975	0.4987531
Park Street, Birmingham	Domestic	170	147	55.78	33.33	10.88	0.5882353	0.5882	1.1765	1.1765	0
Quilter's Vault, Southampton	Domestic	172	112	25.89	60.71	13.39	4.0697674	20.93	1.7442	0.5814	3.4883721
Spitalfields Market (Lamb Street), London b	Domestic	471	252	40.08	48.41	11.51	1.910828	14.013	0.8493	7.6433	3.1847134
St Mary Spital, London b	Domestic	4922	4778	54.46	41.27	4.27	1.4221861	0.9549	0.1219	0.0203	0.0203169
The Riding, Northampton	Domestic	432	407	32.43	59.95	7.617	0.6944444	0	0	0	0
New Street Square, London b	Domestic	1447	1201	52.46	42.13	5.412	4.975812	8.0857	0.5529	0.622	2.6952315
Alms Ln 76, Norwich c	Domestic	1339	1101	40.87	47.05	12.08	2.0164302	7.2442	5.3025	0.2987	0.373413
46-54 Fishergate	Ecclesiastical	1524	1524	46.52	37.73	15.75	0	0	0	0	0
DMU, Leicester a & b	Industrial	1914	1791	9.548	87.49	2.959	0.7836991	3.396	0.8359	0	0.0522466
Black Friars, Newcastle Upon Tyne b	Mixed	1036	944	23.73	71.72	4.555	0.2895753	1.834	0.4826	0	0.2895753
3-15 Eastgate street b	Mixed	133	128	39.84	21.09	39.06	1.5037594	0.7519	0.7519	0	0.7518797
Exeter c	Mixed	1972	1088	38.6	53.58	7.813	4.2596349	16.886	1.0142	0.1521	1.2677485
Lion Walk, Colchester b	Mixed	886	771	50.97	34.24	14.79	0.5643341	6.9977	0.4515	1.0158	0
Southbridge House (Rose Theatre), London b	Mixed	517	432	34.95	58.33	6.713	2.901354	1.354	0.7737	0.3868	2.5145068
St Peters School, Gaol Street, Hereford b	Not defined	319	280	47.86	41.07	11.07	2.8213166	2.8213	1.2539	0.627	1.5673981

Table 4.9: Species representation for domestic and wild mammals and birds from the 17th-18th century by site type

Site name	Site type	NISP (total)	NISP*	Cattle	S/G	Pig	Wild mammals	Chicken	Goose	Duck	Wild birds
25 Bridge Street, Chester c	Domestic	1644	1310	58.09	29.77	12.14	4.5012165	4.562	2.7981	0.365	0.6082725
Christchurch 1969-80	Domestic	295	236	33.9	53.81	12.29	2.3728814	2.7119	1.0169	0.339	0
Crane Wharf, Reading	Domestic	113	113	52.21	30.09	17.7	0	0	0	0	0
Hamilton Place b	Domestic	181	156	61.54	33.33	5.128	2.2099448	1.6575	1.6575	1.105	0.5524862
Holland Street, London b	Domestic	328	278	28.42	59.71	11.87	3.3536585	6.0976	1.5244	0.6098	0.304878
Nicholas Street Mews d	Domestic	277	231	46.75	33.77	19.48	1.8050542	7.9422	1.8051	0.361	1.4440433
Ropetackle, Shoreham by Sea b	Domestic	671	671	37.41	53.8	8.793	0	0	0	0	0
Bermondsey Abbey, London b	Ecclesiastical	478	396	33.33	53.79	12.88	4.3933054	3.3473	0.8368	0	3.1380753
Evesham Abbey 87-8	Ecclesiastical	324	273	42.86	35.9	21.25	13.888889	0	0	0	0
Bridge St East b	Industrial	504	473	79.28	18.6	2.114	0	0	0	0	0
Canalside/Witter Place	Industrial	158	125	87.2	6.4	6.4	0	3.7975	0.6329	0	0
High Street, Uxbridge, London b	Mixed	176	176	96.02	3.409	0.568	0	0	0	0	0
East London Line, London c	Mixed	898	795	30.19	56.6	13.21	0.4454343	0.5568	0.1114	0	0.3340757
Rainbow Quay, Rotherhithe	Mixed	168	161	81.37	7.453	11.18	0	0	0.5952	0	1.1904762
16 - 18 Harrison Street, Hereford b	Not defined	152	141	54.61	29.08	16.31	0	1.3158	0	0.6579	0

Table 4.10: Species representation for domestic and wild mammals and birds from the 18th-19th century by site type

Site name	Site type	NISP (total)	NISP *	Cattle	S/G	Pig	Wild mammals	Chicken	Goose	Duck	Wild birds
Stafford Castle c	Castle	1832	336	27.68	41.67	30.65	31.168122	22.871	0.8734	0.1092	7.478165 9
25 Bridge Street, Chester d	Domestic	1539	972	47.94	38.17	13.89	4.4184535	5.0032	3.2489	0.2599	1.559454 2
Block E: Hungate, York b	Domestic	443	265	41.89	47.55	10.57	11.286682	4.7404	2.7088	0.4515	1.354401 8
Hamilton Place c	Domestic	508	299	69.9	19.4	10.7	4.5275591	1.9685	0.3937	0.1969	0.984252
Huntingdon Street, St. Neots	Domestic	187	138	31.88	65.22	2.899	17.647059	5.3476	2.6738	0	0
Spitalfields Market (Lamb Street), London c	Domestic	832	390	34.36	54.1	11.54	6.9711538	10.817	5.0481	1.5625	9.975961 5
Westgate Road, Newcastle Upon Tyne c	Domestic	578	520	41.35	51.92	6.731	0.1730104	1.9031	1.7301	0	0.173010 4
Keeley House, London	Domestic	272	254	55.91	30.31	13.78	0.7352941	1.4706	3.3088	0.7353	0
St Peters Street, Maidstone	Hospital	244	243	100	0	0	0	0	0.4098	0	0

Table 4.11: Species representation for domestic and wild mammals and birds from the 19th-20th century by site type

Site name	Site type	NISP (total)	NISP*	Cattle	S/G	Pig	Wild mammals	Chicken	Goose	Duck	Wild birds
Castle Mall, Norwich a	Mixed	1964	1493	45.34	44.68	9.98	0.9164969	4.1752	1.2729	0.4582	0.407332
Bridge St East a	Domestic	140	140	48.57	45	6.429	0	0	0	0	0
Classics Centre, Oxford	Domestic	477	411	49.88	41.36	8.759	0.6289308	7.3375	1.0482	0	0
Cliffe, Lewes	Domestic	131	113	35.4	58.41	6.195	0	3.8168	0.7634	0	1.5267176
East London Line: Holywell Priory, London a	Domestic	515	426	36.38	58.69	4.93	2.1359223	4.2718	1.3592	0.5825	1.7475728
Golden Ball Street, Norwich	Domestic	184	137	45.99	48.91	5.109	0.5434783	16.304	5.9783	0	1.0869565
Holland Street, London a	Domestic	544	477	36.27	49.69	14.05	1.2867647	7.5368	1.2868	0.5515	0.5514706
Lincoln College, Oxford	Domestic	412	377	26.26	68.97	4.775	4.368932	0	0.4854	0	1.9417476
Merton College, Oxford	Domestic	439	380	29.21	64.74	6.053	2.2779043	6.8337	1.3667	0.6834	0.4555809
Southgate Redevelopment, Bath a	Domestic	949	886	47.29	44.7	8.014	1.1591149	2.6344	0.3161	0.3161	0.6322445
Spitalfields Market (former), London	Domestic	404	333	34.23	60.66	5.105	0.7425743	3.4653	1.2376	0	0.990099
Spitalfields Market (Lamb Street), London a	Domestic	2351	2061	71.28	24.16	4.561	2.1267546	3.9983	0.7231	0.7656	0.467886
St Giles Court, London	Domestic	332	293	40.96	50.17	8.874	2.7108434	0.6024	1.2048	0	0
St John Clerkenwell, London	Domestic	149	143	79.02	18.88	2.098	1.3422819	0	0	0	0
St John's Street, Bedford	Domestic	296	286	35.66	59.44	4.895	0	0	0	0	0
St Nicholas Place, Leicester a	Domestic	880	462	45.89	33.55	20.56	2.2727273	15	7.2727	0.5682	0.5681818

Table 4.12: Species representation for domestic and wild mammals and birds from the 16th-18th century by site type

Site name	Site type	NISP (total)	NISP*	Cattle	S/G	Pig	Wild mammals	Chicken	Goose	Duck	Wild birds
The Globe Theatre, London	Domestic	279	246	43.5	49.59	6.911	6.09319	2.509	0.3584	0.3584	0.3584229
West Gate, Oxford Castle	Domestic	250	244	49.18	45.9	4.918	0	0	0	0	0.4
Ropetackle, Shoreham by Sea a	Domestic	637	637	47.57	48.98	3.454	0	0	0	0	0
20-26 Cowcross Street, London	Ecclesiastical	249	221	53.39	40.72	5.882	2.811245	5.6225	0	0	0
The Green, Northampton a	Industrial	1183	1075	48.74	43.63	7.628	0.7607777	0	0	0	0
250 Bishopgate, London	Mixed	797	793	96.09	3.026	0.883	0	0.1255	0.1255	0.1255	0
Broadgate, London	Mixed	192	177	59.89	32.2	7.91	0.5208333	1.5625	0	0	0
London Bridge City, London a	Mixed	574	529	56.14	37.05	6.805	1.5679443	3.3101	0.3484	0	0.5226481
St Bartholomews Hospital, London	Mixed	351	270	41.85	41.11	17.04	7.1225071	10.826	1.1396	1.1396	1.7094017
Abbey Wharf, Reading a	Mixed	986	986	84.08	11.46	4.462	0	0	0	0	0
Creedy's Yard, Greenwich	Mixed	179	161	61.49	36.02	2.484	2.2346369	2.2346	0.5587	1.676	0
East London Line, London a	Mixed	684	331	20.85	73.41	5.74	0.4385965	0.4386	0.2924	0	0.4385965
Finsbury Avenue Square, London	Mixed	205	183	52.46	39.34	8.197	1.4634146	6.3415	0.4878	0	0.9756098
King's Lynn	Mixed	1943	1679	53.31	35.08	11.61	0	5.5584	6.5878	0.8749	0.5661348
Bermondsey Abbey, London a	Not defined	256	207	45.89	27.54	26.57	4.6875	5.8594	1.5625	1.1719	0.390625

Table 3.12 (cont.): Species representation for domestic and wild mammals and birds from the 16th-18th century by site type

Site name	Site type	NISP (total)	NISP*	Cattle	S/G	Pig	Wild mammals	Chicken	Goose	Duck	Wild birds
Launceston Castle b	Castle	1702	1497	46.16	44.62	9.218	2.7027027	2.2914	0.1175	0	0.1762632
10 Commonhall Street, Chester	Domestic	148	103	61.17	22.33	16.5	7.4324324	14.865	3.3784	1.3514	0
129 Lambeth Road, London c	Domestic	272	238	29.83	57.56	12.61	3.3088235	3.6765	0	1.1029	0.7352941
Block E: Hungate, York a	Domestic	151	116	37.93	52.59	9.483	7.2847682	6.6225	1.9868	1.9868	0.6622517
Dung Quay, Plymouth	Domestic	118	113	46.9	47.79	5.31	0	3.3898	0	0	0.8474576
Mark Browns Wharf, London	Domestic	1753	1369	24.76	64.57	10.66	2.624073	2.2818	0	0.1711	0.1140901
City Road, Chester	Industrial	3291	2166	98.52	1.247	0.231	0.0303859	0.0912	0.0608	0	0.0607718
67-69 St Thomas' St, Oxford c	Mixed	165	155	34.19	50.97	14.84	1.2121212	3.0303	0.6061	0.6061	0
67 Upper Thames Street, London	Mixed	379	267	33.33	48.31	18.35	8.1794195	9.7625	1.847	0	0
East London Line, London b	Mixed	363	323	40.25	53.25	6.502	1.6528926	0.2755	0	0	0
Exeter d	Mixed	1607	1216	36.6	51.81	11.6	8.7741133	4.9782	1.6179	0.3734	0.3733665
The Rose Theatre, London b	Mixed	800	734	28.2	63.22	8.583	2.125	0.5	0.125	0	0
Palace of Westminster, London	Palace	141	116	53.45	23.28	23.28	4.964539	3.5461	0.7092	6.383	0.7092199

Table 4.13: Species representation for domestic and wild mammals and birds from the 17th-19th century by site type

Site name	Site type	NISP (total)	NISP*	Cattle	S/G	Pig	Wild mammals	Chicken	Goose	Duck	Wild birds
Canterbury Defences	Domestic	220	208	20.67	59.62	19.71	0	0	0	0	0
East London Line: Holywell Priory, London b	Domestic	344	322	33.85	55.9	10.25	2.3255814	2.3256	0	0	0.2906977
Merton Priory, London	Ecclesiastical	253	237	56.54	22.36	21.1	0.7905138	2.3715	1.9763	0	0
Royal London Hospital, London	Hospital	548	362	38.67	58.56	2.762	2.189781	0.9124	0.1825	0	0.5474453
The Green, Northampton b	Industrial	658	633	67.77	28.75	3.476	0.1519757	0	0	0	0
Southgate Redevelopment, Bath b	Mixed	134	125	35.2	48.8	16	0.7462687	2.9851	0	0.7463	0
Southbridge House (Rose Theatre), London c	Mixed	326	303	34.98	58.75	6.271	4.2944785	1.227	0	0	0
Saxon Lundenwic, London	Not defined	265	257	47.86	11.28	40.86	0.3773585	1.8868	0	0	0

Table 4.14: Species representation for domestic and wild mammals and birds from the late 17th-20th century by site type

Table 4.15: Presence/absence of wild birds from post-medieval urban sites included birds from sieved material

Species	Latin name	late-medieval-early modern period				early modern to modern period					Overlapping periods		
		15th-17th	16th-17th	16th	17th	17th-18th	18th	18-19th	19th	19th-20th	16th-18th	17th-19th	L17th-20th
Auk	*Alcidae*		x					x					
Bar-tailed godwit	*Limosa lapponica*		x	x									
Barn owl	*Tyto alba*		x										
Blackbird	*Turdus merula*	x				x	x						
Black goose	*Branta sp.*			x	x								
Black grouse	*Tetrao tetrix*		x										
Brent goose	*Branta bernicla*			x									
Buzzard	*Buteo buteo*		x								x		
Calidris spp.				x									
Coot	*Fulica atra*	x	x	x									
Cormorant	*Phalacrocorax carbo*					x					x		
Corncrake	*Crex crex*		x										
Corvid (small and large)	*Corvus sp.*	x	x	x	x	x	x	x	x	x	x		
Crane	*Grus grus*			x							x		
Crow/rook	*Corvus corone/frugilegus*	x	x	x	x	x	x			x	x		
Chaffinch	*Fringilla coelebs*						x						
Curlew	*Numenius arquata*	x	x	x	x								
Gadwall	*Anas strepera*										x		
Grebe	*Tachybaptes ruficollis*			x									
Grey partridge	*Perdix perdix*	x	x	x	x	x	x	x	x	x	x		
Green plover	*Vanellus vanellus*			x									
Grouse	*Tetrao sp.*	x		x		x							

Godwit	*Limosa sp,*			x									
Golden eagle	*Aquila chrysaetos*		x										
Golden plover	*Pluvialis apricaria*	x	x	x	x	x					x		x
Goshawk	*Accipiter gentilis*							x			x		
Goosander	*Mergus merganser*		x										
Green sandpiper	*Tringa ochropus*		x										
Guillemot	*Uria aalge*			x								x	
Guineafowl?	*Numida meleagris*				x								
Gull	*Larus sp.*	x	x	x	x	x					x		
Herring gull	*Larus argentatus*					x					x		
Heron/Grey heron	*Ardea sp./Ardea cinerea*	x	x	x	x	x				x	x		
House martin						x							
House sparrow*	*Passer domesticus*				x	x							
Jackdaw/magpie	*Corvus monedula/Pica pica*	x	x	x	x	x				x	x	x	x
Jack snipe	*Lymnocryptes minimus*	x				x	x						
Jay	*Garrulus glandarius*		x		x								
Kestrel	*Falco tinnunculus*				x								
Kittiwake	*Rissa sp.*					x							
Lapwing	*Vanellus vanellus*	x		x		x	x		x	x	x		
Lesser black-backed gull	*Larus fuscus*		x										
Moorhen	*Gallinula chloropus*			x							x		
Mute swan	*Cygnus olor*					x							
Osprey	*Pandion haliaetus*		x										
Ostrich	*Struthio camelus*										x		
Oystercatcher	*Haematopus ostralegus*	x	x	x									
Partridge	*Perdix perdix/Alectoris rufa*	x	x	x	x	x		x			x		
Parrot	*Psittaciformes*										x		
Peafowl	*Pavo cristatus*			x	x		x					x	
Passerine	*Passerine*	x	x	x	x	x	x		x	x	x	x	

Peregrine falcon	*Flaco peregrinus*							x			x		
Pheasant	*Phasianus colchicus*		x					x			x		
Pigeon	*Columba livia*	x		x	x	x	x						
Pigeon/dove	*Columbidae*		x	x	x	x	x	x		x	x		
Pintail	*Anas acuta*										x		
Plover unid.	*Charadriinae*		x	x	x	x	x						
Pochard	*Aythya ferina*				x	x							
Quail	*Coturnix coturnix*									x			
Raptor					x								
Raven	*Corvus corax*	x	x	x	x	x	x	x		x		x	
Red grouse	*Lagopus lagopus scoticus*				x								
Red kite	*Milvus milvus*		x	x		x					x		
Redshank	*Tringa cf. Totanus*			x									
Ringed plover	*Charadrius hiaticula*		x										
Rock dove	*Columba livia*					x							
Rock/stock dove	*Columba livia/oenas*		x	x	x	x	x			x	x		
Scoter	*Melanitta sp.*	x											
Skylark	*Alauda arvensis*		x										
Small charadiiform	*Small charadiiform*		x	x	x	x			x				
Smew	*Mergellus albellus*				x								
Snipe	*Gallinago gallinago*	x		x		x	x		x	x	x		
Songthrush	*Turdus philomelos*					x	x						
Sparrowhawk	*Accipiter nisus*		x										
Spoonbill	*Platalea leucorodia*		x										
Starling	*Sturnus vulgaris*		x	x			x						
Stock dove	*Columba oenas*		x		x	x		x		x			
Swan	*Cygnus sp.*	x	x	x		x	x	x			x	x	
Swift	*Apodidae*			x									
Teal/garganey	*Anas crecca/querquedula*	x	x	x	x	x	x			x	x		

Thrushes	*Turdidae*		x	x		x				x	x		
Tufted duck	*Aythya fuligula*		x	x									
Turdid (small and large)	*Turdus sp*	x	x	x	x	x	x			x			
Turkey	*Meleagris gallopavo*		x	x	x	x	x			x	x	x	x
Wagtail	*Motacilla sp.*	x											
Water rail	*Rallus aquaticus*							x					
Wild duck		x											
Wild goose	*Anser/Branta*			x									
Widgeon	*Anas penelope*		x			x					x		
Woodcock	*Scolopax rusticola*	x	x	x	x	x	x	x	x	x	x	x	x
Wood pigeon	*Columba palumbus*	x	x	x	x	x		x					
Wren	*Troglodytidae*						x						

Table 4.16: Presence/absence of fish from post-medieval urban sites included fish from sieved material. Freshwater, migratory and marine species are divided the black boarders. Species were divided into categories using Holmes (2011, table 4.12).

Species	*Latin name*	late-medieval-early modern period				early modern to modern period						Overlapping periods		
		15th-17th	16th-17th	16th	17th	17th-18th	18th	18-19th	19th	19th-20th	20th	16th-18th	17th-19th	L17th-20th
Barbel	*Barbus barbus*					x								
Burbot	*Lota lota*					x								
Carp	*Cyprinus carpio*	x					x					x		
Chub	*Leuciscus cephalus*	x					x							
Cyprinid	*Cyprinid*	x	x		x	x	x		x	x		x	x	x
Dace	*Leuciscus leuciscus*		x											
Pike	*Esox lucius*	x	x	x	x	x				x			x	
Perch	*Perca fluviatilis*		x			x	x		x			x		
Percidae	*Percidae*					x								
Roach	*Rutilus rutilus*	x	x			x	x		x				x	x
Roach/rudd	*Rutilus rutilus/Scardinius erythrophthalmus*						x							
Stickleback	*Gasterosteus aculeatus aculeatus*	x				x								
Tench	*Tinca tinca*					x						x		
Trout	*Salmo trutta*			x		x						x		
Eel	*Anguilla anguilla*	x	x	x	x	x	x	x	x	x	x	x	x	x
Flounder	*Platichthys flesus*	x		x	x	x	x	x	x					
Grey Mullet	*Mugil cephalus*			x								x		
Mullet	*Mugil cephalus*		x											
Pleuronectidae	*Pleuronectidae*	x				x	x		x	x	x	x		
Salmon	*Salmo salar*	x	x			x	x			x			x	

Salmonidae	*Salmonidae*	x	x			x	x					x		
Scad	*Trachurus trachurus*			x								x	x	
Smelt	*Osmerus eperlangus*	x	x	x		x	x	x	x	x		x		x
Sturgeon	*Acipenser sturio*	x										x	x	
Anchovy	*Engraulis encrasicolus*	x				x	x		x					
Anchovy/herring	*Engraulis encrasicolus/Clupea harengus*	x												
Bass	*Dicentrarchus labrax*		x			x	x							
Ballan wrasse	*Labrus bergylta*		x											
Bib	*Trisopterus luscus*	x												
Bothidae	*Bothidae*	x												
Clupeidae	*Clupeidae*	x	x	x		x	x	x	x	x		x	x	x
Cod	*Gadus morhua*	x	x	x	x	x	x	x	x	x		x	x	x
Conger eel	*Conger conger*	x	x		x	x	x	x	x			x	x	
Cottid	*Cottid*			x								x		
Dab	*Limanda limanda*	x	x	x										
Dory	*Zeidae*		x	x		x							x	
Elasmobranch	*Elasmobranch*	x	x	x		x	x	x		x		x	x	x
Flatfish	*Pleuronectiformes*	x	x		x	x	x			x		x	x	
Gadid	*Gadid*	x	x	x	x	x	x	x	x	x		x	x	x
Garfish	*Belone belone*		x			x								
Gadoid	*Gadid*		x			x	x							
Goby	*Gobiidae*		x											
Gurnard	*Triglidae*	x	x	x	x	x	x	x	x	x		x	x	x
Haddock	*Melanogrammus aeglefinus*	x	x	x	x	x	x			x		x	x	
Hake	*Merluccius merluccius*	x	x		x	x							x	
Halibut	*Hippoglossus hippoglossus*			x					x	x		x		
Herring	*Clupea harengus*	x	x	x	x	x	x	x	x	x	x	x	x	x
John Dory	*Zeus faber*				x									

Lamniform	*Lamniform*	x		x										
Lemon sole	*Microstomus kitt*	x												
Ling	*Molva molva*	x	x	x	x	x	x		x	x		x	x	
Mackerel	*Scomber sombrus*	x	x	x	x	x	x	x		x		x	x	
Pilchard	*Sardina pilchardus*		x											
Plaice	*Pleuronectes platessa*	x	x	x	x	x	x	x	x	x		x	x	
Plaice/Flounder	*Pleuronectes platessa/Platichthysflesus*		x		x	x	x	x	x	x		x	x	x
Pollack	*Pollachius pollachius*		x	x								x	x	
Roker/thornback ray	*Raja clavata*	x	x	x		x			x	x		x	x	x
Saithe	*Pollachius virens*	x								x				
Sand eel	*Ammodytidae*	x												
Sea bream	*Spondyliosoma cantharus/Pagellus bogaraveo*	x	x		x									
Shark	*Selachimorpha*							x						
Smooth hound	*Mustelus*	x												
Sole	*Solea solea*	x	x	x		x	x		x					
Sprat	*Sprattus sprattus*		x				x			x		x		
Spurdog	*Squalus acanthias*			x										
Thornback ray	*Raja clavata*	x	x	x		x	x		x					
Tope	*Triakidae*	x												
Triglidae	*Triglidae*					x								
Tub gurnard	*Trigla lucerna*		x				x							
Turbot	*Scophthalmus maximus*	x	x			x						x	x	
Turbot/Brill	*Scophthalmus maximus/Scophthalmus rhombus*			x										
Weever	*Trachinidae*	x				x								
Whiting	*Merlangius merlangus*	x	x	x	x	x	x		x		x	x	x	x
Wrasse	*Labridae*		x			x		x					x	

Length	15th-17th	16th-17th	17th-18th	18th-20th	16th-18th	17th-19th	L17th-20th
N	38	205	29	35	108	63	15
Min	-0.08798296	-0.11818	-0.10508	-0.07485	-0.063868	-0.0638676	-0.07972616
Max	0.05093009	0.070819	0.067336	0.114257	0.0966376	0.07656398	0.08091036
Sum	-0.5190865	-1.367	-0.0689	-0.04413	1.028938	0.7049911	0.02749846
Mean	-0.01366017	-0.00667	-0.00238	-0.00126	0.0095272	0.01119034	0.001833231
Std. error	0.005405851	0.002442	0.007484	0.007669	0.002853	0.00389694	0.01122814
Variance	0.001110483	0.001222	0.001624	0.002058	0.0008791	0.00095673	0.001891068
Stand. dev	0.0333239	0.034964	0.040302	0.045368	0.0296494	0.03093099	0.04348641
Median	-0.0147402	-0.00205	0.003984	-0.00402	0.0058193	0.00796457	0.000999527
25 prcntil	-0.03525267	-0.02776	-0.03376	-0.03471	-0.010531	-0.0089407	-0.0311198
75 prcntil	0.01452306	0.018001	0.025999	0.021902	0.0268722	0.0329101	0.03920388
Skewness	-0.248238	-0.39586	-0.50941	0.929514	0.3212576	0.02725663	-0.01360528
Kurtosis	-0.2649161	0.004249	0.12889	0.754205	0.5214165	-0.1645268	-0.3084175
Geom. mean	0	0	0	0	0	0	0
Coeff. var	0	0	0	0	311.2072	276.4081	2372.119

Table 4.17: Cattle univariate statistics for length post cranial measurements

Breadth	15th-17th	16th-17th	17th-18th	18th-20th	16th-18th	17th-19th	L17th-20th
N	83	462	115	93	440	128	17
Min	-0.15127	-0.159175	-0.1317567	-0.1648727	-0.14263	-0.1354372	-0.1325552
Max	0.029503	0.1455487	0.1373168	0.094047	0.1371732	0.048545	0.1103657
Sum	-4.69338	-22.29259	-4.630929	-3.998309	-4.043552	-5.535482	-0.6247046
Mean	-0.05654675	-0.04825236	-0.040269	-0.04299256	-0.0091899	-0.043246	-0.03674733
Std. error	0.004921782	0.002045201	0.0047921	0.005459179	0.00231172	0.0033632	0.01722352
Variance	0.002010587	0.001932475	0.0026409	0.002771645	0.00235139	0.0014478	0.00504305
Stand. dev	0.04483957	0.04395993	0.0513896	0.05264642	0.04849109	0.0380505	0.07101441
Median	-0.06324	-0.04784149	-0.0482375	-0.05233612	-0.0095847	-0.0432428	-0.05337398
25 prcntil	-0.08888	-0.07741222	-0.0750647	-0.0832817	-0.043623	-0.0725258	-0.09502956
75 prcntil	-0.02247	-0.01774998	-0.0151433	-0.00479778	0.02688674	-0.0153093	0.02081947
Skewness	0.08760295	0.1772666	0.9370333	0.2926209	0.000105	0.1368566	0.4630886
Kurtosis	-0.7679657	0.3870389	1.043263	-0.3029688	-0.4542693	-0.1753117	-0.5580586
Geom. mean	0	0	0	0	0	0	0
Coeff. var	0	0	0	0	0	0	0

Table 4.18: Cattle univariate statistics for breadth post cranial measurements

16th-18th	Northern	Central	Southern
N	69	133	112
Min	-0.09981	-0.07158	-0.11818
Max	0.041336	0.067933	0.096638
Sum	-1.16853	0.176839	0.631717
Mean	-0.01694	0.00133	0.00564
Std. error	0.003994	0.002889	0.003079
Variance	0.001101	0.00111	0.001062
Stand. dev	0.033179	0.033317	0.032589
Median	-0.00934	0.004138	0.002534
25 prcntil	-0.04139	-0.02089	-0.01289
75 prcntil	0.007933	0.025552	0.026662
Skewness	-0.45009	-0.21635	-0.30552
Kurtosis	-0.54613	-0.60811	2.397068
Geom. mean	0	0	0
Coeff. var	0	2505.734	577.7769

17th-20th	Northern	Central	Southern
N	57	27	69
Min	-0.10508	-0.11746	-0.07973
Max	0.094904	0.066048	0.114257
Sum	-0.07501	-0.73347	0.542176
Mean	-0.00132	-0.02717	0.007858
Std. error	0.005066	0.009668	0.004645
Variance	0.001463	0.002524	0.001489
Stand. dev	0.038247	0.050236	0.038582
Median	-0.00342	-0.02992	0.004065
25 prcntil	-0.02948	-0.07485	-0.01772
75 prcntil	0.026918	0.016037	0.032473
Skewness	-0.05765	-0.00526	0.423132
Kurtosis	0.17093	-1.2396	0.366074
Geom. mean	0	0	0
Coeff. var	0	0	491.0148

Table 4.19: Cattle univariate statistics for length post cranial measurements from northern, central and southern England

16th-18th	Northern	Central	Southern
N	131	348	414
Min	-0.1587172	-0.14263	-0.185997
Max	0.035913	0.145549	0.137173
Sum	-7.445836	-14.12448	-4.127815
Mean	-0.0568384	-0.040588	-0.009971
Std. error	0.00387078	0.002309	0.002517
Variance	0.00196276	0.001856	0.002622
Stand. dev	0.04430309	0.04308	0.051206
Median	-0.0612398	-0.04254	-0.008521
25 prcntil	-0.0913733	-0.071207	-0.043997
75 prcntil	-0.01878	-0.013437	0.027193
Skewness	0.0111911	0.406909	-0.252014
Kurtosis	-0.6529923	0.489087	0.050583
Geom. mean	0	0	0
Coeff. var	0	0	0

17th-20th	Northern	Central	Southern
N	147	58	150
Min	-0.1648727	-0.149205	-0.132555
Max	0.1373168	0.051603	0.136483
Sum	-8.700079	-2.312457	-3.472625
Mean	-0.0591842	-0.03987	-0.023151
Std. error	0.00352298	0.005126	0.004368
Variance	0.00182448	0.001524	0.002862
Stand. dev	0.04271388	0.039036	0.053498
Median	-0.065247	-0.038277	-0.033365
25 prcntil	-0.0885394	-0.065724	-0.061475
75 prcntil	-0.03151	-0.00801	0.00829
Skewness	0.8789781	-0.317487	0.484611
Kurtosis	2.26E+00	0.339189	-0.036065
Geom. mean	0	0	0
Coeff. var	0	0	0

Table 4.20: Cattle univariate statistics for breadth post cranial measurements from northern, central and southern England

Length	15th-17th	16th-17th	17th-18th	18th-19th	19th-20th	16th-18th	L17th-20th
N	93	411	69	42	45	122	83
Min	-0.02002	-0.1528	-0.01634	-0.02228	-0.06298	-0.05945	-0.03587
Max	0.130066	0.151109	0.139563	0.166331	0.157412	0.13279	0.173631
Sum	5.152422	16.4633	4.25205	2.660682	3.080515	5.938834	4.892581
Mean	0.055402	0.040057	0.061624	0.06335	0.068456	0.048679	0.058947
Std. error	0.003645	0.001794	0.004436	0.006338	0.006171	0.0035	0.005216
Variance	0.001236	0.001322	0.001358	0.001687	0.001713	0.001494	0.002258
Stand. dev	0.035152	0.036365	0.036845	0.041073	0.041394	0.038659	0.047516
Median	0.058823	0.039509	0.068101	0.058449	0.057539	0.052173	0.058452
25 prcntil	0.024793	0.01494	0.026562	0.035542	0.043555	0.028606	0.024964
75 prcntil	0.081348	0.066611	0.093214	0.084557	0.097786	0.073593	0.085172
Skewness	-0.20524	-0.2214	-0.18504	0.586127	-0.13675	-0.34942	0.407397
Kurtosis	-0.7445	1.45263	-1.00086	0.314008	1.34149	0.048628	-0.08501
Geom. mean	0	0	0	0	0	0	0
Coeff. var	63.44919	90.78465	59.78929	64.83622	60.46751	79.41551	80.60811

Table 4.21: Sheep/goat univariate statistics for length post cranial measurements

Breadth	15th-17th	16th-17th	17th-18th	18th-19th	19th-20th	16th-18th	L17th-20th
N	209	1003	235	137	149	394	262
Min	-0.13047	-0.1034	0.003634	-0.04539	-0.03267	0.012409	0.002829
Max	0.153852	0.195613	0.193232	0.189434	0.196613	0.185264	0.197654
Sum	17.34803	69.38276	19.81011	12.67843	13.41943	36.95186	22.7944
Mean	0.083005	0.069175	0.084298	0.092543	0.090063	0.093786	0.087002
Std. error	0.002307	0.000918	0.002113	0.003548	0.003497	0.001724	0.002315
Variance	0.001113	0.000845	0.00105	0.001724	0.001822	0.001171	0.001404
Stand. dev	0.033354	0.029068	0.032399	0.041525	0.042687	0.034213	0.037467
Median	0.083597	0.069027	0.084644	0.089145	0.085201	0.094013	0.085201
25 prcntil	0.063572	0.050241	0.063572	0.066625	0.059216	0.070581	0.058778
75 prcntil	0.106955	0.08715	0.104866	0.111938	0.120496	0.118599	0.110958
Skewness	-1.26667	-0.11365	0.203604	0.067302	0.355331	-0.06929	0.293594
Kurtosis	7.108701	1.836971	0.153146	0.36794	-0.11682	-0.40335	-0.22047
Geom. mean	0	0	0.076532	0	0	0.086152	0.076976
Coeff. var	40.18365	42.02076	38.43389	44.87098	47.39666	36.47987	43.06434

Table 4.22: Sheep/goat univariate statistics for breadth post cranial measurements

16th-18th	Northern	Central	Southern
N	66	369	97
Min	-0.01237	-0.0608	-0.05945
Max	0.129791	0.151109	0.128966
Sum	3.869197	14.77197	3.91378
Mean	0.058624	0.040032	0.040348
Std. error	0.003345	0.001807	0.004408
Variance	0.000738	0.001204	0.001885
Stand. dev	0.027174	0.034703	0.043419
Median	0.060736	0.038345	0.04467
25 prcntil	0.041393	0.01424	0.003556
75 prcntil	0.075794	0.064602	0.073449
Skewness	-0.1535	0.269228	-0.25515
Kurtosis	0.157035	0.049711	-0.69545
Geom. mean	0	0	0
Coeff. var	46.35308	86.68598	107.6097

17th-20th	Northern	Central	Southern
N	33	33	168
Min	-0.02228	-0.01634	-0.06298
Max	0.150834	0.138971	0.173631
Sum	2.241749	1.859099	10.40458
Mean	0.067932	0.056336	0.061932
Std. error	0.006517	0.006674	0.003447
Variance	0.001402	0.00147	0.001996
Stand. dev	0.037438	0.038338	0.044675
Median	0.06555	0.050892	0.060913
25 prcntil	0.044495	0.026006	0.030426
75 prcntil	0.096168	0.081164	0.093184
Skewness	-0.015	0.286043	0.199439
Kurtosis	0.363265	-0.55951	0.016226
Geom. mean	0	0	0
Coeff. var	55.111	68.05141	72.13618

Table 4.23: Sheep/goat univariate statistics for length post cranial measurements from northern, central and southern England

16th-18th	Northern	Central	Southern
N	190	747	466
Min	-0.01999	-0.1034	-0.01397
Max	0.195613	0.174723	0.185264
Sum	11.71015	55.11438	39.4448
Mean	0.061632	0.073781	0.084645
Std. error	0.002238	0.001068	0.001701
Variance	0.000952	0.000852	0.001348
Stand. dev	0.030854	0.029192	0.036717
Median	0.064332	0.073672	0.083128
25 prcntil	0.039943	0.054787	0.057992
75 prcntil	0.080104	0.09227	0.110805
Skewness	0.192236	-0.25435	0.067577
Kurtosis	1.843978	2.150691	-0.49604
Geom. mean	0	0	0
Coeff. var	50.0617	39.56629	43.3768

17th-20th	Northern	Central	Southern
N	247	85	454
Min	-0.07195	0.003634	-0.03267
Max	0.198709	0.167819	0.197654
Sum	18.59424	7.188164	42.96536
Mean	0.07528	0.084567	0.094637
Std. error	0.002364	0.003494	0.001798
Variance	0.001381	0.001038	0.001468
Stand. dev	0.037156	0.032212	0.038311
Median	0.072129	0.085821	0.093433
25 prcntil	0.049485	0.061114	0.069636
75 prcntil	0.091889	0.10575	0.117709
Skewness	0.293668	0.17317	0.185273
Kurtosis	1.600768	-0.05711	0.013827
Geom. mean	0	0.076651	0
Coeff. var	49.35641	38.09108	40.48139

Table 4.24: Sheep/goat univariate statistics for breadth post cranial measurements from northern, central and southern England

Length	16th-17th	17th-20th	16th-18th
N	17	16	7
Min	-0.06944	-0.02162	0.013538
Max	0.105308	0.150511	0.137364
Sum	0.621488	1.196091	0.538089
Mean	0.036558	0.074756	0.07687
Std. error	0.01235	0.011388	0.016848
Variance	0.002593	0.002075	0.001987
Stand. dev	0.050919	0.045552	0.044575
Median	0.051789	0.07839	0.074573
25 prcntil	-0.00869	0.045386	0.043575
75 prcntil	0.074069	0.101685	0.111557
Skewness	-0.48102	-0.34789	-0.04477
Kurtosis	-0.62579	0.149256	-1.37457
Geom. mean	0	0	0.062022
Coeff. var	139.2817	60.93419	57.9873

Table 4.25: Pig univariate statistics for length post cranial measurements

Breadth	16th-17th	17th-20th	16th-18th
N	40	41	10
Min	-0.19118	-0.10668	-0.1016
Max	0.163623	0.165972	0.164893
Sum	-0.09746	1.010742	0.353077
Mean	-0.00244	0.024652	0.035308
Std. error	0.012945	0.011614	0.02445
Variance	0.006703	0.00553	0.005978
Stand. dev	0.081869	0.074363	0.077317
Median	0.005296	0.033424	0.029434
25 prcntil	-0.04638	-0.03834	-0.01254
75 prcntil	0.059597	0.065422	0.092776
Skewness	-0.55809	0.077916	0.009046
Kurtosis	0.31982	-0.65801	0.010638
Geom. mean	0	0	0
Coeff. var	0	301.6478	218.9804

Table 4.26: Pig univariate statistics for breadth post cranial measurements

Length	15th-17th	16th-17th	17th-18th	18th-20th	16th-18th	L17th-20th
N	36	349	45	79	116	17
Min	-0.19431	-0.19837	-0.17435	-0.17229	-0.103911	-0.09735
Max	0.081976	0.083319	0.145974	0.099061	0.1499985	0.123049
Sum	-0.80721	-7.35674	-0.45095	0.048087	-0.0066624	-0.23549
Mean	-0.02242	-0.02108	-0.01002	0.000609	-5.74345E-05	-0.01385
Std. error	0.008469	0.002404	0.008052	0.005719	0.004538548	0.012681
Variance	0.002582	0.002016	0.002917	0.002584	0.002389417	0.002734
Stand. dev	0.050816	0.044902	0.054011	0.05083	0.04888166	0.052284
Median	-0.03202	-0.02822	-0.01373	-0.0017	-0.0110495	-0.01478
25 prcntil	-0.04806	-0.05501	-0.04214	-0.02569	-0.0346095	-0.05542
75 prcntil	0.013694	0.014996	0.026394	0.036235	0.0264088	0.014967
Skewness	-0.58842	0.059689	-0.25093	-1.01123	0.6260017	0.902014
Kurtosis	2.734839	0.223218	2.41673	2.668702	0.09404769	1.70146
Geom. mean	0	0	0	0	0	0
Coeff. var	0	0	0	8350.6	0	0

Table 4.27: Chicken univariate statistics for length post cranial measurements

Breadth	15th-17th	16th-17th	17th-18th	18th-20th	16th-18th	L17th-20th
N	20	336	36	113	83	33
Min	-0.1095	-0.18613	-0.17485	-0.19552	-0.10316	-0.14267
Max	0.043905	0.106053	0.079181	0.11764	0.116304	0.110339
Sum	-0.58366	-10.5092	-0.71678	-2.14906	-1.28432	-0.93792
Mean	-0.02918	-0.03128	-0.01991	-0.01902	-0.01547	-0.02842
Std. error	0.010785	0.002752	0.009892	0.005781	0.005545	0.009477
Variance	0.002326	0.002545	0.003523	0.003776	0.002552	0.002964
Stand. dev	0.048233	0.050451	0.059354	0.061452	0.050518	0.054442
Median	-0.02082	-0.03451	-0.0166	-0.01744	-0.02211	-0.02462
25 prcntil	-0.06939	-0.06729	-0.05266	-0.04122	-0.05459	-0.06638
75 prcntil	0.014594	0.006619	0.028029	0.027667	0.023767	-0.0031
Skewness	-0.11813	0.015449	-0.48375	-0.78821	0.260688	0.289946
Kurtosis	-1.21067	-0.07947	0.134368	0.554362	-0.57072	0.400398
Geom. mean	0	0	0	0	0	0
Coeff. var	0	0	0	0	0	0

Table 4.28: Chicken univariate statistics for breadth post cranial measurements

16th-18th	Northern	Central	Southern
N	207	147	111
Min	-0.10394	-0.19837	-0.12305
Max	0.059266	0.09532	0.149999
Sum	-4.7482	-1.82578	-0.78942
Mean	-0.02294	-0.01242	-0.00711
Std. error	0.002582	0.004347	0.004993
Variance	0.00138	0.002778	0.002768
Stand. dev	0.037148	0.052706	0.052607
Median	-0.03012	-0.01448	-0.01579
25 prcntil	-0.05318	-0.05044	-0.04337
75 prcntil	0.003221	0.02733	0.023206
Skewness	0.377969	-0.28817	0.544278
Kurtosis	-0.75736	0.426772	0.061784
Geom. mean	0	0	0
Coeff. var	0	0	0

17th-20th	Northern	Southern	Central
N	31	82	22
Min	-0.31461	-0.09735	-0.17229
Max	0.145974	0.123049	0.090743
Sum	-0.2476	-0.4566	-0.20349
Mean	-0.00799	-0.00557	-0.00925
Std. error	0.015389	0.004426	0.01574
Variance	0.007341	0.001607	0.00545
Stand. dev	0.085682	0.040084	0.073825
Median	0.01524	-0.01453	-0.00348
25 prcntil	-0.0417	-0.03035	-0.03936
75 prcntil	0.033184	0.01283	0.045422
Skewness	-1.74352	0.731472	-1.10675
Kurtosis	4.85086	0.861051	0.656772
Geom. mean	0	0	0
Coeff. var	0	0	0

Table 4.29: Chicken univariate statistics for length post cranial measurements from northern, central and southern England

16th-18th	Northern	Central	Southern
N	237	119	68
Min	-0.16123	-0.18613	-0.14267
Max	0.094976	0.106053	0.116304
Sum	-7.89453	-2.45997	-1.43791
Mean	-0.03331	-0.02067	-0.02115
Std. error	0.002938	0.005276	0.006796
Variance	0.002045	0.003313	0.003141
Stand. dev	0.045224	0.057559	0.056041
Median	-0.03562	-0.01804	-0.02462
25 prcntil	-0.06718	-0.05799	-0.06913
75 prcntil	-0.00285	0.021043	0.019294
Skewness	0.163747	-0.3538	0.287987
Kurtosis	-0.18072	-0.04289	-0.53054
Geom. mean	0	0	0
Coeff. var	0	0	0

17th-20th	Northern	Central	Southern
N	35	82	60
Min	-0.17485	-0.19552	-0.14267
Max	0.11764	0.072288	0.110339
Sum	-0.28323	-2.37798	-1.09446
Mean	-0.00809	-0.029	-0.01824
Std. error	0.010194	0.007296	0.006596
Variance	0.003637	0.004365	0.00261
Stand. dev	0.060307	0.066067	0.051089
Median	-0.0062	-0.02462	-0.02085
25 prcntil	-0.04275	-0.05768	-0.04831
75 prcntil	0.034927	0.021834	0.014595
Skewness	-0.51242	-0.66097	0.054593
Kurtosis	0.799852	-0.23752	0.402353
Geom. mean	0	0	0
Coeff. var	0	0	0

Table 4.30: Chicken univariate statistics for breadth post cranial measurements from northern, central and southern England

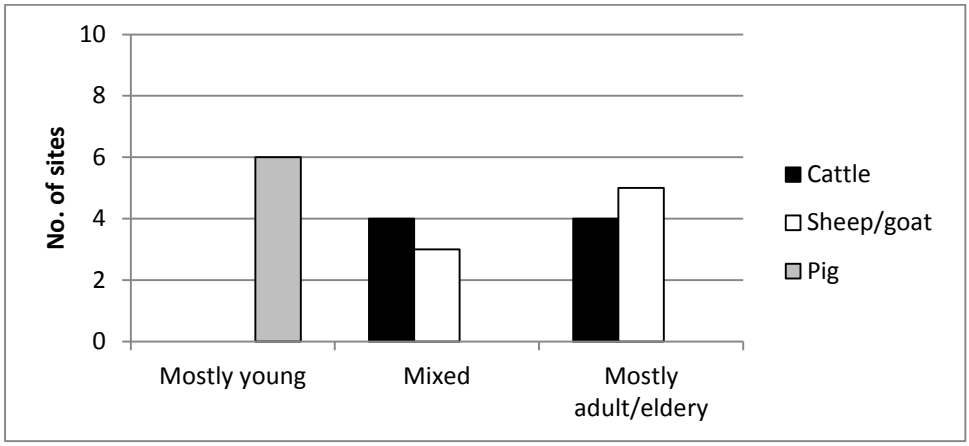

Figure 4.2: Cattle, sheep/goat and pig from broad age categories at 15th-17th-C post-medieval sites. (n)=number of sites

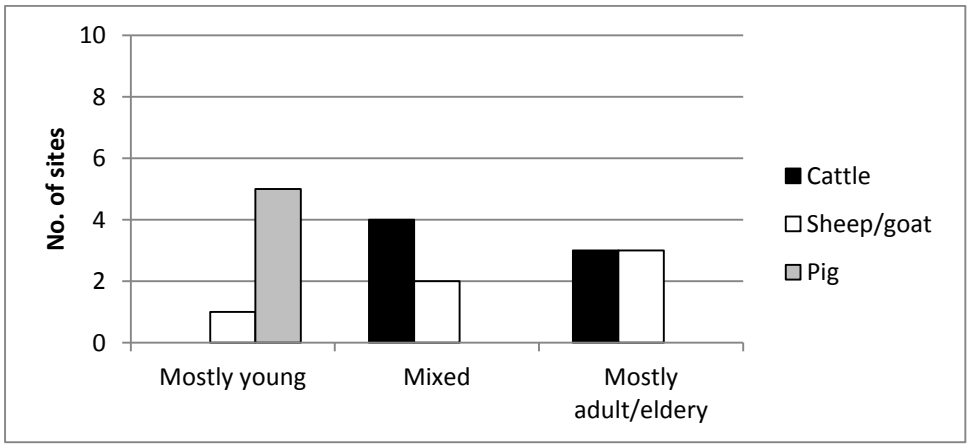

Figure 4.3: Cattle, sheep/goat and pig from broad age categories at 16th-17th-C post-medieval sites (n)=number of sites

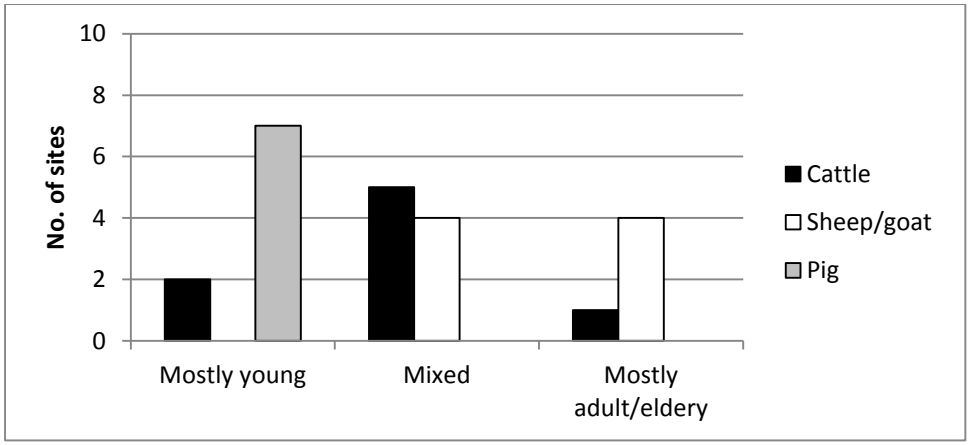

Figure 4.4: Cattle, sheep/goat and pig from broad age categories at 16th-C post-medieval sites. (n=number of sites)

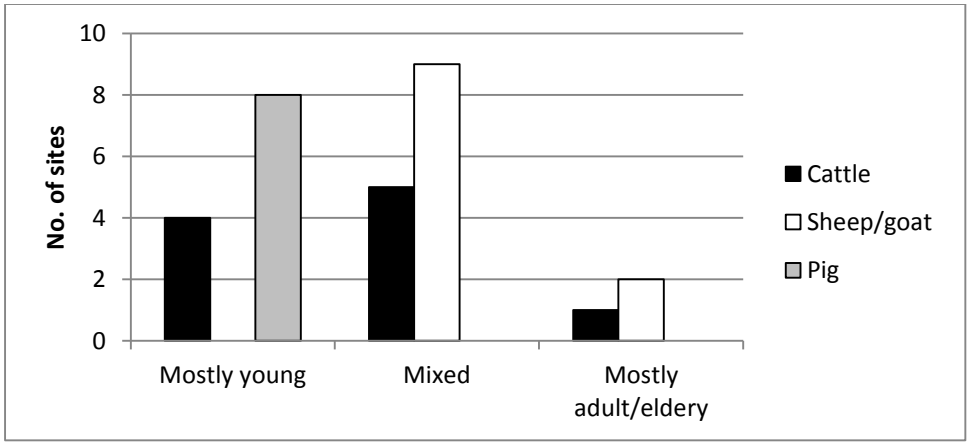

Figure 4.5: Cattle, sheep/goat and pig from broad age categories at 17th-C post-medieval sites. (n)=number of sites

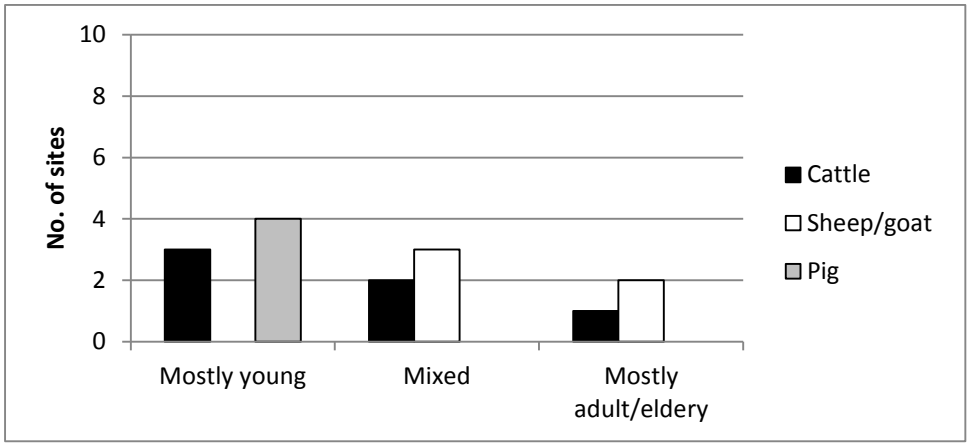

Figure 4.6: Cattle, sheep/goat and pig from broad age categories at 17th-18th-C post-medieval sites (n)=number of sites

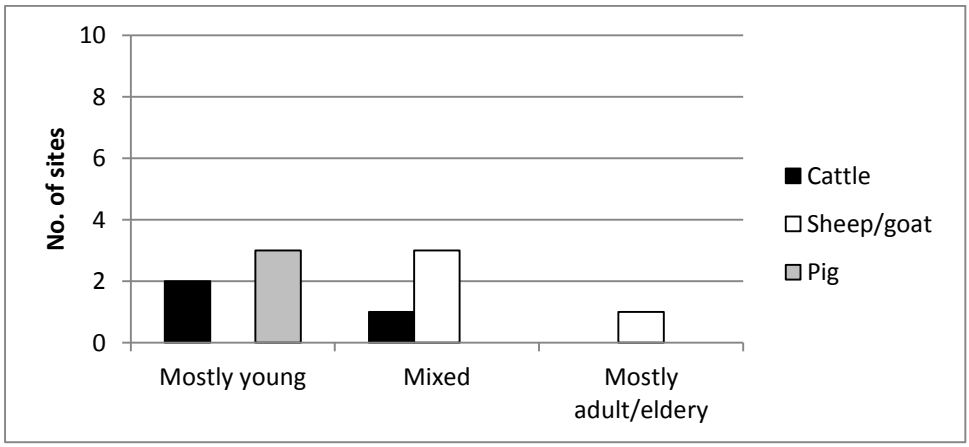

Figure 4.7: Cattle, sheep/goat and pig from broad age categories at 19th-20th-C post-medieval sites (n)=number of sites. 20th-century sites were included

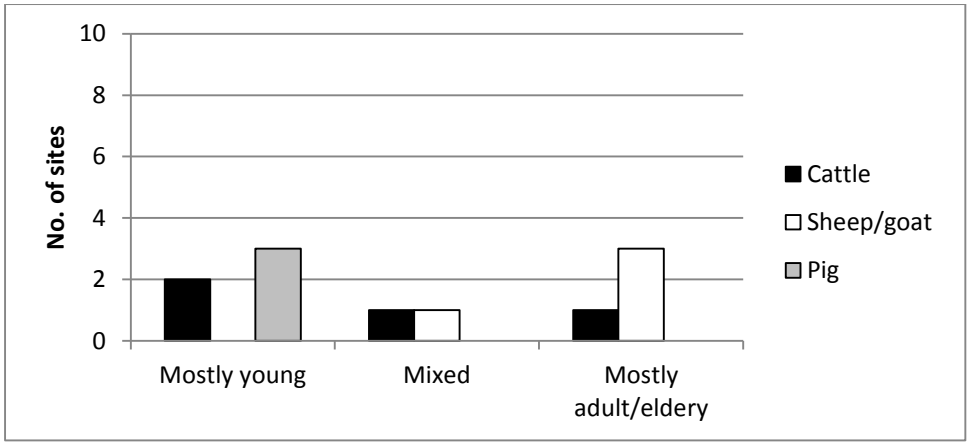

Figure 4.8: Cattle, sheep/goat and pig from broad age categories at 16th-18th-C post-medieval sites. (n)=number of sites

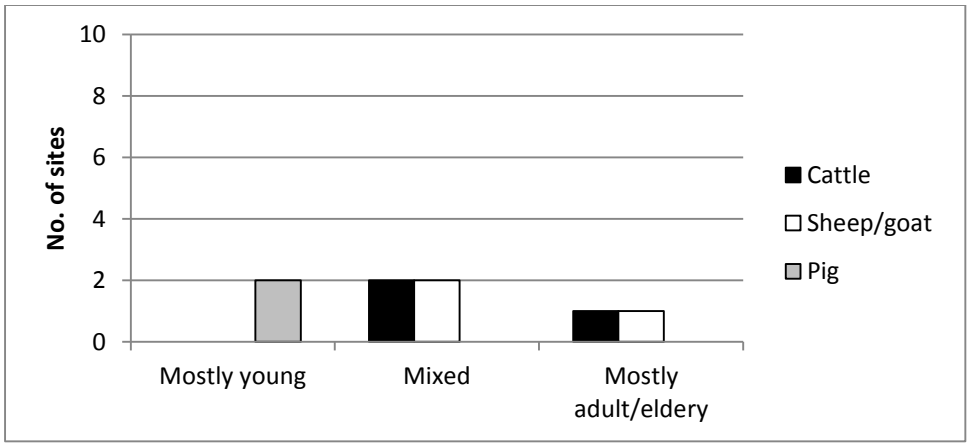

Figure 4.9: Cattle, sheep/goat and pig from broad age categories at L17th-20th-C post-medieval sites. (n)=number of sites

Element	Taxon	Site name	Date	Brief description and summary
First phalanx	Cattle	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	Small cavity on the distal articular surface of three specimens.
Incisor	Cattle	Closegate I & II, Newcastle Upon Tyne a	15th - 16th	Abnormal wear on the lateral side at the base of the crown which looks like small "v" shape notch. Long grass or abrasive soil was considered as the cause.
Incisor	Cattle	Closegate I & II, Newcastle Upon Tyne b	17th - 18th	Abnormal wear on the lateral side at the base of the crown which looks like small "v" shape notch. Long grass or abrasive soil was considered as the cause.
Lumber vertebra	Cattle	Lion Walk, Colchester a & b*	15th - 18th	Severe osteoarthritis - the caudal centrum is heavily grooved and pitted and has osteophytic growth.
Lumber vertebra	Cattle	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	A healed break on the traverse process.
Mandible	Cattle	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	Dental calculus on six mandibles.
Mandible	Cattle	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	Lateral attrition between the deciduous fourth premolar and the first molar.
Metacarpal	Cattle	Crown Court, Newcastle Upon Tyne	15th - 16th	Two specimens with splayed distal condyles.
Metatarsal	Cattle	Closegate I & II, Newcastle Upon Tyne a	15th - 16th	Lateral extension of the medial distal condyle.
Metatarsal	Cattle	Crown Court, Newcastle Upon Tyne	15th - 16th	Porosity and lipping on the proximal end.
Multiple elements	Cattle	Castle Bastion, Newcastle-Upon-Tyne	17th	Scarring/lipping on the phalanges and exostosis/scarring on the distal metatarsal.
Multiple elements	Cattle	Pontefract Castle, Wakefield	17th	Twenty-four bones had evidence of infection, trama and joint disease. Joint diseases were more common.
Multiple elements	Cattle	Lincoln b	Civil War period	Eburnation on the acetabulum of four pelves and on 11 femoral heads.
Multiple elements	Cattle	46-54 Fishergate, York	1650 - 1700	Spavin - ankylosed proximal metatarsal and naviculocuboid.
Pelvis	Cattle	Crown Court, Newcastle Upon Tyne	15th - 16th	Eburnation on the acetabulum of two specimens probably from the same individual.

Element	Taxon	Site name	Date	Brief description and summary
Phalanx	Cattle	Dudley Castle a & b	1533 - 1750	110 phalanges exhibiting exostoses.
Phalanx	Cattle	Little Lane, Leicester a	16th	First and second phalanx showing proximal broadening.
Premolar 2	Cattle	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	Congenitally absence.
Rib	Cattle	Free Grammar School, Coventry	16th	Rib fragment with a notch caused by a vein or an artery.
Sacrum	Cattle	St Nicholas Place, Leicester a	1550-1775	Exhibiting pitting and distortion.
Skull	Cattle	16 - 18 Harrison Street, Hereford a	16th - 17th century	Cranial perforations
Third molar	Cattle	Launceston Castle b	1660 - 1840	Reduced or missing hypoconulid.
Third molar	Cattle	Little Lane, Leicester a	16th	Missing hypoconulid was observed on 1 out 9 third molars present on site.
Third molar	Cattle	Town Wall 76-8, Coventry a	16th - 17th	Reduced/absent hypoconulid observed on 4 out of 8 specimens.
Third phalanx	Cattle	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	Small cavity on the proximal articular surface.
Thoracic vertebra	Cattle	Eagle House (Cannon Street), London	18th	Cavities on the underside of the spinious process probably causes by an inflammation of the muscle ligaments.
Thoracic vertebra	Cattle	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	Lesion on the lateral articulatory facet.
Ulna	Cattle	46-54 Fishergate	1650 - 1700	An osteolytic lesion in the distal end with an oval smooth-surface depression.
Vertebra	Cattle	St Nicholas Place, Leicester a	1550-1775	Exhibiting pitting and distortion.

Table 4.31: Cattle pathologies and non-metric traits from selected post-medieval sites.* Represent specimens which were not clearly assigned to a date. Chester pathologies/non metrics were not included in table but were discussed in the pathologies and non-metric section in Appendix One

Element	Taxon	Site name	Date	Brief description and summary
Femur	Sheep	16 - 18 Harrison Street, Hereford a	16th - 17th century	Achondroplastic femur
Femur	Sheep	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	Two specimens had a very light and thin cortex which was suggestive of osteoporotic conditions.
First phalanx	Sheep/goat	Little Lane, Leicester a	16th	Possibly from an Ancon sheep - the phalanx is shorter than usual and distal end is very distorted displaying broadening and extra bone growth.
First phalanx	Sheep/goat	Little Lane, Leicester a	16th	Bony growths on the posterior margins.
Horncore	Sheep/goat	St Nicholas Place, Leicester a	1550-1775	‘Thumbprint' depressions.
Horncore	Sheep/goat	Little Lane, Leicester a	16th	‘Thumbprint' depressions.
Horncore	Sheep	Bonners Lane, Leicester	16th - 17th century	‘Thumbprint' depressions.
Horncore	Sheep	Aldersgate, London b	17th	Polled sheep.
Horncore	Sheep/goat	Dragon Hall, King Street, Norwich	early 15th to mid-16th century	Thumbprint' depressions.
Horncore	Sheep	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	17 horncores had 'thumbprint' depressions.
Humerus	Sheep/goat	Castle Mall, Norwich a	late 16th-18th	Evidence of 'penning elbow'.
Humerus and radius	Sheep/goat	Chester Road, Winchester	17th	Evidence of 'penning elbow' noted on a number of specimens.
Humerus and radius	Sheep/goat	St John's Street, Winchester	late 15th - 16th	Evidence of 'penning elbow' noted on a number of specimens.
Humerus and radius	Sheep/goat	Victoria Road, Winchester	late 15th - 16th	Evidence of 'penning elbow' noted on a number of specimens.
Humerus and radius?	Sheep	St Peters Lane, Leicester a	16th - 17th century	Evidence of 'penning elbow', congenitally absent sheep/goat P2
Lumbar vertebra	Sheep	Free Grammar School, Coventry	16th	Partially healed fracture.
Mandible	Sheep/goat	Little Lane, Leicester a	16th	Dental calculus on all teeth.
Mandible	Sheep	Pontefract Castle, Wakefield	17th	Four teeth were congenitally absent. The report does not state which teeth were absent.

Element	Taxon	Site name	Date	Brief description and summary
Mandible	Sheep	Walmgate, York	early 18th century	Periodontal disease.
Mandible	Sheep	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	Evidence of periodontal disease, abscesses, malocclusion, lateral attrition and dental calculus on a number of specimens.
Metapodial	Sheep	Walmgate, York	early 18th century	Examples of disease and trauma to the foot bones such as exostosis, signs of inflammation, arthropathy (including eburnation) and osteoarthritis.
Metatarsal	Sheep/goat	Little Lane, Leicester b	17th	Spavin - ankylosed proximal metatarsal with tarsal 2+3.
Metatarsal	Sheep/goat	Edgbaston Street, Birmingham	17th - 18th	Ossified haematoma on the shaft.
Metatarsal	Sheep/goat	Edgbaston Street, Birmingham	17th - 18th	Periostitis on the anterior proximal surface.
Metatarsal	Sheep/goat	Dudley Castle a	1533 - 1647	Butressing on the proximal metatarsus which was observed on 1 out of 11 metatarsals.
Metatarsal	Sheep/goat	Dudley Castle a	1533 - 1647	Ossified haematoma on the shaft of two specimens.
Multiple elements	Sheep/goat	DMU, Leicester a	1500 - 1650	Linear swelling on the shaft of five bones, exostoses on various bones and possible ossified ligaments. Three phalanges had expansion and lipping on the articular surfaces as well as new bone formation.
Multiple elements	Sheep/goat	Dudley Castle a	1533 - 1647	Evidence of 'penning elbow'.
Multiple elements	Sheep	Pontefract Castle, Wakefield	17th	Bones had evidence of infection, trauma, joint disease and oral pathology.
Premolar 2	Sheep	St Peters Lane, Leicester a	16th - 17th century	Congenitally absent.
Premolar 2	Sheep	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	Congenitally absent.
Premolar 4	Sheep/goat	Little Lane, Leicester a	16th	Abnormal wear.
Radius	Sheep/goat	St Nicholas Place, Leicester a	1550-1775	Extra bone growth.
Radius	Sheep	46-54 Fishergate	1650 - 1700	Exostosis on the proximal end located of the lateral site of the epiphysis.
Skull	Sheep	Crown Court, Newcastle Upon Tyne	15th - 16th	Five partial skulls belong to polled sheep.

Element	Taxon	Site name	Date	Brief description and summary
Skull	Sheep	Castle Ditch, Newcastle Upon Tyne	16th	Three polled sheep and one fragment appeared to belong to a four-horned animal.
Skull	Sheep	St Peters St, Northampton	16th - 17th century	Polled sheep.
Skull	Sheep	County Museum, Aylesbury	17th	Polled individuals, although not totally polled as vestigial horns still present.
Tibia	Sheep/goat	Dudley Castle a	1533 - 1647	Ossified haematoma on the shaft.
Tibia	Sheep/goat	Lion Walk, Colchester a	15th - 17th	Proximal end with extreme joint destruction and eburnation which may have resulted from a bacterial infection of the joints such as tuberculosis.

Table 4.32: Sheep/goat pathologies and non-metric traits from selected post-medieval sites. Chester pathologies/non metrics were not included in table but were discussed in the pathologies and non-metric section in Appendix One

Element	Taxon	Site name	Date	Brief description and summary
Lumber vertebra	Pig	Little Lane, Leicester b	17th	Lipping around the cranial epiphysis.
Mandible	Pig	St Nicholas Place, Leicester a	1550-1775	Deep pit below the forth premolar.
Mandible	Pig	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	Six specimens had incidences of oral pathologies including abscesses, inflammation (that was associated with a fracture), malocclusion, attrition and overcrowding of the teeth.
Metacarpal	Pig	Lion Walk, Colchester a	15th - 17th	Had severe proximal arthropathic changes.
Metacarpal	Pig	Aldersgate, London b	17th	Metacarpus III with moderate exostoses as well as pitting/erosion on the medial site - possibly a septic lesion?
Metatarsal	Pig	St Nicholas Place, Leicester a	1550-1775	Ossified haematoma on the shaft.
Metatarsal	Pig	Crown Court, Newcastle Upon Tyne	15th - 16th	Abnormal depression on shaft - cause unknown.
Metatarsal	Pig	Aldersgate, London a	16th	Metatarsus IV displaying proximal exostoses and pitting on the articular surface - possibly osteomyelitis/septic arthritis.
Multiple elements	Pig	Pontefract Castle, Wakefield	17th	Three specimens had evidence of infection and joint disease.
Thoracic vertebra	Pig	Little Lane, Leicester a	16th	Lipping around the caudal epiphysis.

Table 4.33: Pig pathologies from selected post-medieval sites. Chester pathologies/non metrics were not included in table but were discussed in the pathologies and non-metric section in Appendix One

Element	Taxon	Site name	Date	Brief description and summary
Multiple elements	Horse	The Green, Northampton a	1500 - 1700	Ring bone was observed on several elements: radius, metatarsal, first and second phalanx, scapula, astragalus, calcaneum and on the occipital and carpals (scaphoid and cuneiform).
Multiple elements	Horse	Castle Ditch, Newcastle Upon Tyne	16th	Ankylosed vertebrae around the thoracic and lumber region, arthritic conditions in the limbs, particularly the distal tarsals which are associated with spavin and osteoarthritis in the proximal humerus.
Multiple elements	Horse	Pontefract Castle, Wakefield	17th	Evidence of infection or joint disease, ankylosed vertebrae and metacarpal with spavin.
Metatarsus	Horse	Castle Mall, Norwich a	late 16th-18th	Spavin
Premolar 2	Horse	Castle Mall, Norwich a	late 16th-18th	Abnormal wear on the anterior part associated with bit wear.
Humerus	Dog	Little Lane, Leicester a	16th	Lipping around the proximal and distal condyles.
Humerus	Dog	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	Four humeri had severe eburnation and exostoses including a radius and ulna.
Incisor	Dog	Free Grammar School, Coventry	16th	Periodontal disease.
Rib	Dog	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	Healed fractures on at least two individuals.
Scapula	Dog	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	Small pit on the glenoid cavity that may have an infectious origin.
Skull	Dog	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	Fractures on the left and right frontal bones.
Vertebra	Dog	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	Exostoses on the centra of the cervical, thoracic and lumber vertebrae.
Mandible	Cat	St Nicholas Place, Leicester a	1550-1775	Pre-mortem tooth lost.
Skull	Cat	St Nicholas Place, Leicester a	1550-1775	Possible fracture to the upper orbit and the facial bones were misaligned.
Metatarsal	Fallow deer	Dudley Castle a & b	1533 - 1750	Ossified haematoma on the shaft.

Element	Taxon	Site name	Date	Brief description and summary
Femur	Rabbit	Eagle House (Cannon Street), London	18th	Osteoarthritis on the distal articulation.

Table 4.34: Other mammal pathologies from selected post-medieval sites. Chester pathologies/non metrics were not included in table but were discussed in the pathologies and non-metric section in Appendix One

Element	Taxon	Site name	Date	Brief description and summary
Multiple elements	Chicken	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	Traumatic pathologies including healed fractures, inflammation and an ossified haematoma. One femoral head was destroyed, exhibiting eburnation. This is a similar description to the example found at Lion Walk.
Multiple elements	Chicken	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	Several elements exhibited bony outgrowths.
Pelvis and femur	Chicken	Lion Walk, Colchester*	17th	Subluxation of the pelvis possibly caused by trauma, causing the head of the femur to be destroyed. Eburnation is present around the head and the acetabulum rim as well as extra bone growth.
Sacrum	Chicken	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	Spongy outgrowths of new bone suggestive of a tumor. See Chapter Three and Four for a more recent discussion on this pathology.
Skeleton	Chicken	Stafford Castle c	1800 - 1900	Partial skeletion with osteophytosis and ossification of ligament attachments.
Skull	Chicken	Eagle House (Cannon Street), London	18th	Cerebral hernia.
Sternum	Chicken	Little Lane, Leicester b	17th	Abnormal growth on the spine.
Synsacrum	Chicken	Lion Walk, Colchester*	17th?	Deformed synsacrum possibly caused by rickets.
Tarsometatarsal	Chicken	Free Grammar School, Coventry	16th	Exostosis where the spur is usually located on two specimens probably belonging to the same individual.
Tibia	Chicken	Free Grammar School, Coventry	16th	Arthritic exostoses at the distal end.
Tibiotarsus	Chicken	Dudley Castle a	1533 - 1647	Exhibited characteristic of avian osteopetrosis.
Tibiotarsus	Chicken	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	Evidence of rickets.
Tibiotarsus	Chicken	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	Possible early signs of osteopetrosis.
Multiple elements	Goose	Castle Mall Barbican Well, Norwich	mid/late 15th to early 16th C	Swelling, inflammation and bony outgrowths noted on the shaft of various long bones.
Tibiotarsus	Goose	St Nicholas Place, Leicester a	1550-1775	Possibly display characteristics of rickets.

Table 4.35: Domestic bird pathologies from selected post-medieval sites. Chester pathologies/non metrics were not included in table but were discussed in the pathologies and non-metric section in Appendix One