Southampton French Quarter 1382 Specialist Report Download E1: Animal and Bird Bone

By Andrew Bates

Introduction

In total, 32,949 animal bone fragments, or number of individual specimens (NISP), were recovered from the excavation, weighing 484kg. The vast majority of the material was recovered by hand collection, although animal bone was also removed for identification from soil samples taken for charred remains. In addition, 100 litre samples were taken and wet-sieved to 1mm, for the recovery of bone and other artefacts, from layers interpreted as garden soils. The material was identified using the reference collections held by the author, by the Liverpool Museum Natural History Department, and with reference to Halstead and Collins 1995 and Schmid (1972). All parts of the skeleton were identified where possible, including long bone shafts, skull fragments, all teeth and fairly complete vertebra. Sheep/goat distinctions were made using reference material and published work by Boessneck (1969), Kratochvil (1969), and Prummel and Frisch (1986). Red and fallow deer were separated following Lister (1996).

The material was recorded as ‘A’ bones and ‘B’ bones, following the method set out in Dobney, Jaques and Johnstone (1999). For each ‘A’ bone, the following information was recorded where appropriate: context reference; species or species group; element; number of bones; side; the diagnostic zone as either more than or less than half present; fusion state; butchery; measurements; tooth wear development; and other comments. Pathology and other developmental or congenital anomalies were also noted. ‘B’ bones were recorded by species group only, unless they were measurable, displayed butchery marks, pathology or congenital traits, in which instance they were recorded in the same detail as ‘A’ bones.

The diagnostic zones used followed those described in Serjeantson (1996), although this excludes the mandible, which was zoned as described Worley (forthcoming). Measurements followed those set out in Payne and Bull (1988),) Davis (1992) and, von den Driesch (1976), whilst tooth wear development for mandibular teeth was recorded following Payne (1973) and (1987) for sheep, Grant (1982) and Halstead (1992) for pigs, and Grant (1982) and Halstead (1985) for cattle. Skull and horncores were described following Grigson (1976), Armitage (1982), and Armitage and Clutton-Brock (1976). The separation of greylag, domestic and pinkfooted geese was done with reference to metrical data published in Bacher (1967), and, where appropriate, species of duck with reference to metrical data in Woelfle (1967).

The minimum number of elements (MNE) were calculated from the most frequently occurring diagnostic zone of each element. The minimum number of individuals equates to the highest MNE value. The MNI count is problematic, but could be used as a minimum of the total range, as opposed to NISP, which could be seen as the maximum of the total range, of an estimate of the number of animals within the archaeozoological material (O’Conner 2003, 133-5). However, one of the complications of MNIs is that there is an assumption that all portions of the body are present if they are to reflect a live population. This is clearly not always true, particularly in urban assemblages, where joints of meat as opposed to live animals have been circulated.

The presence of certain body parts, forelimb, hind-limb, etc, was calculated from the number of individual specimens (NISP). It was found that MNE counts of the mandible and tarsal bones were greatly affected by their fragmentation and recovery, as opposed to depositional history, compared to long bones. Modified NISP refers to where NISP of elements of body parts have been divided by their occurrence in the body, frequently re-scaled to a mean value of one, following O'Conner (2003, 145). The assignment of elements to body parts, forelimb etc, follows O'Conner (2003, 152), with the exception of the tarsal bones which are kept separate.

The fragmentation record of the material was obtained from the 'A' bone category, calculated from the number of zones recorded as a percentage of the potential number indicated by the NISP of that element.

Taphonomy

A number of factors may affect the animal bone prior to it inclusion in the archaeozoological record. These include butchery, canine gnawing, fragmentation prior to inclusion within an archaeological deposit, attack from acid roots, attack from acids within the soil or sediment, and also the archaeological excavation process. Table 1 provides a overview of the preservation, fragmentation and modification that has occurred to the material. In general, the preservation between periods can be seen to be consistently high, with the vast majority of the bone of a robust nature, with less than 50% of its surface eroded, and approximately half of the diagnostic zones of each 'A' bone present. Direct evidence of bone modifications, by butchery or gnawing, is relatively scarce in each phase. It is also noticeable that the number 'A' to 'B' bones between each phase is fairly consistent. The prehistoric material is excluded from Table 1, but is described below.

Preservation Category	Late Saxon	Anglo-Norman	High Medieval	Late Medieval	Post-Medieval
Surface Erosion	0.42	0.43	0.42	0.42	0.46
Robustness	0.80	0.80	0.80	0.80	0.79
Fragmentation of 'A' bones (% of potential number of zones)	51.97	48.77	49.11	53.13	49.42
Butchered 'A' bones (%)	12.14	10.14	8.09	9.44	10.27
Gnawed 'A' bones (%)	2.74	1.37	1.44	1.150	0.25
'A' bones as a percentage of the total NISP	34.96	32.49	33.26	32.07	36.02

Table 1: Summary of preservation and other taphonomic agents by phase, presented as normalised data and percentages

Re-worked Animal Bone

Residual animal bone is inevitably a problem on multi-phase sites, but difficult to assess. One possibly method is to identify 'A' bones in a significantly worse state of preservation than all other bone as 'residual?'. A second method is to identify within the preservation categories, especially surface erosion and preservation (robustness), contexts with bones recorded as in 'variable' states of preservation. This will not identify contexts with entirely residual animal bone though. In addition, a lower degree of general condition cannot necessarily imply that the material is from a significantly earlier period. This is particularly pertinent where broad stratigraphic phases are used in the analysis.

Tables 2 - 4 summarise the results of the variables described above. Within the 'A' bone categories, 'Residual?' bone is a small component of the overall assemblage. Within each context, where a deposit contains bone with generally a worse degree of surface erosion or preservation, that context is invariably 'variable'. The 'Residual?' material has therefore occurred alongside bone of a better overall condition.

Variable contexts are more frequently found when assessing the surface of the bone, than the overall robustness. Noticeably, the late Saxon surface erosion is more variable than other periods. The late Saxon period is the first recorded with significant levels of activity at the site, although there is certainly earlier recorded activity in the area. This could suggest that a degree of variation within a period is normal, or that human activity from a pre-existing phase has not produced archaeologically visible remains at the site.

In comparison to pottery evidence, only 30 contexts were recorded as containing residual material. Comparing contexts containing residual pottery to contexts containing 'Residual?' bone, or contexts with variable preservation, a match was only found in two instances based on surface erosion. In conclusion, it is thought that residual animal bone in each period comprises a relatively small percentage of the material recovered from the site, particularly within the A bone assemblage upon which much of the following analysis is based. There would appear to be almost no correlation between deposits of residual pottery, and the presence of animal bone with variable levels of condition.

Period	**Residual?**		**Total**	**% Residual?**
	Yes	No		
Late Saxon	7	1615	1622	0.4
Anglo-Norman	21	2412	2433	0.9
High-medieval	20	2679	2699	0.7
Late-medieval	6	790	796	0.8
Post-medieval	6	2302	2308	0.3

Table 2: 'Residual?' 'A' bones

Phase	**Fibrous**	**>50 %**	**50% (approx)**	**<50%**	**None (minimal)**	**Variable**	**Total**	**% variable**
Late Saxon	0	0	5	40	0	9	54	16.7
Anglo-Norman	0	0	9	101	2	17	129	13.2
High-medieval	0	1	9	131	2	23	166	13.9
Late-medieval	0	0	1	46	1	6	54	11.1
Post-medieval	0	1	1	26	2	5	35	14.3

Table 3: Surface erosion of contexts with over 10 NISP, and the percentage recorded as 'variable', of the hand-collected material

Phase	**Very Poor**	**Poor**	**Moderate**	**Good**	**Excellent**	**Variable**	**Total**	**% variable**
Late Saxon	0	0	1	50	0	3	54	5.6
Anglo-Norman	0	0	1	122	0	7	130	5.4
High-medieval	0	0	2	153	1	10	166	6.0
Late-medieval	0	0	0	51	1	2	54	3.7
Post-medieval	0	0	1	29	0	5	35	14.3

Table 4: Preservation (robustness) of bone within contexts with over 10 NISP, and the percentage recorded as ‘variable’, of the hand-collected material

Prehistoric Period

Only two fragments of animal bone from prehistoric contexts were recovered. A medium-sized animal rib fragment, and a sheep/goat or roe deer scapula fragment, were both recovered from posthole 7609.

Late Saxon Activity

Quantification

Table 5 gives the total NISP and MNE values and percentages of the Late Saxon animal bone. Cattle, pig and then sheep/goat bones are the most frequently occurring species from the site, with wild species accounting for 1.8% of the total number of fragments identified to a species level. Some 6.1% of the bone was recovered from the sieving of soil samples taken from 11 pits, 13.9% of the total number of features or layers from which animal bone was recovered. The sieved totals demonstrate a bias in hand-collected material towards cattle, or larger animals, suggesting smaller mammals, such as sheep, goats, pig etc, may be somewhat under-represented in deposits with hand recovery only. Sheep appear to dominate the sheep/goat category, although goat potentially makes up 20% of these bones (Table 5).

Species	**Hand Collected Bone**				**Sieved Bone**	
	NISP	%	MNI	%	NISP	%
Horse	35	0.8	2	1.7	3	
Cattle	1017	23.1	38	29.1	31	27.0
Pig	320	7.3	32	27.4	40	34.8
Sheep/Goat	273	6.2	41	35.0	39	33.9
Sheep	78	1.8			2	1.7
Goat	19	0.4				
Dog	5	0.1	1	0.9	1	0.9
Cat	5	0.1	1	0.9	1	0.9
Rabbit	2	0.0	1	0.9		
Hare	4	0.1	1	0.9		
Red Deer	18	0.4	2	1.7	1	0.9
Fallow Deer	1	0.0	1	0.9		
Roe Deer	6	0.1	1	0.9		
Deer	1	0.0				
Cattle/Horse	2	0.0				
Cattle/Red Deer	236	5.4				
Sheep/Goat/Roe Deer	50	1.1				
Red/Fallow Deer	5	0.1				
Rabbit/Hare	1	0.0				
Medium Mammal	562	12.7				
Large Mammal	1214	27.5				
Small Mammal	7	0.2				
Unidentified Mammal	548	12.4				
Total	**4409**	**100.0**			**115**	
Total identified to a species level	**1783**	**40.4**				
Main domestic species (%)						
Cattle		**59.6**		**31.8**		

Species	**Hand Collected Bone**				**Sieved Bone**	
	NISP	%	MNI	%	NISP	%
Pig		**18.7**		**29.9**		
Sheep/Goat (includes sheep and goat)		**20.6**		**38.3**		

Table 5: Total NISP and MNE values and percentages of the Late Saxon animal bone, from hand-collected material; the MNI of sheep/goat includes sheep and goat categories

Distribution and Carcass Representation

Using the tenement boundaries as the basis of the distribution is slightly flawed when looking at the Late-Saxon material, as these boundaries were not created until the thirteenth century, although they can still be used to reference the material spatially. Tables 6 and 7 give a summary of the principal stock animals by tenement areas and feature types. The vast majority of this material was recovered from pits excavated within the areas defined by tenements 170, 172, 173 and 237. The percentage of species within each tenement area is roughly the same, with the exception of tenements 167 and 171, which have high percentage values for pig bones. However, this is likely to be a product of sample size, as the entire pig assemblages in these tenements, having derived from a single pit in the case of tenement 170, and two pits in tenement 169. The large numbers of pits with bone-bearing deposits are reduced slightly when it is considered that only 19 of these pits produced over 20 bones of a principal stock animal.

Species	167	170	171	172	173	180	237	241
Cattle	46.2	65.4	48.4	61.2	56.7	44.1	52.3	57.9
Pig	40.4	13.7	41.9	16.7	19.3	28.8	26.7	23.7
Sheep/goat	13.5	20.9	9.68	22.1	24.1	27.1	20.9	18.4
N	52	344	31	556	436	59	172	76
N (Features)	3	22	1	13	6	5	12	5

Table 6: Percentage of the principal stock animals from tenements with a sample size of over 20 NISP; sheep and goat has been totalled.

Species	**Pit**	**Cess pit**	**Post-hole**	**Ditch**	**Beam slot**	**Drainage gully**	**Layer**	**Trample**	**Other**	**N**
Cattle	91.2	6.4	0.6	0.1	0.3		0.1	1.0	0.3	**1050**
Pig	95.0	1.9	1.1		0.6	0.3		0.6	0.6	**360**
Sheep/goat	91.0	2.9	4.6	0.2	0.2	0.0	0.0	0.5	0.5	**410**
N (Features)	**69**	**1**	**4**	**1**	**1**	**1**	**1**	**1**	**2**	

Table 7: Percentage of Late Saxon principal stock animals by feature type; sheep and goat has been totalled.

Figures 1 to 3 in *Appendix 1* provide an overview of the frequency of anatomical elements against fragmentation of the principal stock animals. Of the cattle bones, there is high linear correlation between the completeness of long bones and their NISP. The calcaneus and to some degree the astragalus are reasonably well represented, and more complete than other limb bones. Conversely, at the other end of the spectrum, although the mandible is a fairly dense bone producing a high NISP, it is normally often highly fragmented. As such, the tarsal bones perform well in MNE counts, and the mandible less well (*Appendix 2*). Overall, all parts of the cattle carcass are thought to have been deposited at the site. Specific elements have been subject to high degree of fragmentation and loss, however. The density of bone per deposit is fairly low, but with some larger deposits, with a maximum NISP if 129, but an average of 7.6 NISP from 138 deposits.

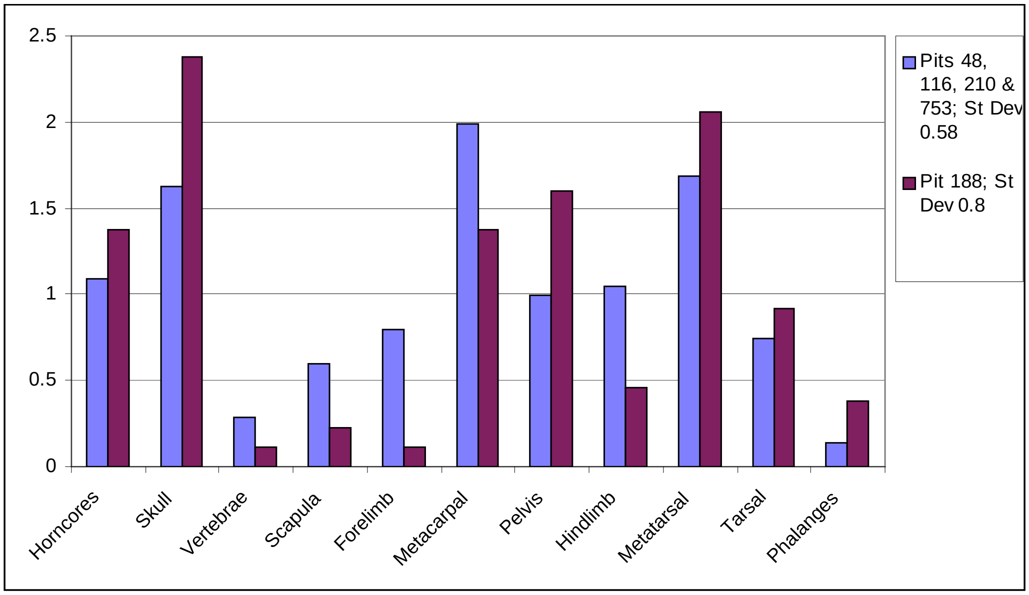

Fig 1: Late-Saxon cattle NISP of body parts from pits ***48***, ***116***, ***188***, ***210***, and ***753,*** scaled to a mean value of 1

Tenements 172 and 173 contained pits in close proximity to each other, with over 40 NISP of cattle in each, notably pits 48, 116, 188, 210 and 753. However, only pit 188 produced significant quantities of bone for statistical analysis (Fig 1), showing significant elements of skull and metapodials, and a distinct lack of fore- and hind-limbs. The remaining pits, considered collectively, show a trend similar to the cattle from the site as a whole, although the forelimbs do appear somewhat under-represented in comparison to metacarpals.

Sheep and goat bones show a medium correlation between the NISP of limb bones and fragmentation (Figure 2 of *Appendix 1*). The distal humerus seems generally lacking in the material, although the proximal radius, which articulates with this element, is fairly abundant, both of which normally have good survival rates. Only pits 48 and 210 produced sheep/goat bones in any numbers, with the sample size low for analysis, but it is clear that pit 210 contained significant numbers of metapodials, potentially butchery waste, with the skulls removed elsewhere for further processing, whereas pit 48 follows the trend of the site as whole (Fig 2). The overall density of deposition within features is low, with a maximum of 27 NISP and an average of 3.5 NISP from 105 contexts.

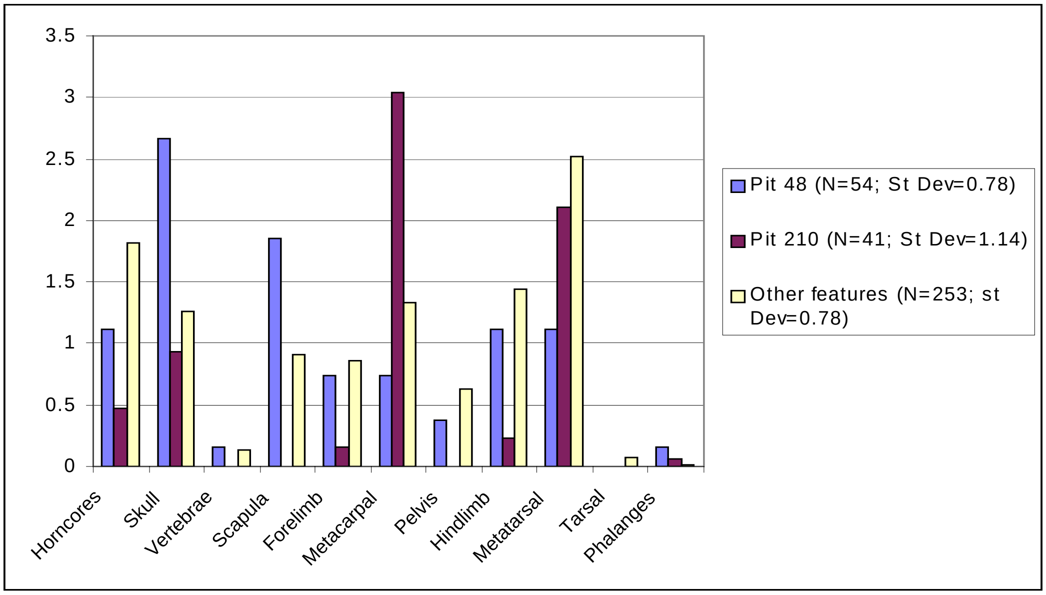

Fig 2: Late-Saxon sheep and goat NISP of body parts from pits ***48*** and ***210*** in comparison to other features, scaled to a mean value of 1

Of the pig bone, the sesamoids have generally low recovery rates due to their small size (Figure 3 *Appendix 1*). A linear correlation can be seen between most other elements, except the mandible and the humerus. The mandible is drawn towards this area of the graph as a result of the nature of its fragmentation, and notably performs less well in MNE counts (*Appendix 2*). An over-abundance of the forelimb as represented by the proximal and distal ends of the humerus is suggested, based on its fragmentation and abundance, but this could not be attributed to specific features or a particular area. The density of pig bones by feature is relatively low, with a maximum of 23 NISP and an average of 2.9 NISP within 91 deposits.

Anglo-Norman Activity

Quantification

Table 8 summarises the NISP and MNE totals of hand-collected and sieved animal bone from Anglo-Norman deposits. In comparing the hand-collected and the sieved bone, sheep/goat and pig appear to be under-represented in the hand-collected material. Sheep appear to dominate the sheep/goat category, with goat comprising potentially 26% of this material.

Species	**Hand Collected Bone**				**Sieved Bone**	
	NISP	**%**	**MNI**	**%**	**NISP**	**%**
Horse	47	0.6	3	1.8		
Cattle	1292	17.6	48	28.9	42	39.6
Pig	442	6.0	31	18.7	24	22.6
Sheep/Goat	766	10.5	76	45.8	32	30.2
Sheep	104	1.4			1	0.9
Goat	37	0.5				

Species	Hand Collected Bone				Sieved Bone	
	NISP	%	MNI	%	NISP	%
Deer	5	0.1			1	0.9
Dog	7	0.1	1	0.6		
Cat	25	0.3	1	0.6	2	1.9
Rabbit	3	0.0	1	0.6		
Hare	2	0.0	1	0.6	1	0.9
Red Deer	27	0.4	2	1.2		
Fallow Deer	11	0.2	1	0.6		
Roe Deer	8	0.1	1	0.6	1	0.9
Cattle/Horse	2	<0.1%				
Cattle/Red Deer	317	4.3				
Sheep/Goat/Roe Deer	116	1.6				
Red/Fallow Deer	7	0.1				
Rabbit/hare						
Rodentia sp					1	0.9
Medium Mammal	1054	14.4				
Large Mammal	1781	24.3				
Small Mammal	38	0.5				
Unidentified Mammal	1230	16.8				
Marine Mammal	1	<0.1%				
Total	**7322**				**106**	
Total identified to a species level	**2776**	**37.9**				
Main domestic species (%)						
Cattle		**48.9**		**31.0**		
Pig		**16.7**		**20.0**		
Sheep/Goat (includes sheep and goat)		**34.3**		**49.0**		

Table 8: Total NISP and MNE values and percentages of the Anglo-Norman animal bone, from hand-collected material; the MNI of sheep/goat includes sheep and goat categories

Distribution and Carcass Representation

The 13th-century tenement boundaries were not established until the end of this period. However, the tenement areas have been used generally to reference spatially the animal bone (Table 9).

	Tenements										
Species	**170**	**171**	**172**	**173**	**176**	**177**	**180**	**237**	**240**	**241**	**242**
Cattle	39.0	52.5	53.8	55.1	73.9	49.5	56.6	44.6	52.2	54.6	39.2
Pig	7.8	17.5	16.2	22.1	21.7	14.3	18.4	18.6	13.0	17.2	3.8
Sheep/goat	53.1	30.0	30.0	22.8	4.3	36.2	25.0	36.8	34.8	28.2	57.0
N	397	40	327	666	23	105	76	794	23	163	79
N (Features)	20	1	21	21	1	2	6	52	1	13	2

Table 9: Percentage of the Anglo-Norman principal stock animals from tenements with a sample size of over 20 NISP; sheep and goat have been totalled

Species	Pit	Cess pit	Well	Post hole	Pit/post hole	Pit/well	Ditch	Gully	Soil horizon	Layer	Other	N
Cattle	86.1	1.7	0.5	2.9	0.1	3.2	0.7	0.0	0.5	1.7	2.7	1329
Pig	83.3	1.7	3.2	1.5	0.0	3.6	0.6	0.2	0.2	0.6	4.9	467
Sheep/goat	77.4	3.0	1.1	2.2	0.0	8.7	1.0	0.0	0.5	2.9	3.3	941
N (Features)	108	5	3	12	1	1	3	1	1	4	12	

Table 10: Percentage of Anglo-Norman principal stock animals by feature type; sheep and goat have been totalled.

As with the Late Saxon material, the majority of the bone of the three main domestic species was recovered from pits (Table 10). Tenement 170 produced much higher proportions of sheep/goat than other tenements, because of a pit 6063, which produced 148 sheep/goat bones, of which 15 were attributed to sheep, as well as 78 cattle bones from deposit 6064. Excluding this feature produces figures of 46% cattle, 42% sheep/goat and 12% pig for Tenement 170. There is a significant bias in the parts of cattle and sheep/goat from pit 6063 towards elements of the skull (Fig 3). The butchery record of these animals contains a single sheep/goat horncore with a chop mark from the removal of the horn from the skull, but the skulls are generally highly fragmented. The horncores of these animals have possibly largely been removed, the material representing the primary butchery waste of a minimum of five cattle and seven sheep, with the majority of limb bones removed.

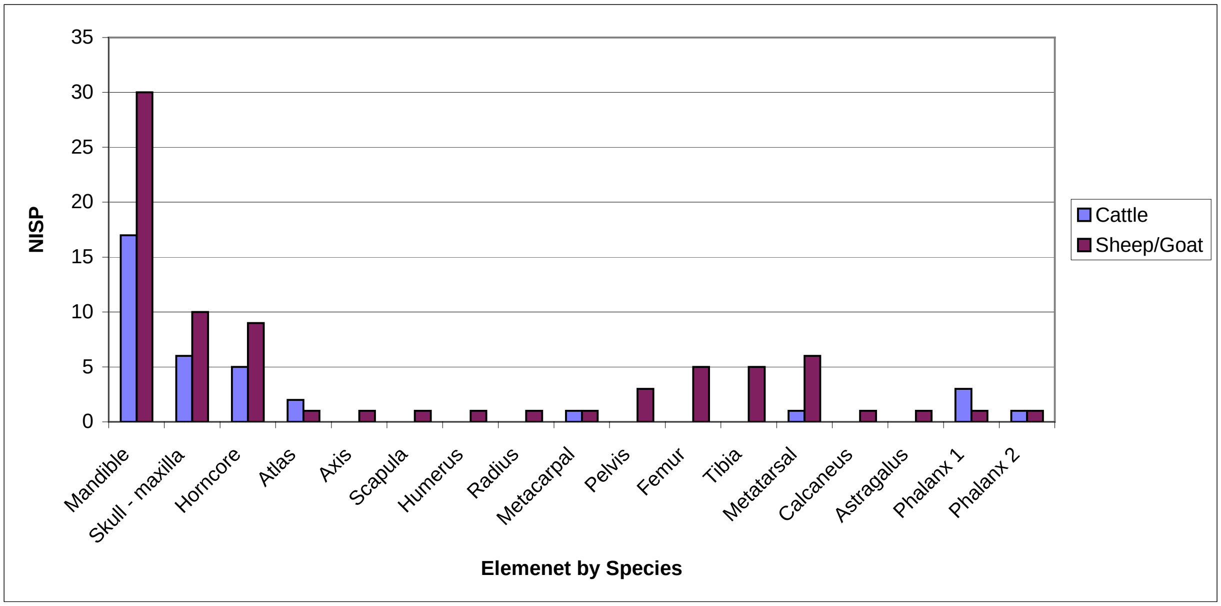

Fig 3: NISP of elements of cattle and sheep/goats from deposit ***6064*** of pit ***6063***

Figures 4 - 6 in *Appendix 1* provide an overview of the frequency of anatomical elements against fragmentation of the principal stock animals. Due to the large number of mandibles, particularly of sheep and goat, the material from pit 6063 has been excluded from figures in *Appendix 1*.

Figure 4 of *Appendix 1* shows a medium correlation between completeness of cattle limb bones and NISP, with sesamoids more complete but less frequently recovered, and the mandible more fragmented but well-represented in NISP counts. Whole carcasses appear to be represented at the site. With the exception of pit 6063, there is a general trend towards relatively low numbers of bones per deposit. A maximum of 78 NISP of cattle bone, with an average of 5.73 NISP, were recovered from 234 deposits. Three further pits contained higher NISP of cattle bone, each with bone recovered from four separate deposits (Fig 4). Pit 173 potentially contains higher quantities of butchery waste from the heads and feet of animals in comparison to the other two features; skulls and metapodials all occur significantly over 1 standard deviation from the mean. Other features reflect the general trend of the site. The butchery record is fairly abundant for cattle bones within pit 173, evidence being located on 39% of the material, evidencing the dismemberment, filleting and skinning of these animals.

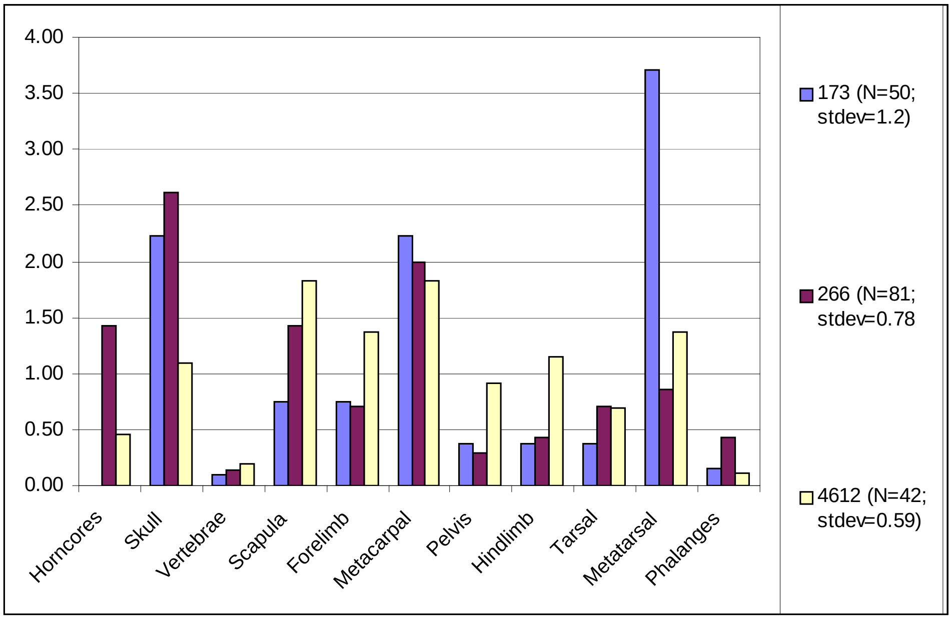

Fig 4: Anglo-Norman cattle body parts in pits ***173***, ***266*** and ***4612***, scaled to a mean value of 1

Excluding pit 6063, of sheep/goat bones, the smaller sesamoids are generally more complete but with low recovery rates (Figure 5, *Appendix 1*). There is a medium to high correlation between fragmentation of long bones and their frequency. Large numbers of mandible fragments were recovered, although these could not be attributed to specific features, and MNE values reduce the abundance of the mandible significantly (*Appendix 2*). All parts of the sheep/goat carcass are considered to have been deposited at the site. Sheep/goat bones have a low density in most pits, with a maximum of 43 NISP and an average of 3.6 NISP from 163 deposits. Only two contexts produced over 20 NISP, including fragmented skulls from deposit 8282 in pit 8280, and a mix of elements from fill 4497 of pit 4614.

Pig bone in Figure 6 of *Appendix 1* shows a medium correlation between the fragmentation of long bones and their NISP. Mandibles are more frequently occurring in NISP counts, but this apparent abundance is reduced in counts of MNE (*Appendix 2*). The foot bones of pig, including metapodials, are relatively small and, although less fragmented, have low recovery rates by hand collection. All parts of the carcass are considered to have been deposited at the site.

High-Medieval Activity

Quantification

Table 11 gives summary data of the presence of each species from both the hand-collected and sieved High-Medieval animal bone. As for earlier periods, the hand-collected material appears to under-represent sheep, goats and pigs in comparison to cattle. Of the sheep/goat bones, sheep appear to be the prevalent species, making up potentially 80% of the sheep/goat category.

Species	**Hand Collected Bone**				**Sieved Bone**	
	NISP	**%**	**MNI**	**%**	**NISP**	**%**
Horse	37	0.4	2	1.1	1	1.6
Cattle	1353	16.3	51	28.0	18	28.1
Pig	657	7.9	35	19.2	16	25.0
Sheep/Goat	924	11.1	64	35.2	24	37.5
Sheep	116	1.4			2	3.1
Goat	26	0.3			1	1.6
Dog	31	0.4	4	2.2		
Cat	57	0.7	11	6.0		
Rabbit	20	0.2	4	2.2		
Hare	13	0.2	3	1.6		
Red Deer	13	0.2	2	1.1	1	1.6
Fallow Deer	16	0.2	2	1.1		
Roe Deer	21	0.3	4	2.2	1	1.6
Deer	3	0.0				
Cattle/Horse	3	0.0				
Cattle/Red Deer	220	2.6				
Sheep/Goat/Roe Deer	130	1.6				
Red/Fallow Deer	9	0.1				
Rabbit/Hare	1	0.0				
Rattus sp	12	0.1				
Rodentia sp	1	0.0				
Medium mammal	1367	16.4				
Large mammal	1981	23.8				
Small mammal	67	0.8				
Unidentified mammal	1240	14.9				
Total	8318					
Total identified to a species level	3250	39.1				
Main domestic species (%)						
Cattle		**44.0**		**34.0**		
Pig		**21.4**		**23.3**		
Sheep/Goat (includes sheep and goat)		**34.7**		**42.7**		

Table 11: Total NISP and MNI values and percentages of the High-Medieval animal bone, from hand-collected and sieved material; the MNI of sheep/goat includes sheep and goat categories

Distribution and Carcass Representation

Tables 12 and 13 give the distribution of the principal stock animals between tenements and feature types. The great house of Richard of Leicester occupied Tenement 237, which was expanded in the late medieval period, and as such is a high-status property. Only 8 of the 22 tenements produced animal bone in any real quantity. As in earlier periods, the principal stock animals were predominantly recovered from pits, with other feature types containing much smaller quantities of animal bone. Twenty-seven of these pits contained over 20 NISP of the listed species, and of these 11 over 50 NISP. These 11 contribute 42% of the material presented in Tables 12 and 13. Generally, there is a consistency in the distribution of species by feature type, but limited variance between tenements, with the exception of tenement 172.

	Tenements								
Species	**169**	**170**	**172**	**173**	**177**	**178**	**180**	**237**	**241**
Cattle	61.9	37.8	22.8	44.9	68.6	57.1	44.1	50.1	47.6
Pig	7.1	19.4	9.0	30.1	17.1	21.4	18.4	13.4	26.7
Sheep/goat	31.0	42.9	68.2	25.0	14.3	21.4	37.6	36.6	25.7
N	42	98	346	1305	35	28	245	785	105
N (Features)	2	9	17	47	2	1	10	75	19

Table 12: Percentage of the High-Medieval principal stock animals from tenements with a sample size of over 20 NISP; sheep and goat have been totalled.

Species	**Pit**	**Cess pit**	**Posthole**	**Layer**	**Levelling deposit**	**Linear**	**Other**	**N**
Cattle	81.9	3.0	1.1	3.2	2.5	2.4	6.0	1354
Pig	82.0	2.3	2.1	2.9	1.5	2.3	6.9	645
Sheep/goat	84.5	3.3	1.4	1.9	2.7	1.1	5.1	1066
N (Features)	130	9	13	10	7	2	27	

Table 13: Percentage of High-Medieval principal stock animals by feature type; sheep and goat have been totalled

Figures 7 - 9 in *Appendix 1* provide an overview of the frequency of anatomical elements of the principal stock animals against the fragmentation. For cattle, Figure 7 of *Appendix 1* shows a high correlation between fragmentation of long bones and NISP. The mandible is typically highly fragmented, producing high counts of NISP, although its abundance in reduced in counts of MNE (*Appendix 2*). The tarsal bones of cattle have good recovery rates, and low fragmentation produces relatively high counts of MNE. Generally, all parts of the cattle are thought to have been deposited at the site, with the archaeozoological record affected by preservation and recovery factors. The density of cattle bones per deposit is fairly low, with a maximum of 77 NISP, and an average of 4.95 NISP, from 273 deposits.

Deposit 338 of pit 172, within tenement 172, produced 163 sheep or goat bones, of which five bones were identified as sheep (Fig 5). This represents the butchery waste of a minimum of 14 animals, based on the MNE of 14 metacarpi from the right side of the animal, presumably from a single event. Notably, the skulls have been removed, presumably for further processing to remove meat, brains, and probably the horn. This material accounts for 36% of the animal bones in Table 12 for tenement 172, the exclusion of which greatly reduced the abundance of sheep/goat bones from this tenement. Figure 8 of *Appendix 1* excludes this deposit.

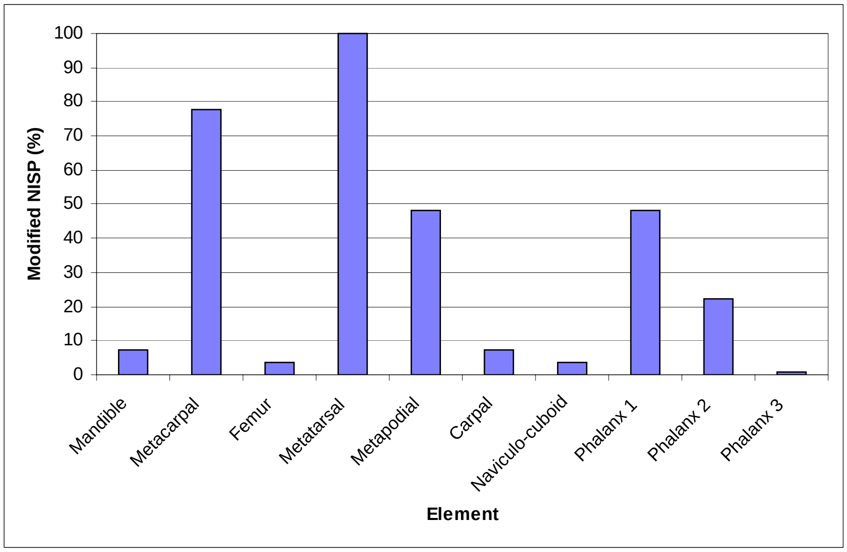

Fig 5: Percentage of modified NISP of sheep and goat bones recovered from pit ***172***

The completeness of the sheep/goat mandibles is better than that of cattle (Figure 8, *Appendix 1*), and counts of MNE reduce its apparent abundance significantly. The sesamoids have typically a lower recovery despite little fragmentation. Long bones have a low correlation between fragmentation and NISP. It might be expected that distal humerus and the proximal end metapodials would have higher, or distal tibia lower, NISP values, considering their position on the Y (completeness) axis. However, the difference between distal tibia and distal humerus is only 11 NISP or five MNE. Generally, all parts of the sheep and goat carcasses appear to be represented at the site, affected by varying preservation and recovery rates. Discounting pit 172, the density of sheep and goat deposition by deposit is low, with a maximum of 26 NISP, and average of 3.22 NISP, from 173 deposits.

Pig bones show a general bias towards the limb bones (Figure 9, *Appendix 1*). Metapodials and phalanges are clearly present, but of low occurrence due to their small size and hand recovery. Limb bones show a good correlation between fragmentation and NISP. Mandibles have suffered a greater degree of fragmentation, producing relatively lower counts of the MNE (*Appendix 2*). It is noticeable that, despite the relative completeness of the scapulae and pelvis, these produce lower relative counts of the NISP. There was no obvious reason for this in the fragmentation record of these elements, with the butchery record for pig pelvis being too small to be meaningful. The atlas, the vertebra which articulates with the skull, is also fairly abundant, whereas the axis, the second vertebra, is absent. It is also noticeable that elements of the forelimb, humerus, ulna and radius appear in greater numbers. The MNE values of elements of pig bones show an abundance of fore-, hindlimb, and skull, and a significant step between skull and scapulae (Fig 6). Although all parts of the pig skeleton are represented at the site, limb bones and skulls appear to have been imported to the site as meat on the bone.

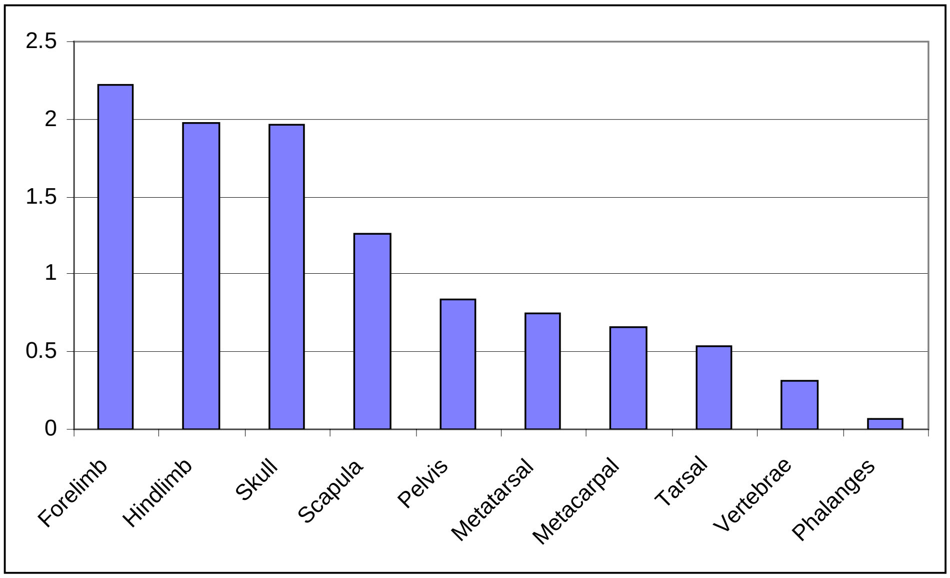

Fig 6: Body-parts of high-medieval pig, scaled to a mean value of 1, with body parts to the left and including skull, to 1 standard deviation from the mean, and to the right and phalanges less than 1 standard deviation from the mean; N=438 and St Dev=0.75

Comparing tenements is problematic, as it relies on reasonable sample sizes of one species from each tenement. Only tenements 173 and 237 produced significant numbers of bone for comparison, pit 172 is discounted. Of cattle, the distribution of elements reflected those for the site as a whole. Plotting the abundance of sheep and goat body parts, and pig bones, generally showed a greater abundance of the denser parts of the limb bones, but does not allow analysis in comparison to fragmentation. Figures 7 and 8 give the relative abundance of sheep and goat body parts as modified NISP. Tenement 173 shows some linear correlation between fragmentation and NISP between metacarpal and horncores, with lower numbers of metatarsals, despite their relative completeness. Hindlimb and pelvis appear to be somewhat over-abundant, despite greater fragmentation. Tenement 237 shows a similar central linear trend between metapodials and pelvis, with hind limb and horncores in greater numbers. Vertebra and phalanxes are typically under-represented, although few scapulae were recovered from tenement 237.

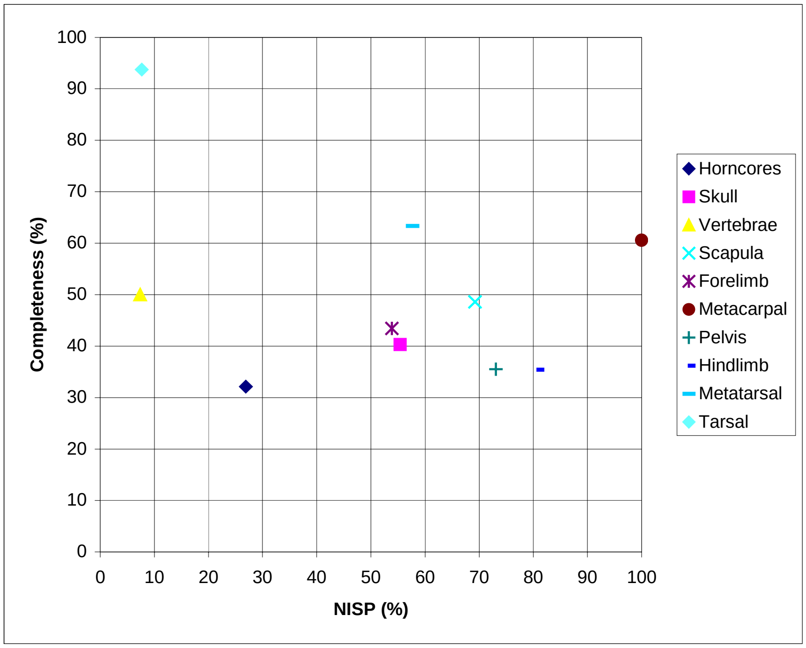

Fig 7: Modified NISP of sheep and goat 'joints' against completeness of T173; N=236

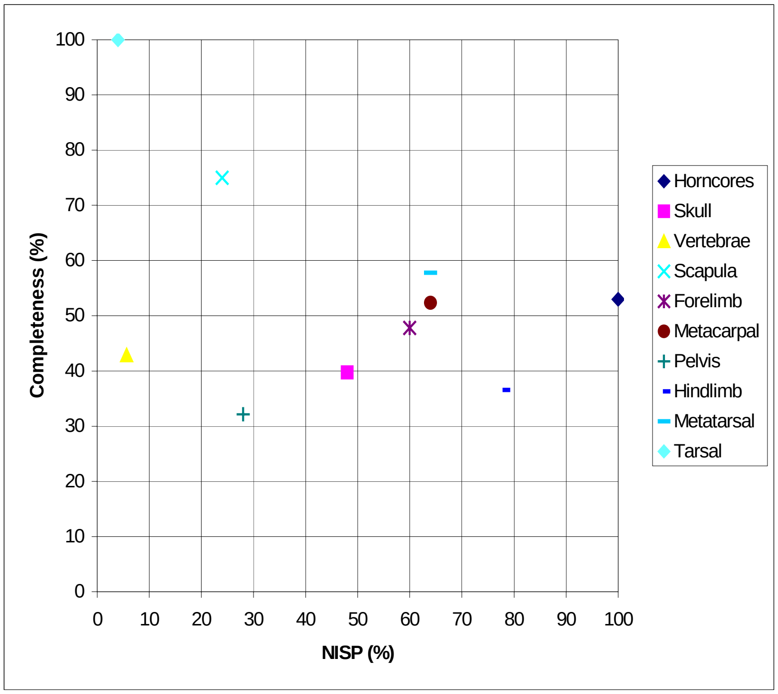

Fig 8: Modified NISP of sheep and goat 'joints' against completeness of T237; N=208

The overall sample size is low in this analysis, and relatively low abundance of one element from a single feature affects the results significantly. Twelve horncores, all but one from goat, were recovered from a single pit, 4494 of tenement 237. Conversely, the abundance of hind limb could not be attributed to specific features, and appears to reflect additional joints brought onto the site as meat on the bone.

Late-Medieval Activity

Quantification

Table 14 gives summary data of the presence of each species from both the hand-collected and sieved late-medieval bone. Cattle bones were the most frequently collected bones, comprising nearly 40% of the hand-collected sample, followed by sheep and pig. The sample from soil samples is small, but follows the same trend as in earlier periods suggesting the under-representation of sheep, goats and pig bones in the hand-collected material. Of the sheep/goat bones, sheep appear to be the prevalent species, making up *c* 87% of the sheep/goat category.

Species	**Hand Collected Bone**				**Sieved Bone**	
	NISP	**%**	**MNI**	**%**	**NISP**	**%**
Horse	10	1.2	2	2.2		
Cattle	339	39.2	18	20.0	15	25.0
Pig	118	13.6	10	11.1	9	15.0
Sheep/Goat	233	26.9	36	40.0	16	26.7
Sheep	48	5.5			1	1.7
Goat	7	0.8			1	1.7
Dog	15	1.7	2	2.2		
Cat	31	3.6	10	11.1		
Rabbit	42	4.9	10	11.1	18	30.0
Hare	1	0.1	1	1.1		
Red Deer	5	0.6				
Fallow Deer	12	1.4				
Roe Deer	4	0.5				
Deer	1	0.1				
Cattle/Horse	1	0.1				
Cattle/Red Deer	104	12.0				
Sheep/Goat/Roe Deer	42	4.9				
Red/Fallow Deer	5	0.6				
Rattus sp	3	0.3				
Medium mammal	342	39.5				
Large mammal	592	68.4				
Small mammal	17	2.0				
Unidentified mammal	357	41.3				
Total	2329	269.2			60	
Total identified to a species level	865	100.0				
Main domestic species (%)						
Cattle		45.7		20.0		
Pig		15.5		11.1		
Sheep/Goat (includes sheep and goat)		38.8		40.0		

Table 14: Total NISP and MNI values and percentages of the Late-Medieval animal bone, from hand-collected and sieved material; the MNI of sheep/goat includes sheep and goat categories

Distribution and Carcass Representation

The great house of Richard of Leicester had become known as Polymonds Hall (tenement 237) by the Late 14th century. The 1445 *Southampton Terrier* (Burgess 1976) describes tenement 238 as the gardens of the hall, and tenement 173 as under the same ownership as tenement 238, possibly with no dividing boundary. Tenement 180 was known as Polymond's Gateway, and appears also to have been connected to this property. The same source describes tenements 167, 177, 178 and 179 as occupied by cottages, 239, 240 and 241 as vacant plots, and 242 as a garden, although each of the latter had been built upon by 1774.

Tables 15 and 16 give the distribution of the principal stock animals between tenements and feature types. Only nine of the 22 tenements produced animal bone in any real quantity. The variance of the principal stock animals' NISP between tenements is largely a product of small sample sizes for most tenements, although tenements 170, 172 and 237 produced larger numbers of bone and similar proportions of species. As for earlier periods, the principal stock animals were predominantly recovered from pits, with other feature types containing much smaller quantities of bone fragments. Twelve of these pits contained 20 or more NISP of the listed species, and of these, one pit contained over 50 NISP from five separate deposits. These 12 contribute 54% of the bone presented in Tables 15 and 16.

	Tenements								
Species	167	170	172	173	178	179	237	238	240
Cattle	40.9	55.8	59.8	34.3	41.7	33.3	41.2	48	42.9
Pig	13.6	12.8	5.9	17.1	16.7	25	20	16	4.8
Sheep/goat	45.4	31.4	34.3	48.6	41.7	41.7	38.8	36	52.4
N	44	86	102	35	24	24	379	25	21
N (Features)	1	15	11	6	2	1	22	1	1

Table 15: Percentage of the Late-Medieval principal stock animals from tenements with a sample size of over 20 NISP; sheep and goat have been totalled

Species	**Pit**	**Cess pit**	**Robber trench**	**Demolition debris**	**Floor**	**Levelling**	**Other**	**N**
Cattle	77.5	4.2	5.4	1.1	0.6	1.7	9.6	355
Pig	70.4		8.0		1.6	4.8	15.2	125
Sheep/goat	82.4	4.6	3.6	2.3	2.3	2.0	2.9	306
N (Features)	51	2	1	2	3	2	9	70

Table 16: Percentage of Late-Medieval principal stock animals by feature type; sheep and goat have been totalled

Figures 10 - 12 in *Appendix 1* provide an overview of the frequency of anatomical elements of the principal stock animals against the fragmentation. In cattle, there is no correlation between the abundance of long bones and fragmentation. Notably humerus, radius and femur appear to be fairly abundant. Phalanges are typically poorly represented due to their relatively small size, although metapodials, despite having suffered low fragmentation of the proximal end, are more poorly represented than the limb bones.

Figure 9 plots the relative frequency of cattle body parts from the tenements of Polymonds Hall and those not associated with the Hall. In each instance, limb bones are the most frequent elements, notably the hind limb. Polymond's Hall appears to have gained more of its meat from the haunch of the animals, with pelvis and metatarsals also reasonably well represented, in contrast to the forelimb, where scapulae and metacarpals have already been removed. Notably, horncores are absent from the late- medieval cattle bone.

Of sheep and goat bones, Figure 11 of *Appendix 1* shows a very weak correlation between fragmentation and NISP. Within Polymond's Hall, an over-abundance of limb bones is evident, both over one standard deviation from the mean (Fig 10). Deposits not associated with the Hall show greater numbers of forelimb, occurring over one standard deviation from the mean, with the hindlimb, although numerous, less well represented (Fig 10). There is also potentially some difference in the treatments of the scapulae, with the shoulder potentially more frequently occurring in the other tenements. Metacarpals compared to forelimbs are generally lacking, suggesting most had been removed elsewhere.

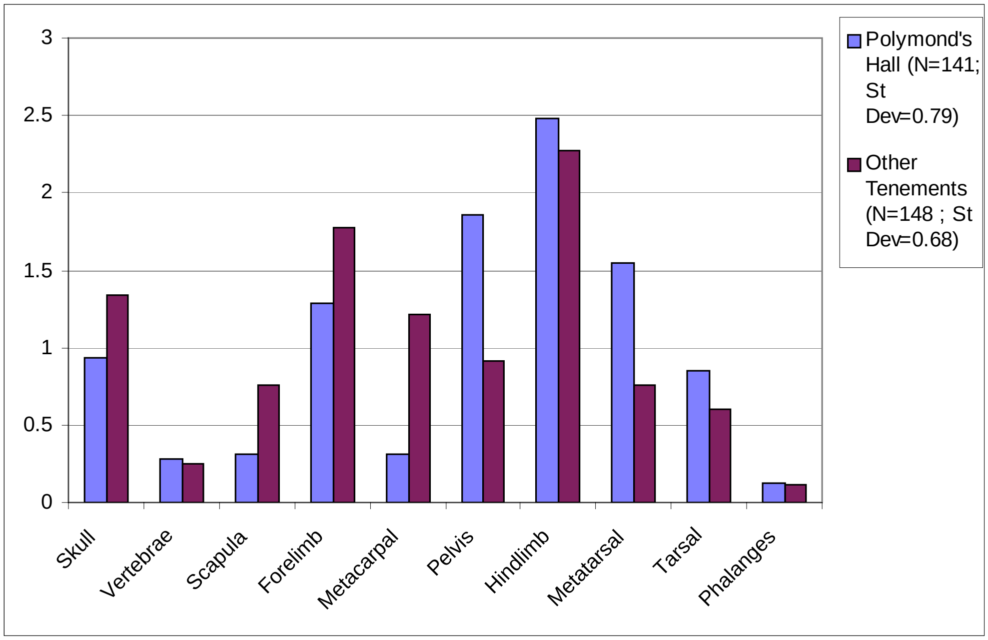

Fig 9: Late-medieval cattle from Polymond's Hall compared against other tenements, scaled to a mean value of 1

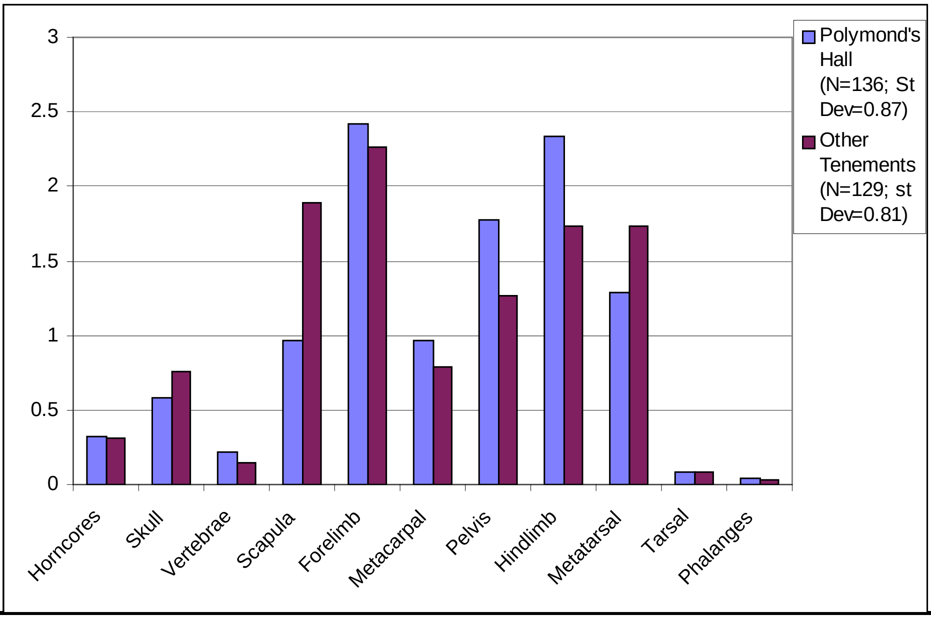

Fig 10: Late-medieval sheep and goat from Polymond's Hall compared against other tenements, scaled to a mean value of 1

Pig bones were too few for a similar analysis, with a total 83 NISP included within the study. Generally, most parts of the pig are represented at the site.

Post-medieval Activity

Quantification

Table 17 gives summary data of the presence of each species from both the hand-collected and sieved bone recovered from post-medieval deposits. The number of bones from soil samples is small, but follows the same trend as for earlier periods, suggesting the under-representation of sheep, goats and pig bones in the hand-collected material in comparison to cattle. Sheep/goat bones were the most frequently collected animal bone, followed by cattle. Sheep bones make up *c* 94% of the sheep/goat category.

Species	**Hand Collected Bone**				**Sieved Bone**	
	NISP	**%**	**MNI**	**%**	**NISP**	**%**
Horse	4	0.1	2	1.0		
Cattle	563	9.1	51	25.4	9	3.3
Pig	200	3.2	15	5.6	15	5.5
Sheep/Goat	941	15.2	114	55.3	64	23.4
Sheep	153	2.5			5	1.8
Goat	6	0.1				
Dog	10	0.2	2	1.0	1	0.4
Cat	77	1.2	8	4.1	16	5.8
Rabbit	41	0.7	7	3.6	3	1.1
Hare	5	0.1	1	0.5		
Red Deer	4	0.1	2	1.0		
Fallow Deer	9	0.1	2	1.0		
Roe Deer	7	0.1	2	1.0		
Deer	3	0.0				
Cattle/Red Deer	115	1.9			1	0.4
Sheep/Goat/Roe Deer	201	3.3			11	4.0
Sheep/Goat/Dog/Roe Deer	3	0.0				
Red/Fallow Deer	6	0.1				
Rabbit/Hare	2	0.0			1	0.4
Rattus sp	10	0.2				
Medium mammal	1768	28.6			67	24.5
Large mammal	912	14.8			23	8.4
Small mammal	54	0.9			12	4.4
Unidentified mammal	1085	17.6			46	16.8
Total	6206		207		274	
Total identified to a species level	2047	32.7			113	41.2
Main domestic species (%)						
Cattle		30.3		28.3		9.7
Pig		10.6		8.3		16.1
Sheep/Goat (includes sheep and goat)		50.6		52.8		68.8

Table 17: Total NISP and MNI values and percentages of the Post-Medieval animal bone, from hand-collected and sieved material; the MNI of sheep/goat includes sheep and goat categories

Distribution and Carcass Representation

Tables 18 and 19 give the distribution of the principal stock animals between tenements and feature types. Tenement 237 is recorded as a large house in 1620, the home of a sergemaker, with outbuildings, stables, shops, cellars, gardens and orchard. Tenements 239 and 241 were the site of the Black Swan Inn and the Shakespears Public House by the nineteenth century. However 64% of the principal stock animals were recovered from tenement 237, with most of the remaining material excavated from tenements 170 and 172. Most of the animal bone was recovered from pits, with higher densities of animal bone recovered from pits 249, 6200, 7364, and cess pits 584, 3169, and cistern 3549. These features account for 78% of the material presented in Tables 18 and 19.

	Tenements							
Species	170	171	172	173	176	180	237	240
Cattle	60.3	48.1	31.8	46.2	37.9	18.8	17.9	25.0
Pig	18.9	11.1	10.3	13.5	6.9	34.4	7.6	35.7
Sheep/goat	20.8	40.7	57.9	40.4	55.2	46.9	74.5	39.3
N	361	27	233	52	29	32	1202	28
N (Features)	9	6	11	11	1	3	22	1

Table 18: Percentage of the Post-Medieval principal stock animals from tenements with a sample size of over 20 NISP; sheep and goat have been totalled

Species	Pit	Cess pit	Tank	Layer	Floor	Other	N
Cattle	67.5	13.5	4.4	5.1	2.4	7.2	572
Pig	57.5	17.5	8.0	4.2	1.9	10.8	212
Sheep/goat	70.6	18.2	6.1	0.6	0.8	3.7	1182
N (Features)	30	3	1	6	3	30	73

Table 19: Percentage of Post-Medieval principal stock animals by feature type; sheep and goat have been totalled

Cess pits 3169 and 3549 in tenement 237, and pit 7364 in tenement 170, account for 50% (288 NISP) of the cattle bone recovered from the site. Pit 7364 contained exclusively metapodials and a single astragalus from its only fill, totalling 90 NISP (Fig 11). Butchery marks on these elements attest to the dismemberment and skinning of the cattle. Cess pits 3169 and 3549 contained a wider range of elements, predominantly from three of six deposits in 3160 and from one of five deposits in 3549, and have been included in the analysis of the remainder of the cattle bone.

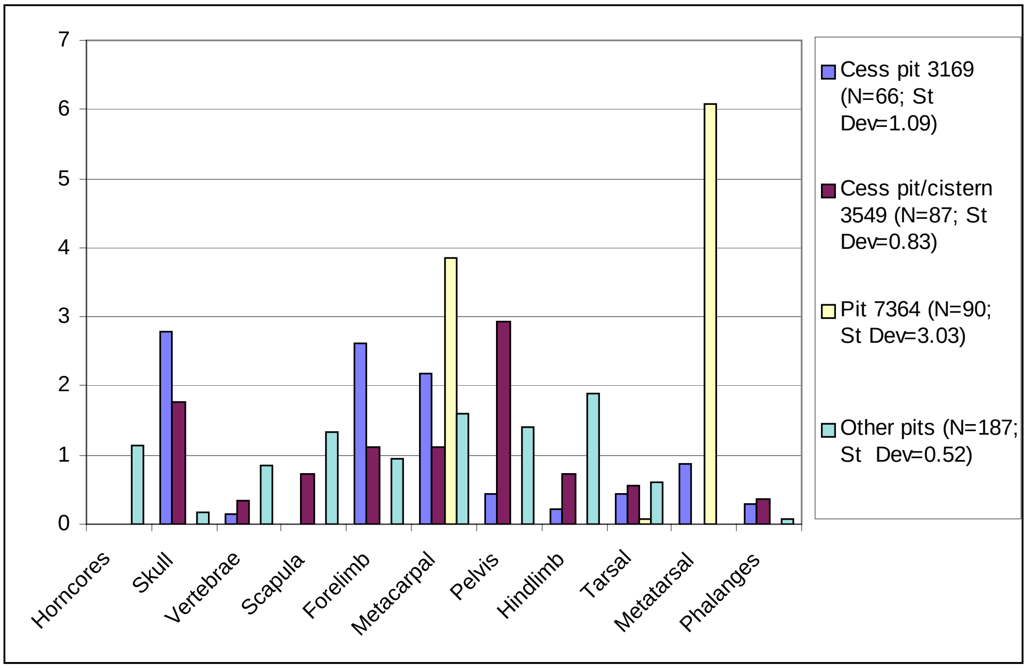

Fig 11: Modified NISP of post-medieval cattle bone in pits ***3169***, ***3549***, ***7364*** and other pits; cattle/red deer vertebra are included in the vertebra category.

Pit 7364 is excluded from Figure 13 of Appendix 1 because of the nature of the deposit, and there is no linear relationship between the fragmentation of cattle limb bones and the NISP. The material from Pit 3169 trends towards the skull and forelimb, but otherwise the contents of pit 3549 contained mixed deposits with no obviously meaningful trends (Fig 11). Further analysis would not have been meaningful, given the small sample.

Some 775 NISP, 82%, of the post-medieval sheep and goat bones were excavated from just three features, cess pits 584 and 3169 in tenements 172 and 237 respectively and a pit containing a stone cistern, feature 3549, also in tenement 237, which also contained cess-like deposits. Modified NISP of the body parts of these elements are presented in Figure 12. The cess pits in tenement 237 contained a large number of sheep skulls, as represented by both of the skull and the mandible, whereas pit 584 of tenement 172 contained exclusively metapodials and feet bones. Minimum numbers were calculated for these features, with a minimum of 15 animals from pit 584, a minimum of nine animals from pit 3169, and a minimum of 53 animals from pit 3549.

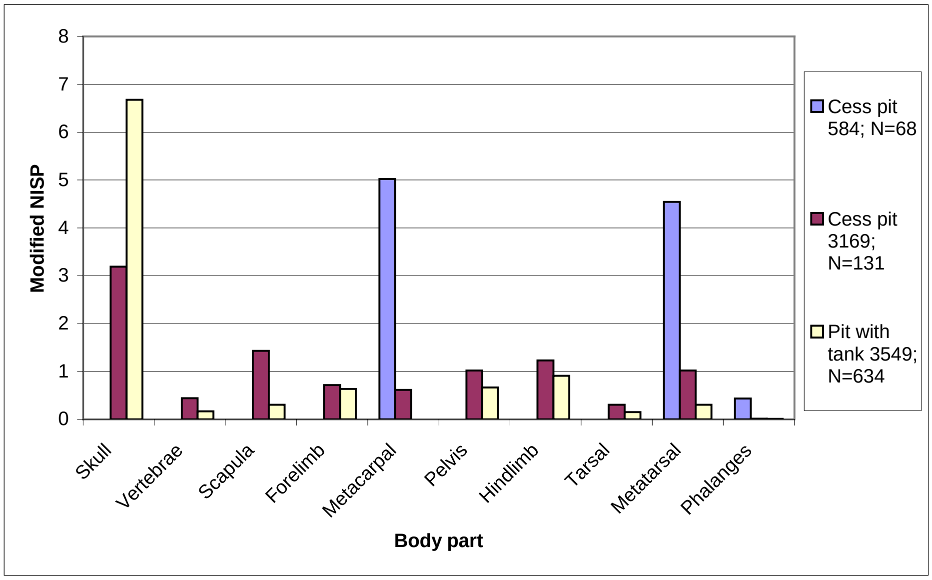

Fig 12: Modified NISP of sheep and goat bones from pits ***584***, ***3169*** and ***3459***; sheep/goat/roe deer vertebra are included in the vertebra category

The butchery marks on the remains from pit 3169, which comprised 59% of the butchered sheep and goats bones, demonstrated the removal of the head from the body of the sheep, the splitting of the skull in two via a chop down the length of the skull, to remove the brain, and the removal of the horncores. In one instance a chop mark showed where the left and right side of the mandible had been separated, presumably when still attached to the skull. Butchery marks on the smaller number of post-cranial bones demonstrated the dismemberment of the shoulder by chopping through the scapulae, dismemberment of ‘elbow’ and hip with a knife, and filleting of the hind limb. A chop mark through most of the tibia shaft, followed by a break, demonstrated where the rear foot had been removed. Skinning marks were visible on a single metatarsal.

The remaining sample of sheep and goat bones is much reduced by excluding these features, with between 50 and 60 NISP each from tenements 170, 172 and 237. Although a small sample, these remains show little correlation between fragmentation and NISP of the long bones (Figure 14, Appendix 1). Only two tenements produced over 20 NISP of pig bones, tenements 170 (60 NISP) and 237 (91 NISP). Considered collectively, most elements of the pig’s body are represented, with tarsal bones and vertebra under-represented, as a result of preservation and recovery problems.

Age at Death, and Sex

Cattle

Figure 13 and Table 20 give an indication of the age of slaughter of cattle, using the stage of mandibular tooth wear and the epiphysial fusion states. Generally, there is good correlation between the two methods. The earliest three periods show little evidence for the slaughter of animals before adulthood. This equates to 20% of the cattle in late-Saxon and high-medieval, and 26% of the cattle in Anglo-Norman deposits.

This correlated well with stage C (2-3 years) of the fusion data, with the exception of the Anglo-Norman period, which gives a slightly higher figure of 32.8% slaughtered by or at this fusion stage. The peak in slaughter appears to be in adult animals, accounting for 41.2% of the late-Saxon and 34.9% of the Anglo-Norman and high-medieval cattle (Fig 13), with around 34% of the stock remaining. The fusion data generally correlated with this, with the exception of the late-Saxon period, in which a greater percentage of older animals is indicated.

Only 10 mandibles were recovered from which an age of death could be estimated from late-medieval deposits. One of these was less than one month old, two between two and a half and three years, a young adult, five adults and one ‘senile’ animal. Similarly, epiphysial fusion of some of the fusion stages is relatively low (Table 20). Generally, the fusion data indicated a slightly greater number of younger animals in Stage B (1-1.5 years) and in Stage C (2-3 years). However, Stage E (3.5-4 years), the largest sample size, gives similar figures to those of the Anglo-Norman period.

The sample for mandibular tooth wear in the post-medieval period is small (Fig 13), but shows a very different picture from the preceding periods, with 51.8% of animals culled before adulthood, at a notably early age. Epiphysial fusion data suggest a peak between Stages C and E, with around 72% of the population culled before three and a half to four years. Younger animals were therefore being consumed, but there was possibly not quite the same emphasis on the very young animals as more than previously indicated by the mandible wear stages.

The total sample size from which the sex of the animal could be determined was relatively low, notably in the later two periods, but generally the remains of female animals appear to be more abundant at the site than male in each period (Table 21). This agrees with the metric study conducted on cattle metacarpi (*see Metrical Traits*).

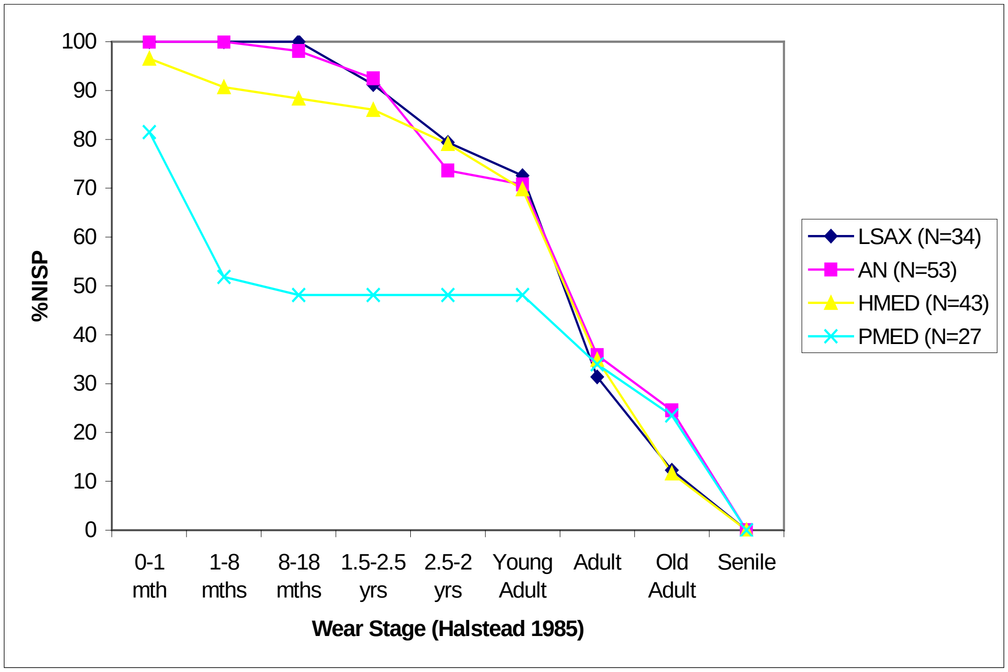

Fig 13: Mandibular tooth wear of cattle, presented as a decreasing percentage of the total NISP by period

Fusion Stage/ Fusion State	A	B	C	D	E	F
	7-10 months	12-18 months)	2/2.5-3 yrs	3-3.5 yrs	3.5-4 yrs	4.5-5 yrs
Late-Saxon						
Fused	100.0	90.2	74.6	50.0	61.5	50.0
Fusing	0.0	0.0	3.4	20.0	9.2	16.7
Unfused	0.0	9.8	22.0	30.0	29.2	33.30
N	26	112	118	10	65	42
Anglo-Norman						
Fused	97.1	93.2	67.2	46.7	31.5	28.7
Fusing	0.0	2.0	1.6	20.0	15.1	12.8
Unfused	2.9	4.8	31.2	33.3	53.4	58.5
N	35	147	125	15	73	94
High-medieval						
Fused	88.6	94.2	75.5	46.2	42.6	33.3
Fusing	0.0	1.6	3.1	15.4	8.8	17.5
Unfused	11.4	4.2	21.4	38.5	48.5	49.1
N	35	190	98	13	68	57
Late-medieval						
Fused	70.0	86.5	56.5	20.0	39.0	18.5
Fusing	10.0	0.0	4.3	20.0	7.3	14.8
Unfused	20.0	13.5	39.1	60.0	53.7	66.7
N	10	52	23	5	41	27
Post-medieval						
Fused	42.9	72.7	66.7	30.8	27.7	19.5
Fusing	0.0	0.0	0.0	7.7	6.4	7.3
Unfused	57.1	27.3	33.3	61.5	66.0	73.2
N	21	55	66	13	47	41

Table 20: Percentage of epiphysial fusion states of cattle bone; cattle/red deer vertebra are in included in each stage

Period	Male	Male?	Female	Female?	Male:Female
Late-Saxon	4	-	12	-	1:3
Anglo-Norman	4	-	16	-	1:4
High-medieval	2	2	9	-	1:2.25
Late-medieval	-	-	3	-	-
Post-medieval	1	-	6	-	1:6

Table 21: Percentages of male and female cattle, as determined from pelves

Sheep and Goat

Figure 14 and Tables 22 and 23 estimate the ages of slaughter of sheep and goats, using mandibular tooth wear and the epiphysial fusion states. The late-Saxon to high-medieval periods show a similar rate in slaughter, with around 50% of animals culled by two to three years of age, slightly more in the Anglo-Norman period. Similar figures are indicated by Stage E (3-3.5 years) in Table 23, with again a greater number of younger animals culled in the Anglo-Norman period.

Only 13 mandibles were recovered from which an age of death could be estimated from late-medieval deposits (Table 22). Epiphysial fusion (Table 23) shows a significant number of animals slaughtered at before Stage C (1.5-2.5 years), suggesting a greater emphasis on the consumption of younger animals such as lambs, than previously seen. After this age group, just under 50% of animals survived beyond this, predominantly sheep husbanded for their wool.

Post-medieval mandible wear data are dominated by material from cess pit 3549, although, generally, a good correlation can be seen between mandibular tooth wear and epiphysial fusion. A high rate in the slaughter of adult animals is clearly present in Figure 14. Few animals appear to have been culled before three years of age, with the first peak in slaughter at three to four years, accounting for 26% of the mandibles, with 61% of the animals surviving this age group. Epiphysial fusion gives a similar pattern, with slightly greater number culled between Stage D (2.5-3 years) and Stage E (3-3.5 years), with 41.7% of the population surviving this age group.

A discrepancy is seen between Stages B, C and D in Table 23, with large numbers of unfused distal metapodials and proximal phalanxes in Stage C. This fusion stage is highly biased by the contents of cess pit 584, which produced large numbers of these bones. Excluding this feature from Table 23 produces figures of 92% fused and 8% unfused in Stage B (N=48) and 53% fused, 4% fusing and 43% unfused in Stage C (N=49). The number of sexable pelves in each period is low, although the Anglo-Norman period suggests a ratio of around 60:40 (female:male) (Table 24).

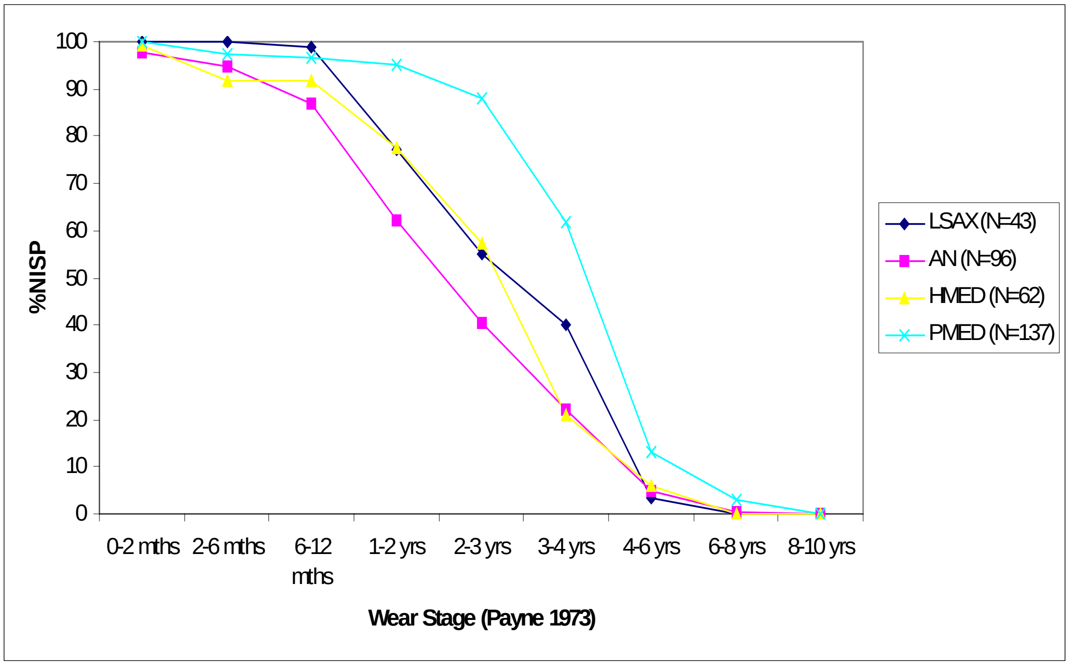

Fig 14: Mandibular tooth wear of sheep and goat, presented as a decreasing percentage of the total NISP by period

Wear Stage	**Estimated Age**	**Late-medieval (N=13)**
A/B	0-2 months	11.5
B	2-6 months	11.5
C	6-12 months	
D	1-2 years	7.7
E	2-3 years	7.7
F	3-4 years	30.8
G	4-6 years	15.4
H	6-8 years	11.5
I	8-10 years	11.5

Table 22: Late-medieval mandibular tooth wear of sheep and goat

Fusion Stage/ Fusion State	**A**	**B**	**C**	**D**	**E**	**F**
	6-10 months	**10-16 months)**	**1.5-2/2.5 yrs**	**2.5-3 yrs**	**3-3.5 yrs**	**4-5 yrs**
Late-Saxon						
Fused	100.0	95.3	76.2	45.5	25.0	25.9
Fusing	0.0	0.0	3.2	18.2	16.7	3.7
Unfused	0.0	4.7	20.6	36.4	58.3	70.4
N	18	43	63	11	24	27
Anglo-Norman						
Fused	84.9	82.4	62.7	25.0	25.5	22.0
Fusing	0.0	0.0	0.0	0.0	10.9	22.0
Unfused	15.1	17.6	37.3	75.0	63.6	55.9
N	53	68	75	16	55	59
High-medieval						
Fused	85.2	89.2	68.2	34.6	38.2	21.6
Fusing	0.0	5.4	7.1	34.6	7.9	9.8
Unfused	14.8	5.4	24.7	30.8	53.9	68.6
N	81	111	85	26	76	51
Late-medieval						
Fused	92.3	90.3	50.0	33.3	46.7	42.9
Fusing	0.0	0.0	7.1	22.2	13.3	23.8
Unfused	7.7	9.7	42.9	44.4	40.0	33.3
N	26	62	42	9	45	21
Post-medieval						
Fused	76.5	62.0	31.7	71.0	41.1	37.7
Fusing	0.0	0.0	2.4	6.5	21.9	20.8
Unfused	23.5	38.0	65.9	22.6	37.0	41.5
N	51	71	82	31	73	106

Table 23: Percentages of epiphysial fusion states of sheep and goat bones; sheep/goat/roe deer vertebra are in included in Stage F

Period	**Male**	**Male?**	**Female**	**Female?**	**N**
Late-Saxon	66.7	-	33.3	-	3
Anglo-Norman	31.2	6.2	59.4	3.1	32
High-medieval	-	16.7	66.7	16.7	12
Late-medieval	-	-	83.3	16.7	6
Post-medieval	30.8	-	53.8	15.4	13

Table 24: Percentages of male and female sheep and goat, as determined from pelves

Pig

The total sample sizes for pig mandibular wear are generally low, the results being presented in Figure 15. Only 10 mandibles from late-medieval and 14 mandibles from post-medieval deposits were recovered from which an age of death for the animal could be estimated, the results being presented in Table 24. Both mandibular tooth wear and epiphysial fusion data give a similar picture, that of a high rate of slaughter of younger animals, with around 50% or more of the population culled before two years of age.

A high rate of slaughter of younger animals is not surprising in an animal husbanded predominantly for its meat. A decrease in the presence of older animals at the site in the high-medieval period is suggested by both mandibular tooth wear (Fig 15) and by the unfused percentage at Stage B (2-2.5 years, Table 25). The late-medieval and post-medieval periods appear to continue this decline (Table 25), and this evidence may correlate with the occupants of the tenement being less involved with the production of their pork. Sexing data for pig are presented in Table 26, but the sample sizes are too small to be useful. For example, a high ratio of females, 1:4.3, was produced by high-medieval canines, and a ratio of 1:1.3 from mandible alveoli of the same period.

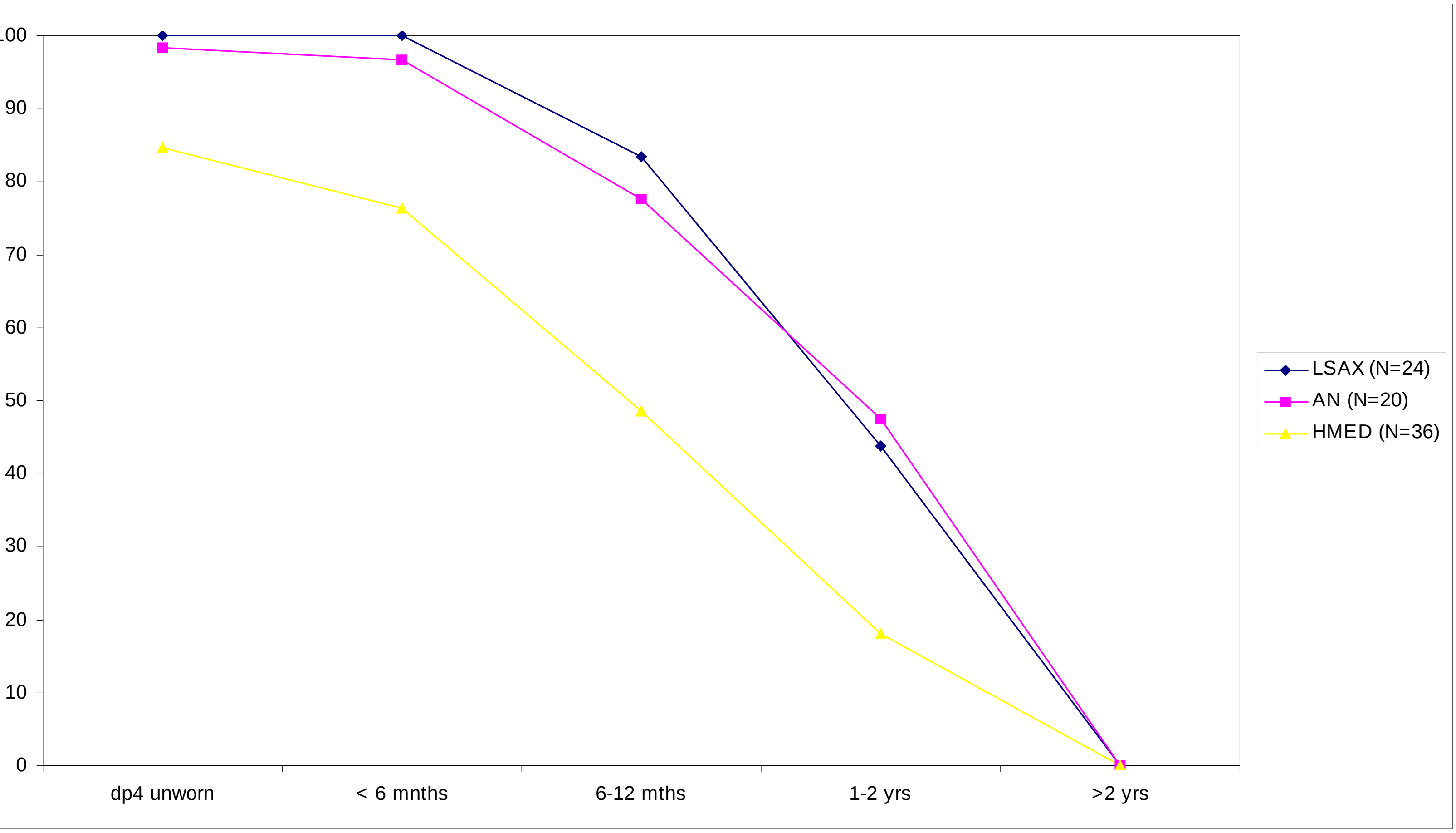

Fig 15: Mandibular tooth wear of pig, presented as a decreasing percentage of the total NISP by period

Wear Stage	**Wear/estimated Age**	**Late-medieval (N=14)**	**Post-medieval (N=10)**
A	dp4 unworn	15.2	10
B	Less than 6 months	8.3	10
C	6-12 months	27.8	25
D	12-24 months	30.5	40
E	Over 2 years	18.0	15

Table 24: Late- and Post-medieval pig mandibular tooth wear

Fusion Stage/ Fusion State	**A**	**B**	**C**	**D**
	by 12 months	**2-2.5 years**	**by 3.5 years**	**4-7 years**
Late-Saxon				
Fused	89.5	38.2	18.4	0
Fusing	1.2	8.8	18.4	8.3
Unfused	9.3	52.9	63.2	91.7
N	86	34	38	012
Anglo-Norman				
Fused	70.4	37.7	10.6	18.2
Fusing	2.8	1.4	4.3	9.1
Unfused	26.8	60.9	85.1	72.7
N	71	69	47	11
High-medieval				
Fused	76.1	22.4	5.7	0.0
Fusing	6.0	4.5	9.4	5.6
Unfused	17.9	73.1	84.9	94.4
N	67	67	53	36
Late-medieval				
Fused	87.5	8.7	10.5	0.0
Fusing	0.0	0.0	5.3	0.0
Unfused	12.5	91.3	84.2	100.0
N	16	23	19	5
Post-medieval				
Fused	68.4	15.4	7.4	8.3
Fusing	0.0	0.0	11.1	8.3
Unfused	31.6	84.6	81.5	83.3
N	19	26	27	12

Table 25: Percentages of epiphysial fusion states of pig bones

Period	**Male**	**Female**	**Male:Female**
Mandibular Canine			
Late-Saxon	6	2	3:1
Anglo-Norman	7	1	7:1
High-medieval	3	13	1:4.3
Late-medieval	2		-
Post-medieval	2	2	1:1
Mandible alveolus			

Period	Male	Female	Male:Female
Late-Saxon	6	7	1:1.7
Anglo-Norman	9	3	3:1
High-medieval	6	8	1:1.3
Late-medieval	3	1	3:1
Post-medieval	4	1	4:1

Table 26: Pig sexing data, as determined from mandibular canines and mandible alveolus

Butchery

Cattle

The frequency of butchery marks in each period is relatively low, between 10% and 20% of the bones from each period (Table 27). Of the limb bones, knife marks are more frequently the result of the filleting of cattle, and chop marks from their dismemberment (Table 28). Of the skull, evidence for the decapitation of the animal, dismemberment of the mandible from the skull by cutting the masseter (cheek) muscle and at the mandibular hinge, as well as the removal of the tongue, are present, but there are only small numbers per period. In one high-medieval cattle skull, a chop mark was present on its dorsal aspect, where an attempt to split the skull longitudinally had been made. Removal of horncore, from which the horn would have been soaked off, was evident in the late-Saxon and high-medieval periods. Similarly, the removal of the animal's hide was evident in each period, except the late-medieval, although, these raw materials were clearly utilised in each period.

Period	Acts of Butchery	Knife marks (%)	Chop Marks (%)	Sawn (%)	Number of Butchered Bones	Percentage of Cattle Bones Butchered
Late-Saxon	150	36	63	-	144	17.3
Anglo-Norman	138	56	44	-	134	13.9
High-medieval	111	57	43	-	119	13.1
Late-medieval	42	45	56	-	43	15.2
Post-medieval	78	60	39	1	74	15.1

Table 27: Summary of frequency of butchery marks on cattle bones

Period	Butchery Mark	Filleting	Dismemberment	N
Late-Saxon	Knife	61.9	38.1	21
	Chopper	37.1	62.9	35
Anglo-Norman	Knife	71.4	28.6	28
	Chopper	48.3	51.7	29
High-medieval	Knife	83.8	16.2	37
	Chopper	31.4	68.6	35
Late-medieval	Knife	88.9	11.1	9
	Chopper	35.3	64.7	17
Post-medieval	Knife	100	-	14
	Chopper	54.3	45.7	35

Table 28: Summary of the butchery of limb bone, including pelves and scapula, from cattle

The dismemberment of the lower part of the limb is a point of interest, particularly in assessing the presence of absence of the forelimb, as the distal end of the radius and tibia may be chopped off and discarded as butchery waste. This is problematic for each limb in different ways. The distal end of the tibia is the best surviving part of the forelimb, and as such is often well-represented in comparison to the proximal tibia and the femur. Conversely, the distal end of the radius, as well as the proximal end of the humerus, survives poorly in relation to the proximal radius and distal humerus.

Figure 16 demonstrates a potential change in the late- and post-medieval periods for the butchery of the tibia, although notably with declining samples sizes. Diagnostic zones of the proximal end would normally be lower than that of the distal. A decrease between zones 5 and 6, the distal shaft, and zones 7 and 8, the distal end, may suggest the removal of the distal ends from the shaft. Although this is visible in the late-medieval and post-medieval periods (Fig 16), the sample of tibias is very small. Otherwise, removal of the foot in this position does not appear to be present.

Within the radius there is a general decline in the frequency of diagnostic zones from the proximal end of the bones towards the distal, as expected from taphonomic processes. The butchery record is also not overly helpful. There is only one instance of a high-medieval cattle radius, out of 44 butchery records of this element, where the proximal half of the shaft has been chopped half-way through and the remainder broken off.

The longitudinal splitting of cattle metapodials to remove the marrow was noted in a number of specimens (Table 29). It was also noted that where this occurs the butchery associated with it is located at just one end of the bone. Examples of metapodials, which have split longitudinally, although with no butchery mark evident for the break, have also been quantified. The number of examples in each period is small, notably declining after the Anglo-Norman period.

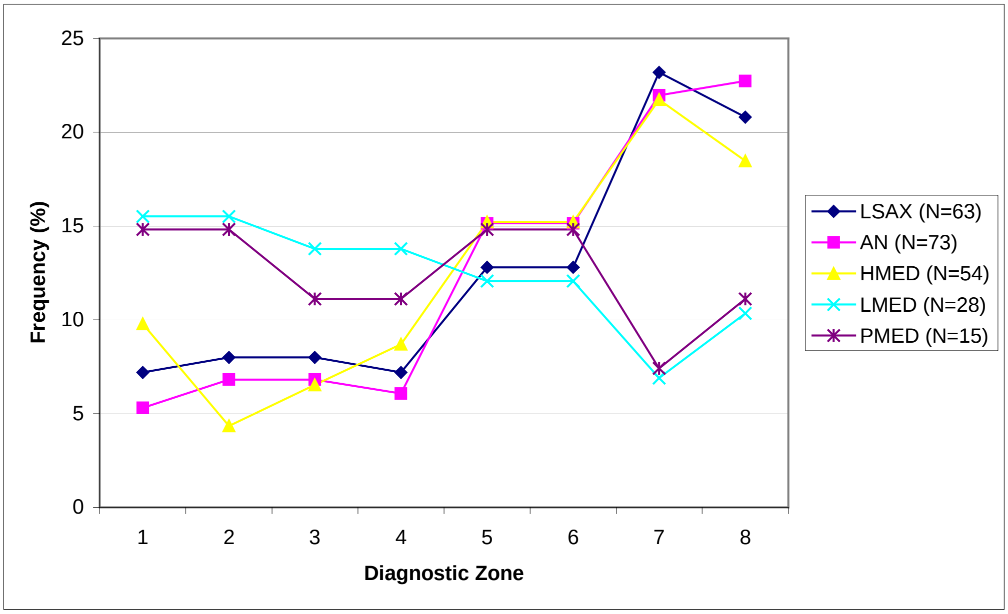

Fig 16: Presence of diagnostic zones of cattle tibia; zones 1 and 2 being the proximal end and zones 7 and 8 the distal

Description	Late-Saxon	Anglo-Norman	High-medieval	Late-medieval	Post-medieval
Split longitudinally (%)	10.2	7.7	0.7	-	0.9
Split attempted (%)	1.6	1.3	0.7	-	-
Possibly split (%)	15.7	17.4	12.0	-	-
Not split (%)	72.4	73.5	86.6	100	99.1
N	127	155	142	22	112

Table 29: Summary table of longitudinal splitting of cattle metapodials

Sheep and Goats

The frequency of butchery marks on sheep and goat is relatively low (Table 30). Of the limb bones, knife marks are more frequently the result of the filleting of the animal and chop marks represent their dismemberment (Table 31). The same butchery of the skull seen in cattle was evidenced. Some 20 NISP or 55.5% (N=36) of post-medieval mandibles were recovered with the diastema (zone 7) chopped through from the buccal side, presumably to remove the marrow, although there is no evidence of heating the bone to aid this. A single example of this (2%; N=42) was recovered from a high-medieval deposit.

Removal of horncore, from which the horn would have been soaked off, was evident in the late-Saxon to high-medieval periods. Similarly, the removal of the animal's hide was identified in the late-Saxon, high-medieval and post-medieval periods. Both the horn and the skin of the sheep and goats would, however, have been utilised in each period.

Period	Acts of Butchery	Knife marks (%)	Chop Marks (%)	Sawn (%)	Number of Butchered Bones	Percentage of Sheep/Goat Bones Butchered
Late-Saxon	50	50	48		37	10.5
Anglo-Norman	68	50	47		81	11.6
High-medieval	76	70	29		74	8.8
Late-medieval	38	53	57		39	14.8
Post-medieval	153	32	66	2	126	13.8

Table 30: Summary of frequency of butchery marks on sheep and goat bones

Period	Butchery Mark	Filleting	Dismemberment	N
Late-Saxon	Knife	90.0	10.0	10
	Chopper	20.0	80.0	10
Anglo-Norman	Knife	73.9	26.1	23
	Chopper	55.6	44.4	27
High-medieval	Knife	93.9	6.1	33
	Chopper	53.8	46.2	26
Late-medieval	Knife	77.3	22.7	22
	Chopper	40.0	60.0	10
Post-medieval	Knife	94.1	5.9	17

	Chopper	52.0	48.0	25
	Saw		100	3

Table 31: Summary of the butchery of limb bones, including pelves and scapula, from sheep and goat

As with the cattle, the presence of the distal ends of the radius and tibia is relevant not only to the butchery of the animals, but in how we assess the presence or absence of the limb. The taphonomic history of the material is also relevant is assessing the presence or absence of the proximal and distal ends of these bones.

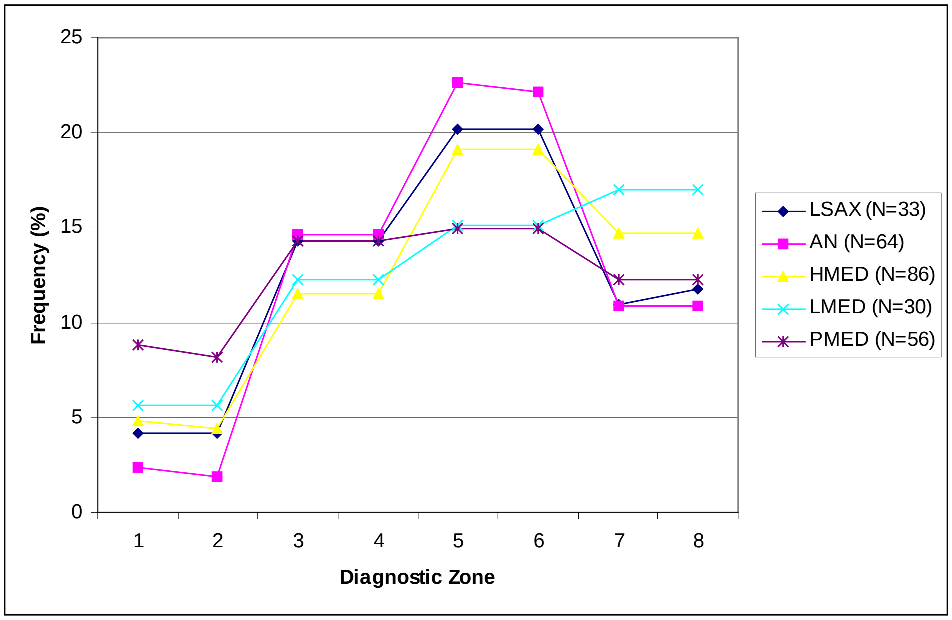

Fig 17: Presence of diagnostic zones of sheep and goat tibia; zones 1 and 2 being the proximal end and zones 7 and 8 the distal

Figure 17 presents the presence of the diagnostic zones of the distal tibia. From the late-Saxon and Anglo-Norman periods, and to a lesser degree in the high-medieval, there is an apparent drop in the presence of zones from the distal end. It is this end, being the denser part of the bone, which we might expect to be the most abundant. An alternative explanation to butchery is that these zones were lost as unfused epiphysis. Table 32 gives the presence of zones 7 and 8 as a percentage of the MNE as well as the percentage of unfused distal tibias. Some correlation in unfused distal tibia is seen in the Anglo-Norman period, but not in the late-Saxon and high medieval periods.

Period	MNE of Tibia	MNE of zones 7 and 8	% of zones 7 and 8	% unfused	N (fusion)
Late-Saxon	24	14	58.33	11.76	17
Anglo-Norman	48	23	47.92	38.89	36
High-medieval	48	37	77.08	15.56	45
Late-medieval	18	18	100.00	14.29	21
Post-medieval	22	18	81.82	33.33	27

Table 32: Presence of zones 7 and 8 of sheep and goat tibias against distal fusion

It is therefore suggested that the loss of the tibia this end through the butchery is more clearly evidenced in the late-Saxon, and to a lesser degree in the Anglo-Norman and high-medieval periods. Given that sheep and goat metapodials are clearly present at the site, it is the removed distal end that has been lost to the achaeozoological record.

Examples of this in the butchery record were few, with two late-Saxon and one late-medieval example. Of the post-medieval tibias, two had been sawn through and one chopped through. Similar analysis of the radius is hampered by the fact that this part of the bone normally has a low survival rate. However, the unfused percentage of the distal epiphysis is roughly equal to or higher than the apparent loss of these zones. In the butchery record one late-Saxon and two late-medieval radii were recorded which had been chopped through to remove the foot.

Pig

Butchery marks on pig bones were relatively scare in each period (Table 33). Knife marks account for the majority of butchery acts in most instances (Table 34). Only eight acts of butchery were recorded on elements of the skull, in which its dismemberment and removal of the tongue was evidenced. In one post-medieval example, it has been split by chopping the skull from its dorsal aspect to remove the brain.

Period	Acts of Butchery	Knife marks (%)	Chop Marks (%)	Number of Butchered Bones	Percentage of Pig Bones Butchered
Late-Saxon	32	84	17	34	10.6
Anglo-Norman	35	94	6	30	6.8
High-medieval	24	83	17	23	3.5
Late-medieval	7	71	29	7	6.1
Post-medieval	9	67	33	10	5.1

Table 33: Summary of frequency of butchery marks on pig bones

Period	Butchery Mark	Filleting	Dismemberment	N
Late-Saxon	Knife	100.0	0.0	6
	Chopper	87.5	12.5	16
Anglo-Norman	Knife	100.0	-	17
	Chopper	100.0	-	12
High-Medieval	Knife	70.6	5.9	13
	Chopper	58.3	16.7	9
Late-medieval	Knife	100.0	0.0	4
	Chopper	33.3	66.7	3
Post-medieval	Knife	100	-	6
	Chopper	-	100	2

Table 34: Summary of the butchery of limb bone, including pelves and scapula, from pig

Vertebra

Within each period, butchered vertebra proved relatively scarce (Table 35 and 36). Chop marks are present in most acts of butchery, with the exception of the removal of the tenderloin, which was completed by a knife in each period. Decapitation of the animals is evidenced by both chop and knife marks. Transverse chop marks separating the spinal column horizontally were recorded on cervical, lumber and thoracic vertebra of cattle (large) and sheep (medium) sized animals.

A number of vertebra had longitudinal chop marks, either splitting the vertebra roughly equally into two halves or, of lumbar and thoracic vertebra, down the side of the body of the vertebra, often removing the transverse process. The former practice appears to increase in frequency in the High-Medieval period on large-sized animals, and in both large and medium sized animals in the post-medieval period. Evidence of the latter practice, removing the ribs of the animal, has a fairly low frequency in each period. It should be noted that figures from the post-medieval period are greatly influenced by cattle, sheep and goat remains from a small number of features (*see Post-Medieval Distribution*).

	Late-Saxon	**Anglo-Norman**	**High-medieval**	**Late-medieval**	**Post-medieval**
Percentage Butchered	19.0	17.9	15.5	30.6	37.2
Percentage longitudinally chopped/split down the middle	5.5	19.3	40.9	36.8	63.1
Percentage of thoracic and lumber vertebra with chop marks down side of vertebra body	6.4	7.8	6.7	8.8	3.8
N (all vertebra)	189	173	142	62	102
N (thoracic and lumbar)	106	90	60	34	53

Table 35: Summary table of vertebra from large mammals

	Late-Saxon	**Anglo-Norman**	**High-medieval**	**Late-medieval**	**Post-medieval**
Percentage Butchered	6.2	19.2	8.4	16.9	34.1
Percentage longitudinally chopped/split down the middle	1.2	20.0	4.6	16.9	30.5
Percentage of thoracic and lumber vertebra with chop marks down side of vertebra body	7.1	3.9	1.2		
N (all vertebra)	80	120	215	65	167
N (thoracic and lumbar)	42	51	83	34	100

Table 36: Summary table of vertebra of medium mammals

Metrical Traits

Cattle

For the metacarpal, the breadth of the distal end (Bd) and the breadth at the distal epiphysial fusion line (BFd) are plotted against each other in Figure 18. Three clusters are identified, a larger female grouping lower left quarter, and much smaller male clusters in the top right quarter, with a small number of intermediate possible castrates. This remains true for each period, with the exception of the post-medieval, where four specimens fall into the male group, one in the male/possible castrates, and two in the female grouping. A similar exercise for cattle horncores (Figure 19) demonstrates a similar result in the late-Saxon, Anglo-Norman and Higher-medieval specimens, with very few late examples in the larger male grouping.

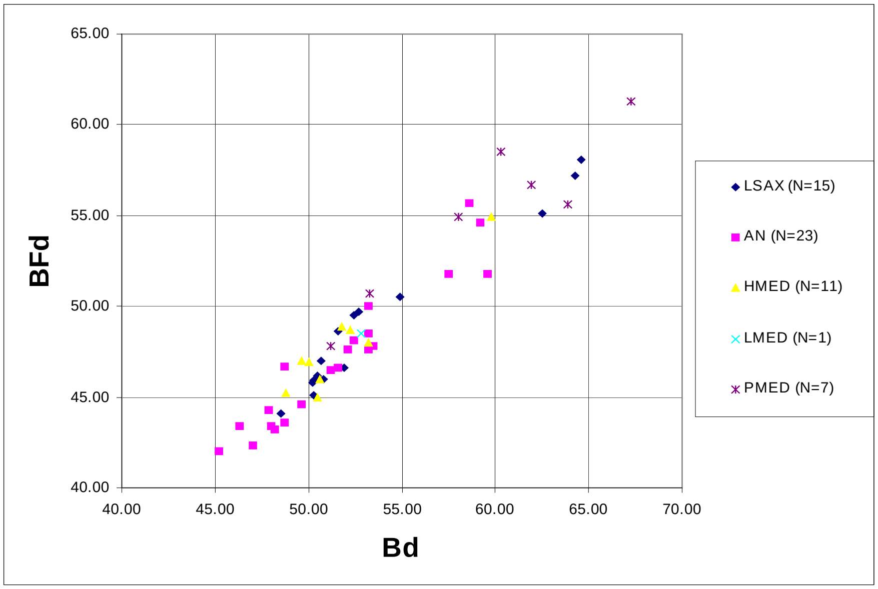

Fig 18: Size of distal, breadth of distal metacarpal (BD): Breadth of distal metacarpal at epiphysial fusion point (BFd)

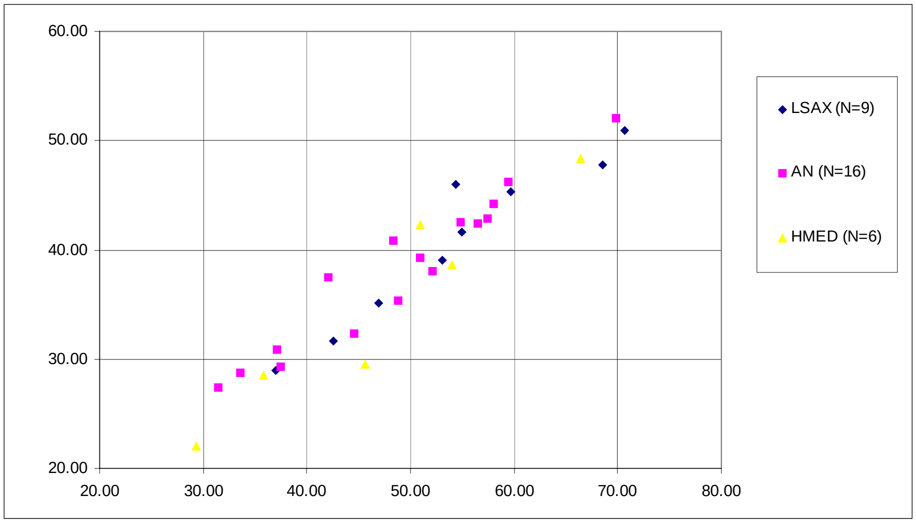

Fig 19: Size of cattle horncores, maximum basal breadth (46 Max); minimum basal breadth (46 min)

The general size of cattle bones was assessed using the greatest proximal breadth (Bp) of the metatarsal (Figure 20). Students' t-test on the mean values of high-medieval and post-medieval Bp measurements of the metatarsal suggests a significant increase in the size of cattle in the post-medieval period (Fig 20). Wither heights for cattle, calculated from the greatest length (GL) of metapodials (Table 37) would suggest that this change in size of the limb bone is also reflected in the height of the animals, although the sample size in each period is notably small.

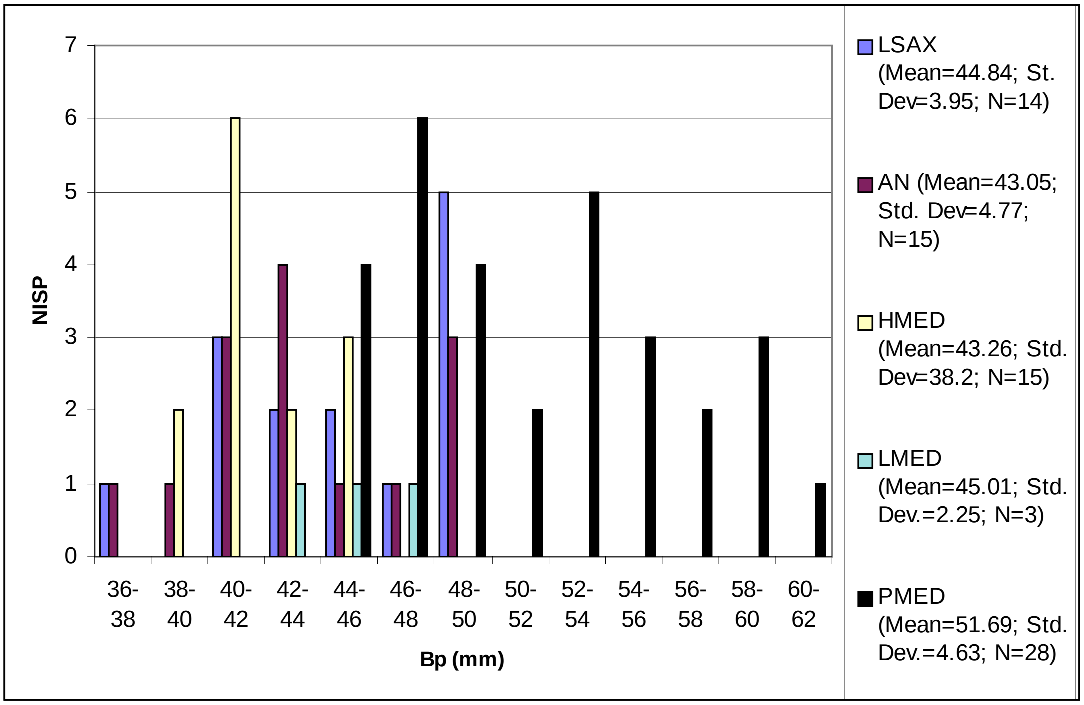

Fig 20: Size of cattle metatarsals; breadth of proximal end (Bp)

Period	**Min (m)**	**Max (m)**	**Mean (m)**	**Stdev (mm)**	**N**
Late-Saxon	1.09	1.29	1.17	59.13	7
Anglo-Norman	1.02	1.25	1.13	62.00	9
High-Medieval	1.06	1.15	1.10	34.42	3
Late-medieval	1.05	1.13	0.00		2
Post-medieval	1.10	1.36	1.21	85.30	5

Table 37: Cattle wither heights

Sheep and sheep/goat

Breadth of proximal radius (BFp), breadth of distal tibia (Bd) and the breadth of the distal humerus (Bd) produced sufficient sample sizes to give an overview of the size of sheep and sheep/goat bones between the periods (Figs 21-23). Applying students'-t test to these figures suggests a significant increase between the average size of high-medieval and post-medieval mean values of radius (BFp), and Anglo-Norman and post-medieval tibia (Bd), but little difference in the size of the distal humerus, which articulates to the proximal radius. It is likely that these differences do not relate to an increase as size, *per se*, as much as to an increase in meat weight. Wither heights of sheep bones, excluding sheep/goat, are presented in Table 38.

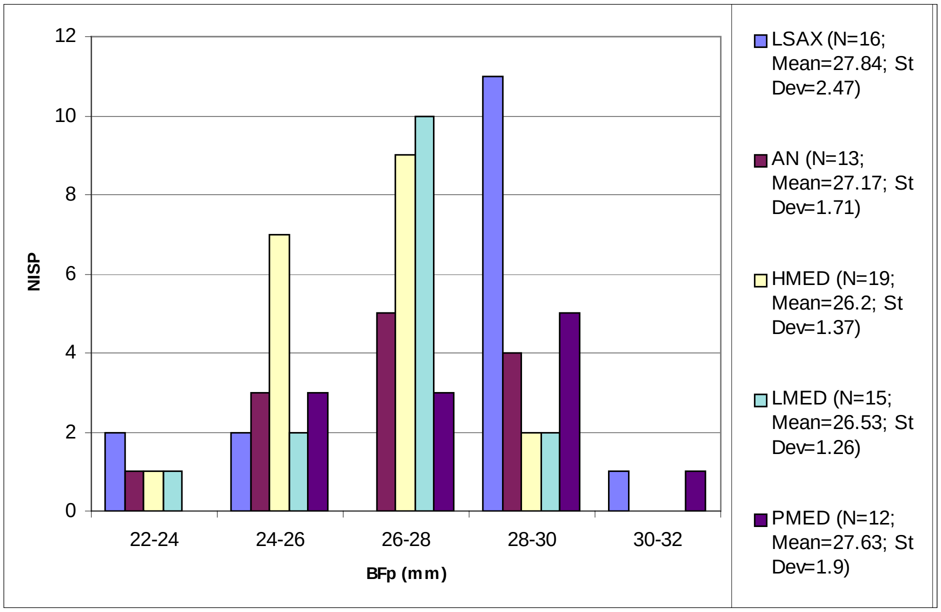

Fig 21: Size of sheep and sheep/goat; breadth of fusion proximal (BFp)

Period	Min (mm)	Max (mm)	Mean (mm)	Stdev (mm)	N
Late Saxon	543.28	654.21	599.65	29.56	13
Anglo-Norman	542.30	588.76	568.93	17.68	9
High-medieval	521.19	626.90	577.54	34.89	7
Late-medieval	496.07	590.70	555.53	35.14	7
Post-medieval	632.65	632.65			1

Table 38: Sheep wither heights

Pig

Pig teeth and post-cranial bone measurements were compared to the standards (ie value 0) published for Kizilcahamam wild boar in Payne and Bull (1988), using the log ratio method. There were no possible wild boars suggested by the teeth and most of the post-cranial bones in the assemblage. The exceptions are the greatest length of articular process (GLP) and smallest length of the collum (SLC) of the scapulae and greatest lateral length (GLl) of the astragalus (Fig's 24 to 26). Out-lying log values close to the '0' may potentially be wild boar. However, the forelimb bones are more susceptible to sexual dimorphism than the hind limb, and it is noticeable that one of the late-Saxon SLC measurement lies within the range of domestic pigs in the GLC measurement. Much fewer astragali were measured, although one Anglo-Norman example lies within the wild boar range. There was no evidence in the teeth measurements for the increase in size of this animal. Wither heights of pig are presented in Table 39.

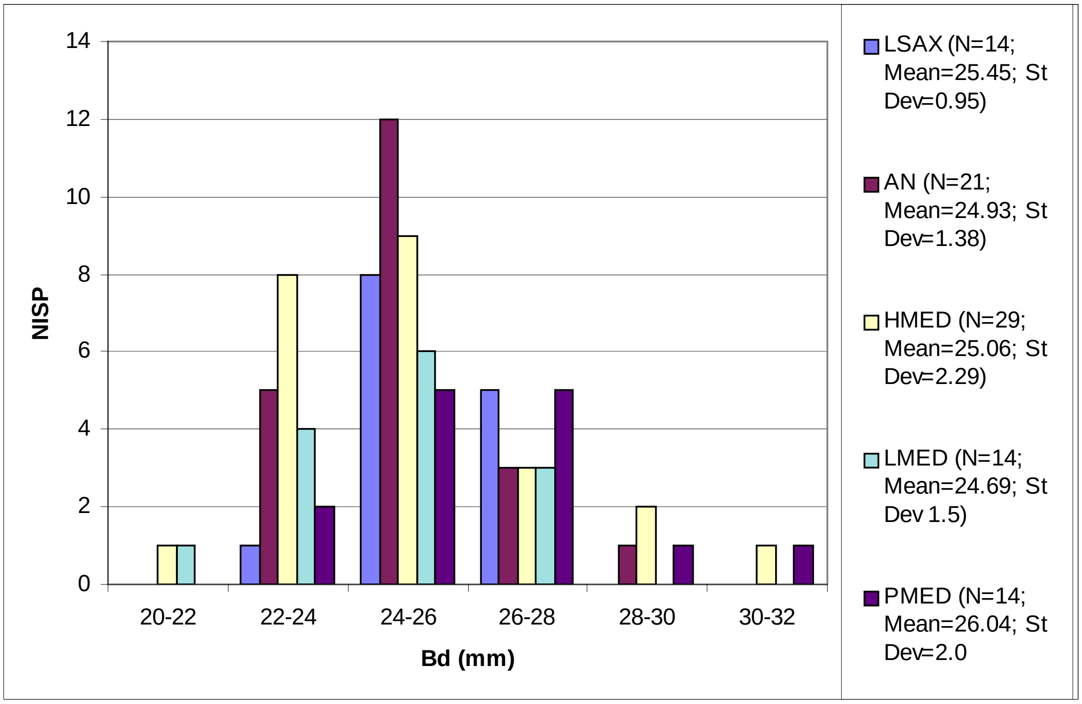

Fig 22: Size of sheep and sheep/goat; breadth of distal tiba (Bd)

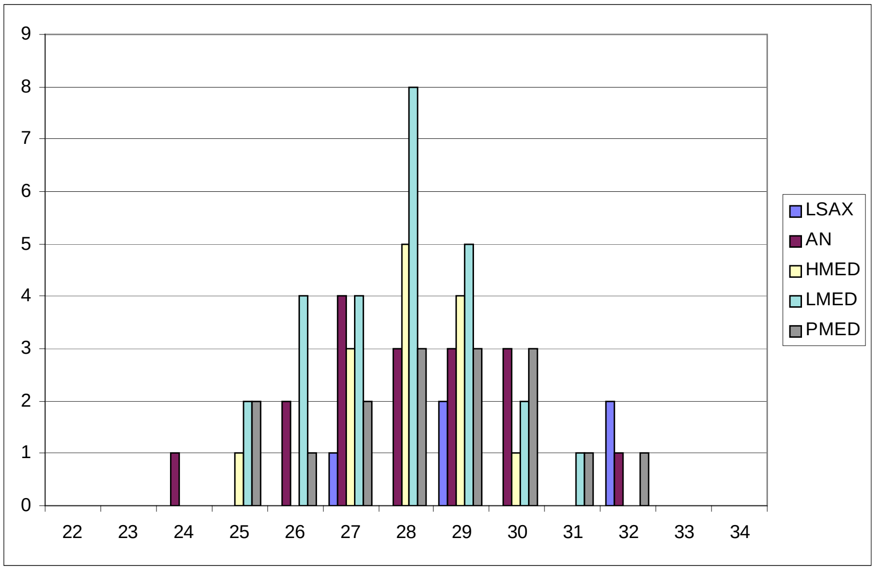

Fig 23: Size of sheep and sheep/goat, breadth of distal humerus (Bd)

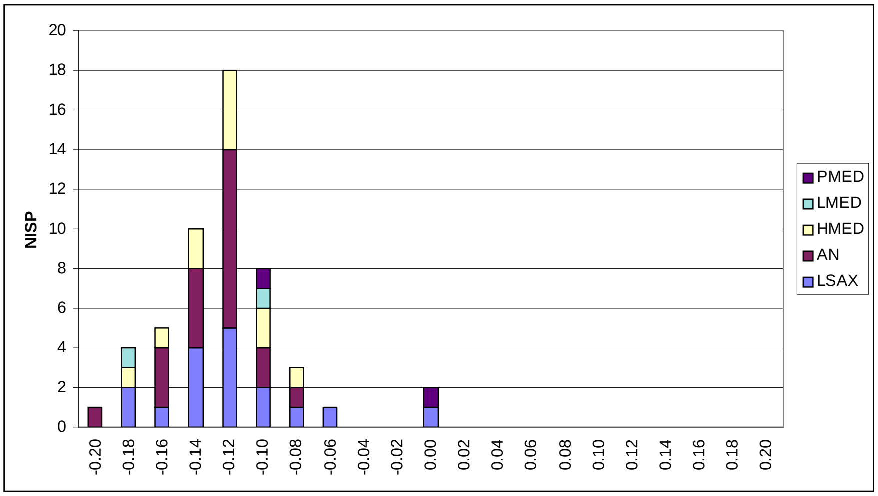

Fig 24: Variation of pig scapulae GLC measurement, using the log ratios

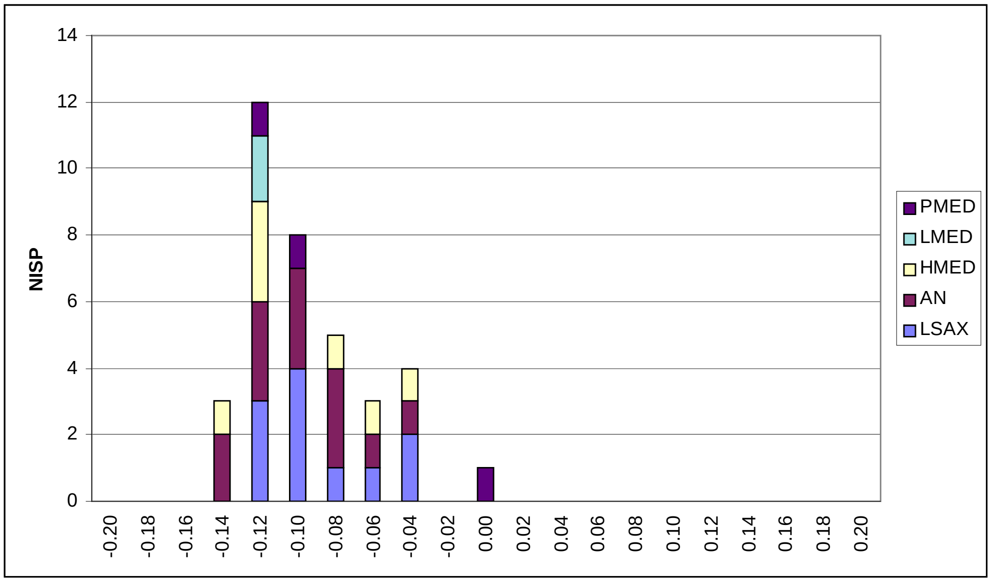

Fig 25: Variation of the pig scapulae SLC, using the log ratios

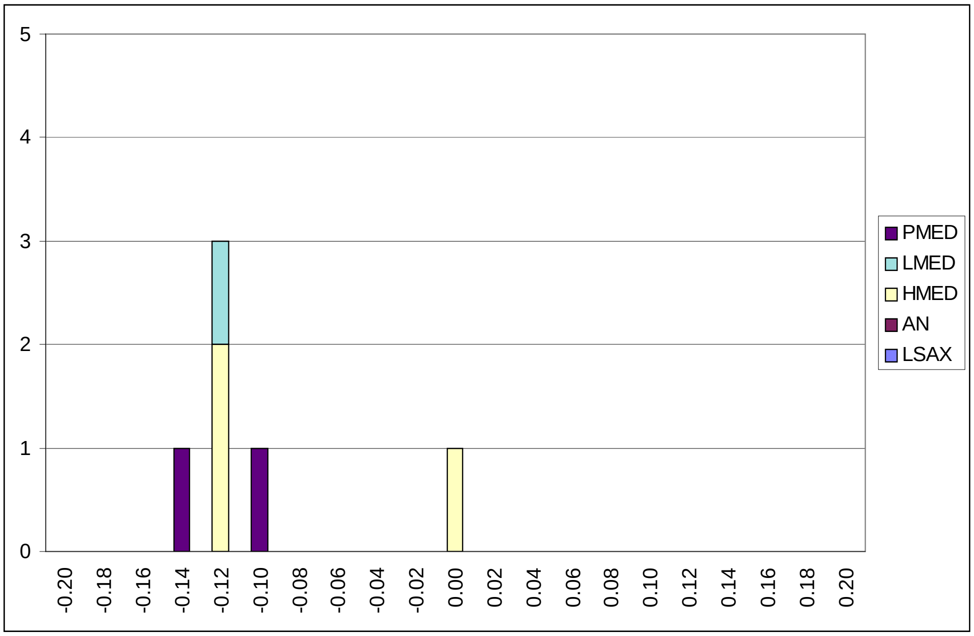

Fig 26: Variation of the pig astragalus GLl measurement, using the log ratios

Period	Min (m)	Max (m)	Mean (m)	N
Late-Saxon	0.76	0.76		1
Anglo-Norman	0.67	0.73	0.70	3
High-medieval	0.66	0.66		1

Table 39: Pig wither heights

Pathologies

Cattle

Two late-Saxon mandibles and one maxilla, as well as one Anglo-Norman maxilla, were recovered with evidence of an over-shot or under-shot jaw, resulting in abnormal wear of the teeth. A single high-medieval mandible had crowded premolars. One late-Saxon, two Anglo-Norman and one high-medieval animal had evidently shed the second premolar, ante-mortem, with the alveolus subsequently healed over. A single Anglo-Norman and a high-medieval mandible had no second premolar, but it could not be discerned whether the alveolus was healed over completely, or if it was congenitally absent.

Few examples of chronic infection were present. A mandible from a late-Saxon deposit showed signs of infection, osteoperiostisis, on the lingual side. A second fragment of the same context, but on the opposing side, had signs of infection around the alveolus border of the second and third premolar. Such infection and inflammation are non-specific in origin, but possibly caused by a wound within the mouth. Two late-Saxon and two Anglo-Norman teeth were recovered with additional growths around the roots, possibly the result of chronic infection within the jaw (Baker and Brothwell 1980, 151).

A post-medieval navicular-cuboid was recovered with pitting on the distal articular surface, suggestive of an infection within the joint. A late-Saxon metacarpal had been swollen by infection within the marrow cavity (osteomyelitis), which had been subsequently discharged through a puss hole within the shaft of the bone. A post-medieval metatarsal had the same infection, evidenced by a swelling of the shaft, but with no further effect. These non-specific infections are haematological in origin, carried through the blood stream to the site from an infected part of the body (*op cit*, 64). In the second example, the animal appears to have overcome the infection. In the first example, the animal may also have recovered once the puss had drained from the body, but the effects of the infection have been more severe.

A high-medieval metatarsal had been broken, and subsequently healed, although slightly off-set from its original position, with evidence of an associated infection (osteoperiostisis) from the injury. Osteophytic growth around the proximal articulation and pitting of the surface shows the infection spread to this joint. A late-medieval first phalanx had evidence of osteomyelitis from when the animal was young, resulting in a lifting of the epiphysis out of position and subsequent osteophytic growth to fix the epiphysis, followed by osteoperiostisis along the shaft of the bone and around the epiphysis.

Anthropathies, abnormalities of the joint, were of a fairly low frequency. The most common form was osteophytic growth around the proximal metatarsal articular surface, noted in three late-Saxon, one Anglo-Norman and one late-medieval case, resulting from damage to the cartilage of the joint (Vaughan 1960, 534). The same pathology was also recorded on the head of a Anglo-Norman femur, and the proximal articulation of a late-Saxon and late-medieval second phalanx. Eburnation on a high-medieval distal humerus epiphysis, a late-medieval pelvis acetabulum, and eburnation and grooving on the proximal epiphysis of a high-medieval first phalanx demonstrate where the cartilage of the joint had been worn away to allow the bone to be exposed and worn by movement in the joint. Two instances of osteoporosis were recorded, resulting from a reduction in the mineral density of the bone, on the proximal articulation of a late-Saxon and an Anglo-Norman metapodial. A single case of osteoarthritis was recorded, that of a high-medieval first phalanx, with osteophytes, eburnation, grooving and osteoporosis all in evidence on or around the proximal epiphysis. These anthropathies are all degenerative diseases or faults within the joint, which would have worsened with age.

Two instances of osteochrondrosis dissecans were present, defined as the focal ischemic necrosis of the growth cartilage initiated by necrosis of the cartilage canal blood vessel during growth of the bone Ytrehus *et al* (2007, 445). These were located on the proximal articular surface of a late-Saxon first phalanx, and the condyle of the hinge of a high-medieval mandible.

Splaying of the metapodials was noted in each period in small numbers, with the exception of the late-medieval period (Table 40), possibly the result of excessive stress placed on the feet from use as a traction animal (Dobney *et al* 1996, 39). In addition, it was noted that a similar extension of the upper half of the proximal lateral articular surface of the first and second phalanx was also present, also noted in Roman contexts in Carlisle (Evans forthcoming).

	Late-Saxon	**Anglo-Norman**	**High-medieval**	**Late-medieval**	**Post-medieval**
*Metacarpa*l	-	-	-	-	-
Splayed (%)	4.8	3.4	-	-	22.2
N (Zone 8)	21	29	14	1	9
Metatarsal					
Splayed (%)	-	-	7.1	-	16.7
N (Zone 8)	25	10	14	4	6
1st Phalanx	-	-	-	-	-
Extended (%)	14.3	3.7	13.4		11.1
N (Zone 2)	35	53	82	9	18
2nd Phalanx					
Extended (%)	-	9.5	-	-	-
N (Zone 2_	15	21	31	3	5

Table 40: The extension of the lateral distal condyle (zone 8) of metapodials and the lateral articular surface (zone 2) of the first and second phalanx by period

Occipital perforations in the posterior aspect of the skull were present in three instances, on two Anglo-Norman and one high-medieval skull fragments. It has been speculated that they are congenital in origin, or caused by parasitic infection (although with no clinical evidence), but may potentially relate to remodelling of the shape of the skull due to the abnormal stress from use of an ill-fitting yolk (Dobney *et al* 1996, 37).

Sheep and goat

Two late-Saxon, two Anglo-Norman, one high-medieval and five post-medieval mandibles had irregular wear typical of an over- or under-shot jaw. Crowded teeth were evident in three post-medieval mandibles and a maxilla. In two of the mandibles and in one maxilla, infection (osteomyelitis) was evident, in one mandible having discharged through a puss hole on the buccal side. The second mandible had ante-mortem loss of the fourth premolar and the first molar as a result of the infection, allowing the abscess to discharge. The third post-medieval mandible had suffered infection (osteomyelitis), with puss holes present below the third molar on the buccal side and at the back of the jaw on the lingual side, through which the infection had discharged. In addition, loose teeth, one late-Saxon, one high-medieval, one late-medieval and two post-medieval in date, were recovered with growths around their roots, possibly the result of chronic infection within the jaw (Baker and Brothwell 1980, 151).

Ante-mortem loss of the second premolar was recorded in one late-Saxon, one Anglo-Norman and three post-medieval mandibles. The alveolus in each case were at varying stages of healing over.

Traumatic injury was recorded on a high-medieval radius and an Anglo-Norman and post-medieval tibia, evidenced by a ossified haematoma on the shaft of the bones caused by a wound with bleeding at the sub-periosteal level. The resulting swelling had been replaced by a swelling of smooth bone (Baker and Brothwell 1980, 83). Osteomyelitis was present on a late-medieval sheep humerus and a high-medieval first phalanx. In the former case, puss holes in the olecranon fossa and distal epiphysis had allowed the abscess to discharge, with the bone surface well resolved (smoothed over) after the animal recovered from the infection. In the first phalanx, the infection had affected the metaphysis of the proximal end, resulting in osteophytic growth between the diaphysis and the epiphysis, and an extension of the lateral side of the proximal articulation.

There were eight cases of exostosis around the lateral side of the distal humerus or proximal radius and ulna, the elbow joint, two late-Saxon and Anglo-Norman examples, and single cases from each of the later periods. Such pathology is thought to relate to trauma, or knocks, to the joint when animals are put through races or pens (Baker and Brothwell 1980, 127).

A single case of late-medieval osteoarthritis, a sheep/goat proximal radius, was evidenced by osteophytes extending the articular surface, and eburnation and grooving on the articular surface. Osteoporosis along the length of a single late-medieval radius may relate to dietary insufficiencies from poor pasture and/or overstocking (Baker and Brothwell 1980, 53).

A single late Anglo-Norman metatarsal was recovered with a boney ridge on the anterior aspect of the proximal end of the bone. This pathology is described in Dobney *et al* (1996, 43), with some conjecture as to whether it is caused by a change in gait or physical activity of sheep relating to foot rot. A single Anglo-Norman metacarpal and two Anglo-Norman metatarsals showed some ossification of the proximal ligament attachments on the posterior aspect of the shaft.

Pig

In two pig mandibles, one late- and one high-medieval in date, caries (decay) of the teeth was present. A third metatarsal had suffered an infection within the marrow cavity (ostemyelitis), which had discharged at the metaphysis separating the diaphysis (shaft of the bone) from the epiphysis, with additional osteophytic growth between the two.

Congenital Traits

The absence of the second premolar, as opposed to the ante-mortem loss of the tooth, was relative scarce in cattle. One late-Saxon and one Anglo-Norman case was found, 5.9% (N=17) and 4.3% (N=23) respectively. In sheep or goat, one late-Saxon and six post-medieval cases were identified. This equates to 2.6% (N=38) of 5.3% (N=112) of post-medieval mandibles in each respective period.

Additional foramen on the buccal side of sheep or goat mandibles, below second or third premolar, were recorded in each period, with lower frequencies in the post-medieval period (Table 41). It could be conjectured that the change in congenital traits although not necessarily genetic (Andrew and Noddle 1975), may reflect changes to the stock in post-medieval period.

Period	Additional foramen present	Percentage	N
Late-Saxon	5	13.1	38
Anglo-Norman	13	16.4	79
High-medieval	6	12.8	47
Late-medieval	1	20.0	5
Post-medieval	7	6.25	112

Table 41: The frequency of sheep or goat mandibles with additional foramen in the buccal side of the mandible

Low numbers of congenital clefts, as defined in Baker and Brothwell (1980, 110), were recorded on the lateral side of the proximal and distal ends of cattle first phalanx (Table 42).

Period	Proximal	Distal		N	
	Type	Type		Proximal	Distal
	1	1	2		
Late-Saxon	1 (2.8%)	-	-	35	43
Anglo-Norman	-	-	2 (3.6%)	53	56
High-medieval	3 (3.6%)	2 (2.5%)	-	82	79
Late-medieval	-	-	1	9	10
Post-medieval	1	-	-	18	19

Table 42: Frequency of congenital clefts on cattle first phalanx

In addition, a Type 1 cleft was recorded on the proximal articulation of a high-medieval and post-medieval second phalanx. In the high-medieval period, this equates to 3.2% of second phalanges (N=31), and in the post-medieval, 20% (N=5) of phalanges. A single third phalanx was recorded, from a high-medieval deposit, with a Type 3 cleft (3.7%; N=27). Two Anglo-Norman astagali were recovered with Type 2 clefts in the distal anterior aspect (6.9%; N=29). In pigs, clefts were recorded on the scapulae glenoid fossa, distal articulation of the humerus and the proximal articulation of the fourth metatarsal (Table 43).

Period	Type			N
	1	2	3	
Scapula Glenoid Fossa				
Anglo-Norman	2 (6.2%)	-	-	31
Distal Humerus				
Late-Saxon	-	2 (13.3%)	-	30
Anglo-Norman	-	3 (15.8%)	-	19
High-medieval	-	3 (20%)	-	15
Late-medieval	-	2	-	6
Post-medieval	-	1	-	5
Proximal Ulna				
Late-Saxon	-	-	1 (6.2%)	16
Anglo-Norman	-	-	1 (3.4%)	29
High-medieval	-	-	7 (18.9%)	37
Late-medieval	-	-	-	5
Post-medieval	-	-	-	4
Proximal Metatarsal 4				
Anglo-Norman	2 (13.3%)	-	-	15

Table 43: Frequency of congenital clefts on pig bones

Where present, such clefts appear to be a fairly infrequent trait within the stock of each period.

Other Species

Horse

Horse bones were recovered in small numbers from each period, typically less than 1% of the sample for each period. The number of late-Saxon horse bones (Table 5) is possibly inflated somewhat by 17 fragments of the skull, including mandible and skull, six loose teeth, as well as six vertebra, from a minimum of three individuals excavated from pit 753. Six horse bones were recovered with butchery marks, with evidence of filleting on a late-Saxon humerus and high-medieval pelvis, dismembering marks on a, Anglo-Norman scapulae and femur, and skinning marks on a metatarsal. Horse is unlikely to have been consumed in Britain except as a famine food, although its meat would have been fed to dogs and its skin was evidently utilised (Wilson and Edwards 1993, 50). No new-born or neonatal horse bones were recovered from the site, although younger animals are attested. Of the three mandibles from which an age of the horse could be estimated, one, late-Saxon in date, was estimated to be less than a year old, one, Anglo-Norman in date, less than two years old, and one, late-medieval in date, less than three years old. Epiphysial fusion data, however, suggest predominantly adult animals. Four bones were recovered from which the wither heights could be calculated (Table 44), giving heights all within the range of ponies.

Period	Element	Wither Height (mm)	Hands
Late Saxon	Tibia	1343.926	13
Anglo-Norman	Humerus	1345.581	13
Anglo-Norman	Metatarsal	1365.546	13
High Medieval	Metacarpal	1383.278	14

Table 44: Estimated height of horses

Two pathological horse bones were excavated from the site. Osteophytic growth around the edges of an Anglo-Norman navicular, cuboid and external cuniform (tarsal bones within the ankle) had caused the bones to fuse together (excavated from ditch 4300 of tenement 237). The aetiology of spavin is undetermined, but is thought to relate to stresses placed on the joint, creating inflammation of the soft tissues spreading to the periosteum, the membrane which lines all bones, stimulating new bone formation in the joint. Stresses could be caused by working on hard surfaces, faulty shoeing, or simply heavy work (Baker and Brothwell 1980, 118-23). The result would have been a mild lameness, after which the animal would have been suited for slow work (*ibid*). A high-medieval second phalanx from pit 257 of tenement 173 had severe pitting and exostosis on the left side of the proximal articular surface. These modifications are the result of osteomyelitis, an infection, within the first inter-phalange joint, most likely of haematological origin. The infection may have spread from another part of the body or from a penetrating wound such as caused by faulty shoeing (*ibid*).

Dog

Sixty two dog bones were recovered from the site, forming a small percentage of the animal bone from each period. Wither heights were calculated from five specimens, which demonstrate the presence of both smaller and larger breeds (Table 45). A High-Medieval tibia from cess pit 811 of tenement 173 was evidently of a bandy-legged animal, with a wither height calculated at 273mm. No articulated remains were excavated, although both mandibles of the same animal was recovered from pit 3552 of tenement 237, and the two femurs of one animal were excavated from pit 7199 of tenement 241, but otherwise dog bones were found mainly in pits with bones of other species. No butchery marks were recorded on dog bones.

Period	Element	Wither Height (mm)
Late-Saxon	Tibia	612.032
High-medieval	Femur	327.222
High-medieval	Tibia	273.312
High-medieval	Tibia	410.2016
Late-medieval	Tibia	303.68

Table 45: Estimated wither heights of dog

These animals would have served as working animals, both in agriculture and hunting, with the three smaller animals most likely simply pets. A single pathological specimen was present, a pelvis with a small amount of exostoses around the illial section of the acetabulum (the socket of the hip joint), signifying damage to the cartilage of the joint, most likely a degenerative problem that would increase with age.

Cat

Several cat bones were recovered from each period, frequently more numerous than dog. Six skeletons or partial skeletons of cat were recovered from pits (Table 46), although none of these features can be said to have been dug specifically for the remains. These animals would have been kept as vermin control as much as for pets. No butchery marks were recorded, although the skins of these animals are likely to have been utilised.

Period	Tenement	Feature	Feature Description	Skeleton Description
Late-Saxon	173	672	Pit	Fairly complete
Anglo-Norman	172	179	Cess pit	Skull and limbs only
High-medieval	173	747	Pit	Fairly complete
Late-medieval	170	6144	Pit	Legs only
Late-medieval	237	3130	Pit	Fairly complete
Post-medieval	237	3169	Cess pit	Fairly complete

Table 46: Summary of the presence of cat skeletons

Deer

Deer form a small part of the assemblage from each period, each species presumably taken in the highly ritualised pastime of the elite, hunting (Table 47; Cummins 2001). The single late-Saxon fallow deer bone was excavated from a feature attributed to this period, but the separation of late-Saxon and Anglo-Norman features is a grey area, and an Anglo-Norman date is not unfeasible for this feature.

Period	Red Deer	Roe Deer	Fallow Deer	Deer	N
Late-Saxon	69.2	23.1	3.8	3.8	26
Anglo-Norman	52.9	21.6	15.7	9.8	51
High-medieval	24.5	39.6	30.2	5.7	53
Late-medieval	22.7	18.2	54.5	4.5	22
Post-medieval	17.4	30.4	39.1	13.0	23

Table 47: Presence of deer species by period

The butchery of deer was ritualised in the 'unmaking' of the animal, within which specific body parts would be gifted to specific members of the hunt, reflecting their status and role in the hunt (Sykes 2007).

The presence of fore- or hind limb, and also the side of the forelimb, has been shown to reflect the social status of the inhabitants and their role in society (*ibid*). However, the total sample size is too small at the site to make such analysis feasible. In the pre-tenement period, the most abundant species is red deer, declining after the Anglo-Norman period. Fallow deer are the most frequently occurring species by the late-medieval period. This most probably reflects the rise in keeping deer enclosed in parklands, an environment to which this species was more suited, being hunted by bow and stable as opposed to *par force* in the open forest (Cummins 2001, 87).

An attempt was made to look at the presence of deer, if not the specific species or body part, between tenements. Although tenement 237 produced more deer fragments than any other, it was clear that this took no account of the percentage of the quantity of animal bone excavated from each tenement. Comparison of percentage values produces such small changes in deer as to be untenable in analysis.

Figure 27 presents the percentage of NISP as their natural logarithm (log$_e$%NISP), which has the advantage of compressing the higher values to see more variation in the lower values of %NISP. Using this method, deer are fairly evenly distributed in the high-medieval period, with the exception of tenement 173, which, despite quantities of animal bone, produced no deer. In the late-medieval period, only tenements 170 and 237 produced significant quantities of deer, and tenement 170 from post-medieval deposits only.

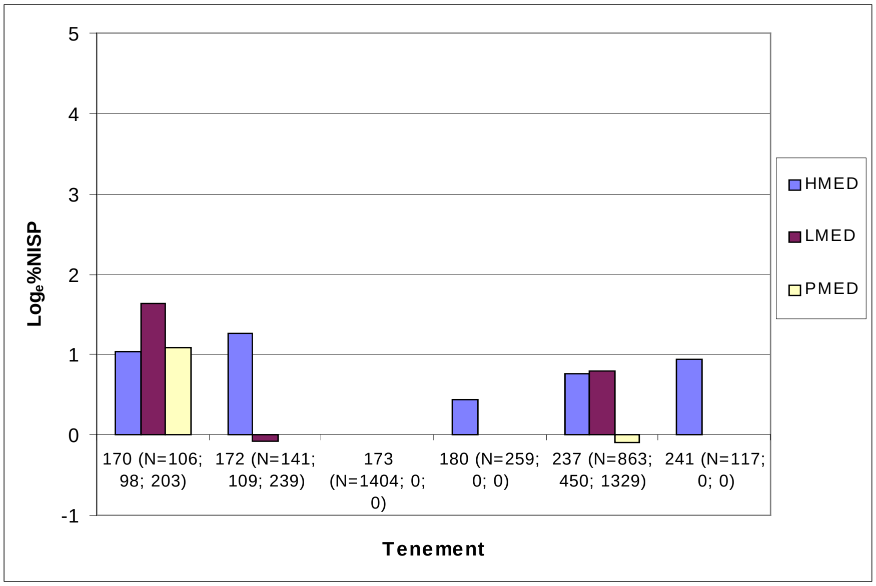

Fig 27: Log$_e$%NISP of deer bones between tenements

Lagamorphs

Rabbit and hare comprise a small number of the bones recovered within each period. Hare would have been hunted both by falconry, using larger falcons such as a lanner falcon, coursing with hounds, and the setting of snares (Cummins 2001, 110-21). The high-medieval period produced the most hare bones, 13 NISP, of which nine were excavated from tenement 237 and two from tenement 173. In the high-medieval period, hare occurs in slightly smaller numbers to rabbit (Table 11), but by the late-medieval period it had evidently declined in favour of rabbit (Table 14). No butchery marks were recorded on hare, although they would certainly have been eaten and their skins utilised.

Rabbits are thought to have been introduced to Britain in the twelfth century (Maltby 1979, 61), and a late-Saxon date for rabbit would be early for this species (Table 5). However, there is a grey area between the late-Saxon and Anglo-Norman stratigraphy, and an Anglo-Norman date is not unfeasible for pits 4050 and 6139 from which these rabbit bones were excavated. Rabbit remained an expensive commodity, and in the thirteenth and fourteenth centuries cost four to five time the price of chicken (Davis 1995, 194). They were husbanded in artificial burrows in warrens, but had established wild populations certainly by the post-medieval period (Almond 2003, 22), although some areas report rabbits being a nuisance to agriculture as early as the fourteenth century (Hammond 1995, 17).

Two butchery marks were recorded on rabbit bones, a chop mark on a high-medieval radius and a knife mark on a post-medieval femur. Some 11.8 % of high-medieval (N=17), 17.3% of late-medieval (N=52), and 25% of post-medieval (N=36) rabbit bones were unfused, suggesting either the consumption of a number of fairly young rabbits or natural fatalities of younger rabbits kept at the site. In general, hare and rabbit would only have made a small contribution to the meat diet.

Rodentia

Small numbers of bone fragments were recovered of this order, which includes squirrels, rats, mice and voles, although in most instances they have been identified as of the genus *rattus*, either brown rat or black rat. Rats are commensal animals, whose presence is not unexpected in association with food waste.

Marine Mammal

A single fragment of marine mammal, probably a vertebra fragment of a larger dolphin or whale, was recovered from Anglo-Norman pit 266 in tenement 173. Whale was caught and eaten, whales and porpoises being seen as royal ‘fish’. However, others also consumed whale meat when available, the tongue being particularly seen as a delicacy (Hammond 1995, 21-2).

Bird bone

Bird species evidently formed a minor part of the diet in comparison to the principal stock animals. Domestic birds comprise the principal species, although a range of wild birds was also consumed (Table 48). The bulk of the material, 87.8%, was collected by hand. Most bird bones are relatively small and thin, and are highly likely to by under-represented in comparison to mammal bones in the archaeozoological collection.

Species	Late-Saxon		Anglo-Norman		High-medieval		Late-medieval		Post-medieval	
	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%
Bantam	29	20.0	43	14.5	136	16.3	21	3.6	41	6.2
Domestic Fowl	10	6.9	35	10.6	91	10.8	126	20.4	113	17.0
Pheasant			3	1.0	4	0.5	5	0.8	1	0.2

Species	Late-Saxon		Anglo-Norman		High-medieval		Late-medieval		Post-medieval	
	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%
Partridge			2	0.6	1	0.1			2	0.3
Red Legged Partridge					1	0.1			2	0.3
Red Grouse					1	0.1			2	0.3
Domestic Goose ?							1	0.2	2	0.3
Domestic/Greylag Goose	2	1.4	1	0.3	3	0.4	6	1.0	2	0.3
Greylag/Pinkfooted Goose	16	11.0	5	1.6	18	2.3	25	4.1	22	3.3
Pink Footed Goose ?			1	0.3			1	0.2		0.0
Brent Goose	1	0.7			1	0.1	1	0.2	2	0.3
Swan			2	0.6	1	0.1	4	0.7	2	0.3
Woodpigeon	1	0.7			2	0.2			2	0.3
Rock/Stock Dove									1	
Mallard	4	2.8	1	0.3	6	0.7	17	2.8	6	0.9
Teal					2	0.2	4	0.7	3	0.5
Wigeon			5	1.6	1	0.1	1	0.2	5	0.8
Heron									1	0.2
Cormorant			1	0.3						
Coot							1	0.2	7	1.1
Curlew					4	0.5				
Godwit			1	0.3	2	0.2				
Woodcock					6	0.7	2	0.3	3	0.5
Snipe					2	0.2				
Dunlin					1	0.1			1	0.2
Red Shank					1	0.1				
Golden Plover	1	0.7	1	0.3	3	0.4				
Auk (guillemot/razor bill)					1	0.1			1	0.2
Great Auk									3	0.5
Common/herring gull			1	0.3						
Lesser Black-Backed Gull					1	0.1				
Red-/Black-throated diver									1	
Starling							1	0.2		
Magpie							1	0.2	1	0.2
Dunnock			1					0.2		
Raven	1	0.7			1	0.1				
Crow							2	0.3	4	0.6
Jackdoor					1	0.1			3	0.5
Gyrfalcon							1	0.2		
Peregrine Falcon							1	0.2		
Domestic Fowl/Bantam	2	1.4	4	1.3	14	1.7	9	1.5	23	3.5
Domestic Fowl/Pheasant	18	12.4	36	11.6	76	9.1	46	7.5	79	11.9
Galliform	10	6.9	21	6.8	44	5.3	26	4.2	38	5.7
Duck					4	0.5	3	0.5	11	1.7
Goose	1	0.7	6	1.9	6	0.7	3	0.5	5	0.8
Gull					2	0.2			2	0.3
Thrush	1	0.7	4	1.3	7	0.8	1	0.2	4	0.6
Passerine			3	1.0	7	0.8				
Unidentified bird	48	33.1	134	43.1	383		303	49.5	269	40.5
Total	145		311		834		612		664	
Total identified to a species level	47	32.4	96	30.9	269	32.1	190	31.0	209	31.5

Table 48: Bird bones by species and phase

Fowl

Domestic fowl (chicken) and the smaller bantam are the most frequently occurring bird bones, bantam declining after the high-medieval period. The presence of the spur on the tibio-tarsus can be used to some degree to indicate the ratio of male and female, the spur being rare on the female bird and almost always present on the adult cock (Dobney *et al* 1996, 487). Figures 28 and 29 present the size of the bantam and domestic fowl tibio-tarsi, by phase and by the presence and absence of the spur. A clear separation can be seen between domestic fowl and bantam, with spurred specimens larger than the unspurred examples. The outlying larger spurred tibio-tarsus is post-medieval in date, and may indicate the presence of some larger birds being bred during this period.

Table 49 presents the presence or absence of spurred tibio-tarsi, regardless of the measurements taken. The sample in each period is small, although females appear to be the most frequent in each period, with the exception of the late-medieval domestic fowl, where six out of seven tibio-tarsi were spurred.

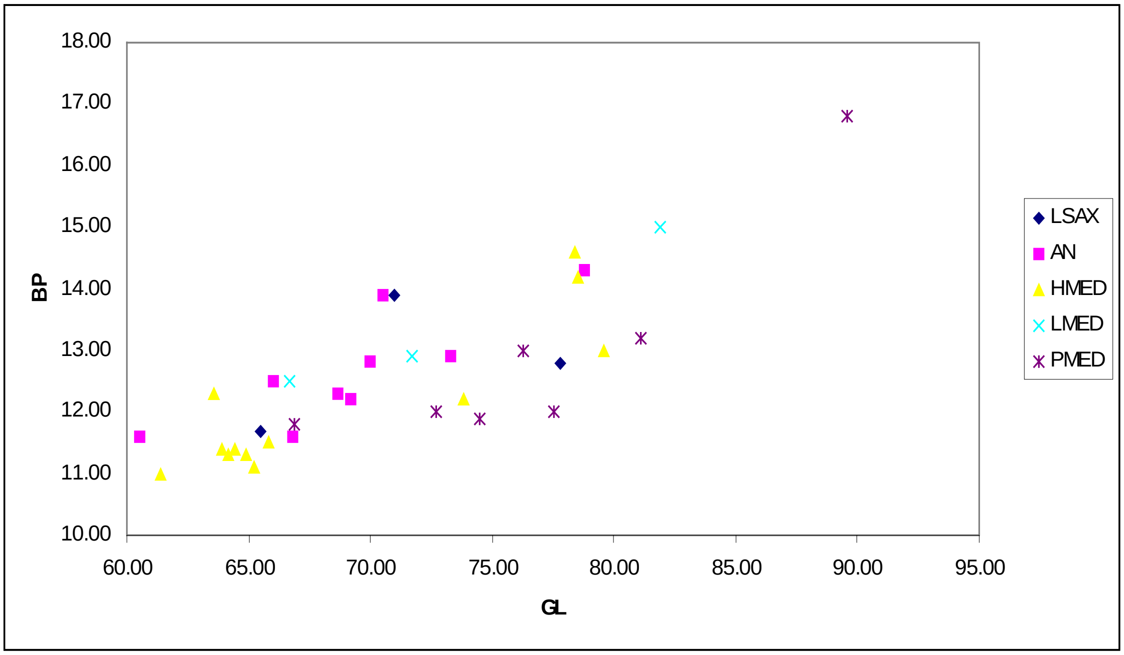

Fig 28: Size of domestic fowl and bantam tibio-tarsus by phase; greatest length (GL) against breadth of proximal (Bp)

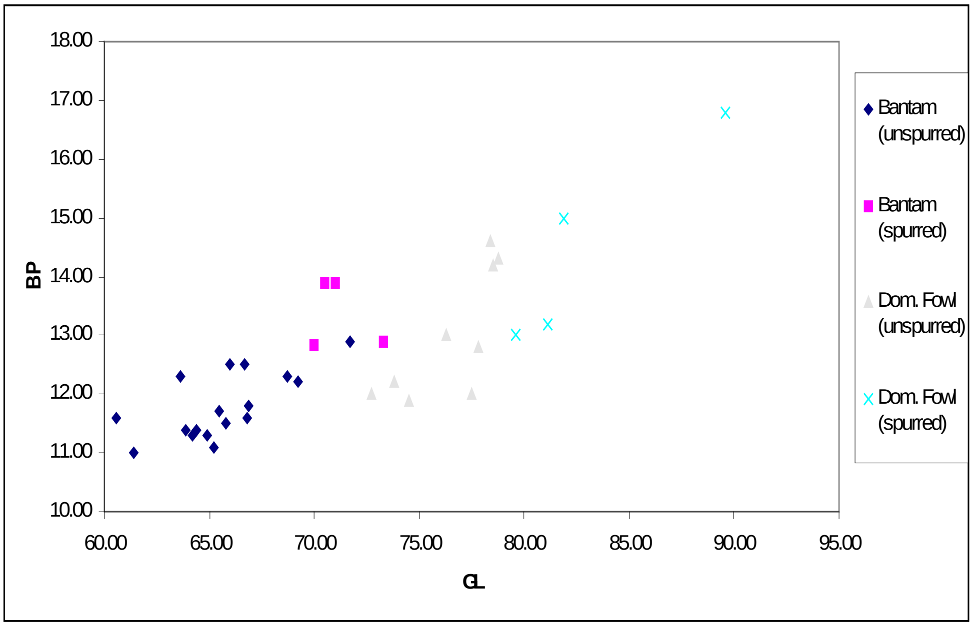

Fig 29: Size of domestic fowl and bantam tibio-tarsus showing the presence or absence of a spur; greatest length (GL) against breadth of proximal (Bp)

Species	**Late Saxon**		**Anglo-Norman**		**High-medieval**		**Late-medieval**		**Post-medieval**	
	No-spur	**Spurred**	**No-spur**	**Spurred**	**No-spur**	**Spurred**	**No-spur**	**Spurred**	**No-spur**	**Spurred**
Bantam	1	1	5	3	10		2		1	
Domestic Fowl	1		1	2	5	3	1	6	7	4

Table 49: Presence of the spur on the tibio-tarsus

Butchery marks on bones of these birds were rare, there being only 11 examples, all knife marks associated with the filleting of the bird’s wings and legs. Bones with unfused epiphysis or from young bantam and domestic fowl were present in each period in small quantities, demonstrating that these birds were bred at the site.

Fourteen pathological domestic fowl bones were recorded, from thirteen birds. Eight tarso-metatarsi, two of the same bird, were recovered with exostosis along the shaft of the bone, particularly around the spur in all but one case where the distal end was missing, and in one instance extending to the proximal articulation. One was Anglo-Norman, three late-medieval and four post-medieval in date, the later period including the paired bones. Similar exostosis was recorded on the lateral edge of the distal condyle of four late-medieval tibio-tarsi, which articulate with the proximal end of the tarso-metatarsus. The aetiology of these pathologies are unknown, but are thought to occur in older birds (Baker and Brothwell 1980, 167). In addition, a post-medieval coracoid and domestic fowl/pheasant scapulae were recorded with exostosis.

Three pathological bantam bones were recorded, a late-Saxon tarso-metatarsus, and a tibio-tarsus from each of the high-medieval and post-medieval periods. These bones had been broken mid-shaft and subsequently reset.

Geese, swan and ducks

Geese comprise the second most frequent bird bone group at the site within each period, consistent with the middle Saxon bird bone excavated from Melbourne Street (Bourdillion and Coy 1980, 117), although there is twice the amount of meat on goose compared to domestic fowl (Davis 1995, 188). The domestic goose was domesticated from the greylag, and separation of these two birds from each other, as well as from the slightly smaller pink-footed goose, is problematic. The total sample size of these geese bones is small, but some separation was made with reference to metrical data published in Bacher (1967). In two instances, bones within the range of pink-footed goose were identified, a late-Saxon humerus and high-medieval tarso-metatarsus. Greater numbers of bones, although still few, were larger than the pink-footed goose bones published in Bacher (1967). In only three instances, two post-medieval humeri and one high-medieval carpo-metacarpus, were within the larger domestic goose range. However, in each instance the identification of domestic, and pink-footed goose was on a single measurement from the end of the bone, such as the greatest proximal breadth (BP), and should not be considered conclusive. Pink-footed and brent goose would only have been available locally within the winter months (Heinzel *et al* 1974, 46-8).

Geese comprise 33% of the goose fowl bones in the late-Saxon period, with a decline in the Anglo-Norman and high-medieval periods to 8% and 9% respectively. Late-medieval and post-medieval periods demonstrates some revival in the consumption of goose, comprising 19% and 15% of the goose fowl bones.

Five acts of butchery were recorded on goose bones, with one exception knife marks associated with the dismemberment of the leg and wing. A single chop mark was recorded through the proximal end of a carpo-metacarpus, removing the lower part of the wing.

The identification of mallard, teal and wigeon in the bone assemblage was made with reference to skeletal material and biometric data published in Woelfle (1967). Each identified species would have been available locally in the estuary and environs of the rivers Itchen and Test, although wigeon would have been available in the winter months only (Heinzel *et al* 1974, 52). Mallard or its domestic form are the most commonly occurring duck species, although found in smaller numbers than goose bones. Domestic duck is difficult to separate from mallard, and none of the mallard examples fit within the range of the larger domestic duck measurements given in Woefle (1967), although two late-medieval tibio-tarsi were close.

Although wild species of geese and duck are evident, it seems likely that domestic examples comprise a significant percentage of the goose and duck bones. The meat, feathers, grease and eggs would have been utilised from these birds.

Small numbers of swan were excavated from Anglo-Norman to post-medieval deposits. Swan was consumed at festive times, and regarded as a high-status symbol (Dobney *et al* 1996, 52). They were kept in a state of semi-domesticity in the medieval period, with young swans removed from their parents at ‘swan-upping’, to be fattened for the table (Allison 1985). Mute swan would have been present in the estuaries of the Itchen and Test all year, with Whooper and Berwick swan being winter visitors.

Two swan bones were recovered from Anglo-Norman pit/well deposits in tenement 237, one bone from a high-medieval pit in tenement 170, three bones from a late-medieval pit in tenement 237/238, one bone from a late-medieval pit in tenement 167, and two bones from post-medieval pits in tenements 170 and 172. Although swan bones are small in number, its consumption was evidently not restricted to the higher-status occupants of tenement 237/238.

Other Galliformes

Other galliformes, including pheasant, partridge, red-legged partridge and red grouse, are recorded from Anglo-Norman to post-medieval periods in relatively small numbers. Their contribution to the table was evidently smaller compared to that of domestic fowl and geese. These birds would have been trapped, or dogs used to flush out the birds to be taken by a falcon (Almond 2003, 34), although in the latter period the falcon would eventually be replaced by the gun.

Pigeon and dove

Woodpigeon and dove would have been present in the surrounding woodland and fields throughout the year (Heinzel 1974, 170), but would also have been maintained in dovecotes. However, these species comprise only a small number of the bird bones, and all appear to have been consumed. Doves were considered a delicacy, and in the medieval period peasants were, unsuccessfully, forbidden from eating them (Hammond 1995, 17).

Waders and Rails

Curlew, godwit (black-tailed or bar-tailed), woodcock, snipe, dunlin, red shank, golden plover and coot were all recovered from high-medieval deposits, with a smaller range of wading species present in other periods. All of these species would have been found in the estuaries of the Itchen and Test, procured through wild fowling expeditions, although golden plover would also be found on farmland and heaths. Curlew, woodcock, snipe and coot could have been taken from the wild all year, with godwit, dunlin, red shank and golden plover being winter visitors (Heinzel *et al* 1974, 116-40).

Sea Birds

Seagulls, attracted by the rubbish of the town, may have been an incidental inclusion, but were also eaten in the medieval period (Hammond 1995, 130). Species of auk, razorbill and guillemot do breed on cliffs on the east coast and along some parts of the coast of the continent (Heinzel *et al* 1974, 164). Great auk (Table 48), the original puffin, or garefowl as it was known, became extinct in the mid-nineteenth century (Gaskell 2000). It had few suitable nesting sites, in Newfoundland, Greenland and Iceland, and St Kilda, and it is from these nests that they were taken. They were particularly easy to take, being flightless, and could even be driven onto the boats for slaughter, after which the eggs were collected. As such, it was easy source of food for local populations and, notably, for a ship's crew. Their down, the finer feathers below the larger outer feathers, was also utilised for its insulting properties. Although in the 1530s records of 10s, possibly 100s, of thousands of birds are decribed, their population suffered a swift decline, followed by their eventual extinction, with the increase of maritime traffic (*ibid*).

Diver

Species of diver, either red- or black-throated diver, breed in freshwater lakes, on moorland and forested areas of northern Britain, Scandinavia, Greenland and Artic Canada, spending the remainder of its time at sea (Heinzel *et al* 1974, 20). Its presence in late-medieval deposits in Southampton is undoubtedly the result of the town's maritime history.

Falcons

A single bone from a Peregrine Falcon was recovered from tenement 172 and one of a gyrfalcon from tenement 237, both late-medieval in date. The ownership of birds of prey was linked to social status within medieval society. The *Book of Saint Albans*, *c* 1486, lists birds of prey with people of appropriate rank, and the Peregrine it described as belonging to an earl. The gyrfalcon, however, is one of the most prestigious birds of prey, which is record as belonging to the king, second only to birds suitable for an emperor (Almond 2003, 43). Gyrfalcon are found in Scandinavian countries, Greenland and Iceland, and would have been purchased at considerable cost (Cummins 2001, 191). The birds were not always used for hunting, but sometimes were kept as decorative accoutrements (*ibid*), a symbol of status and wealth to be shown off as much as used in hunting. Alternatively, the bird may have been raised with the intention to sell. In either case, its loss would have been seen as a significant financial blow.

Other Birds

Thrushes, including blackbird, dunnock, and starling, were caught either with snares or the use of a falcon such as a sparrow hawk (Almond 2003, 91; Cummins 2001, 194) and eaten. Species of crow, including raven, carrion crow, magpie, and jackdaw, as well as starling, are commensual birds. Their presence as incidental inclusions is not unsurprising, although, they may also have been taken as a food resource or simply killed as pests (Maltby 1979, 73).

Livestock, and Supply and Consumption

Livestock

It was not possible to discern different breeds of stock animals within the assemblage, although some differences which are considered to reflect variation in the stock were identified. The total numbers of cattle horncores from which the length could be measured were few, restricted to the periods from the late-Saxon and high-medieval (Table 50). Although percentage values would be meaningless here, Table 50 does demonstrate the presence of different breeds within the assemblage, although no identification of breed is implied.

Period	Small horn	Short horn	Medium horn	Long horn
Late-Saxon	1	3	2	1
Anglo-Norman		5	2	1
High-medieval	1	2	1	1

Table 50: Variation in length of cattle horncores (NISP), following Armitage and Clutton-Brock (1976)

Similarly, the presence of polled, as opposed to horned, sheep was difficult to assess due top the fragile nature of the cranium. However, horned sheep appear to be abundant in each period, either evidenced by the horncore or where the horncore has been removed from the skull. Only three skulls of polled sheep were recovered, one late-Saxon, one high-medieval and one post-medieval in date.

Biometrical analysis does show an increase in the size of cattle, and in the meat weight of sheep if not height, in the post-medieval period. Improvements to livestock certainly became actively pursued and more widely disseminated in the eighteenth century, by workers such as Robert Bakewell (Trow-Smith 1959, 46), but individuals were evidently at work earlier in the post-medieval period, which led to an increase in the size of animals (Dobney *et al* 1995, 33), in order to make animals more profitable in the appropriate markets.

Although pathological specimens are present, including trauma and degenerative disease, the health of the stock animals appears to have been generally good. Splaying of the lateral condyle of cattle metapodials, as well as extension of the lateral proximal articular surface of the first and second phalanxes, is present in each period, potentially associated with the use of these animals for traction (Albarella and Davis 1994, 27).

Late-Saxon to high-medieval cattle were slaughtered in adulthood, with notably more females than males as evidenced by inspection of the pelves and metacarpi metrical analysis. There was little evidence for the younger fatalities expected in any herd from these periods. It is clear that the animals deposited at the site represent animals specifically chosen for slaughter, predominantly older dairy animals. However, the herds from which these animals were obtained may have been maintained in the surrounding hinterland, or by the other towns folk if intra-site variation within the town is a factor. The late-medieval assemblage proved difficult to assess due to the lack of data, but changes are evidently present by the post-medieval period, with the presence of much younger animals at the site slaughtered after reaching their meat weight. A percentage of veal calves (animals under one year of age) is present within the assemblage, although perhaps not quite as abundant as suggested by the mandibular wear data.

Sheep dominate the sheep/goat category in each period. Wool was seen as the staple of the medieval economy from the thirteenth century (Trow-Smith 1957, 133). Between the late-Saxon to high-medieval periods, most of the animals consumed were culled at between two and three years of age, husbanded primarily for their meat. These may have been husbanded specially to supply the town, or alternatively were seen as excess animals to the wool flocks. A survey of wool prices in 1343 states that Hampshire wool fetched an average price, at £6 per wool clip (Trow-Smith 1957, 163). The increase in the economic importance of wool in the later-medieval and early post-medieval periods (Maltby 1979, 47) appears to be reflected in the amount of mutton consumed, predominantly derived from older animals, from which a number of clips had been taken. The milk of sheep would also have been taken in each period, but appears to be secondary in the husbandry of these animals.

Within the sheep/goat category, it is evident that goat is present, although in smaller numbers than sheep. Between the late-Saxon and high-medieval periods, goat averages 22% of the sheep/goat category, but this declines to 13% in the late-medieval and only 6% in the post-medieval period, which probably reflects the boom in British wool in the late-medieval and early post-medieval periods. Pig, unsurprisingly, was husbanded predominantly for its meat in each period.

Supply and Consumption

The carcass-representation of each of the principal stock animals is highly suggestive of the entire carcass being represented at the site during the earlier periods. In the high-medieval period, whole cattle appear to be represented at the site, but in the supply of pork, limb bones and to a lesser degree the heads of pigs appear to be more abundant. A decline in the percentage of older breeding pigs at the site reflects this change in supply. There is also some evidence also for additional meat from the hind-limbs of sheep or goats. Significant changes appear to have occurred by the late-medieval period. Within the distribution of elements of both the late-medieval and post-medieval periods there is little correlation between the fragmentation of bones and their frequency at the site. The bones from fore- and hind-limb bones of sheep and cattle appear in significantly greater numbers, and suggest a change in supply, with carcasses more frequently divided and sold as smaller joints of meat. A similar interpretation was suggested for high-medieval animal bone elsewhere in the town (Noddle 1975, 332). There is, however, no evidence that the bones themselves are more greatly fragmented by butchery, as suggested by Noddle (*ibid*). Further change occured in the post-medieval period in the butchery record of large mammal vertebra (predominantly cattle), with the majority (63%) of carcasses have been being split down their centre. A similar increase in this practise is seen in medium-sized mammal vertebra (predominantly sheep), although as a lower percentage of the total vertebra (30%).

Figure 30 gives the proportion of the principal stock animals against bird bones and other animals, as the natural logarithm of the percentage NISP. This allows for changes in the less frequently occurring species to be considered, which are unlikely to produce significant changes in the percentage of NISP. The decline in numbers of cattle and pig in relation to sheep/goat, particularly in the post-medieval period, is clearly apparent. The increase in bird numbers, predominantly domestic fowl, in the medieval period reaching values greater than that of pig, is also apparent. A wide range of bird species was present. Great auk, as well as red-/black-throated diver, undoubtedly attests to the maritime history of Southampton, as most probably does the single fragment of marine mammal from the Anglo-Norman period.

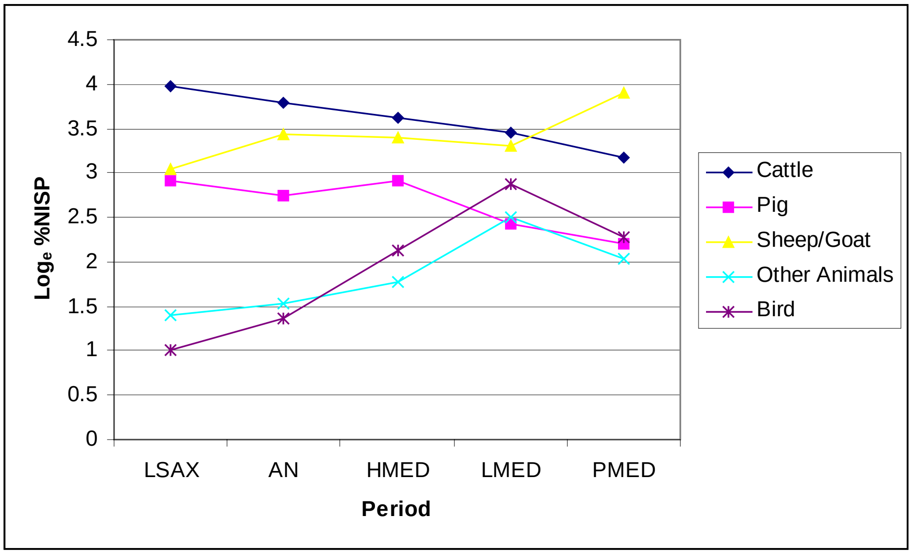

Fig 30: The natural logarithm (Log$_e$) of the percentage NISP of the principal stock animals, other animals and bird by period

The relative percentages of NISP do not, however, equate to the percentage of beef, mutton and pork consumption. Figure 31 gives the consumption of meat types of the principal stock animals, from older or younger animals, using the meat weights published in Harvey (1993, appendix 2, table B). In this analysis, the total NISP of fused and unfused bones within Stage B for cattle (12-18 months) and sheep/goat (10-16 months) and Stage A for pig (by one year) were used. Veal and lamb, strictly speaking, includes animals less than one year old. As such, using the fusion stages in this way may over-estimate lamb and veal, although narrowing the analysis to a single bone would produce percentages of these animals widely different to those given by the total NISP. It was necessary to discount cess pit 584, due from the deposition of large numbers of unfused elements from a small number of sheep/goat in this pit (*see Ageing Data*).

Meat	Weight
Beef	139.8 kg
Veal	25.9 kg
Mutton	14.1 kg
Lamb	5.2 kg
Pork (Mature)	32.7kg
Pork (Immature)	8.2kg

Table 49: Weight per carcass of the principle stock animals by age group/meat type

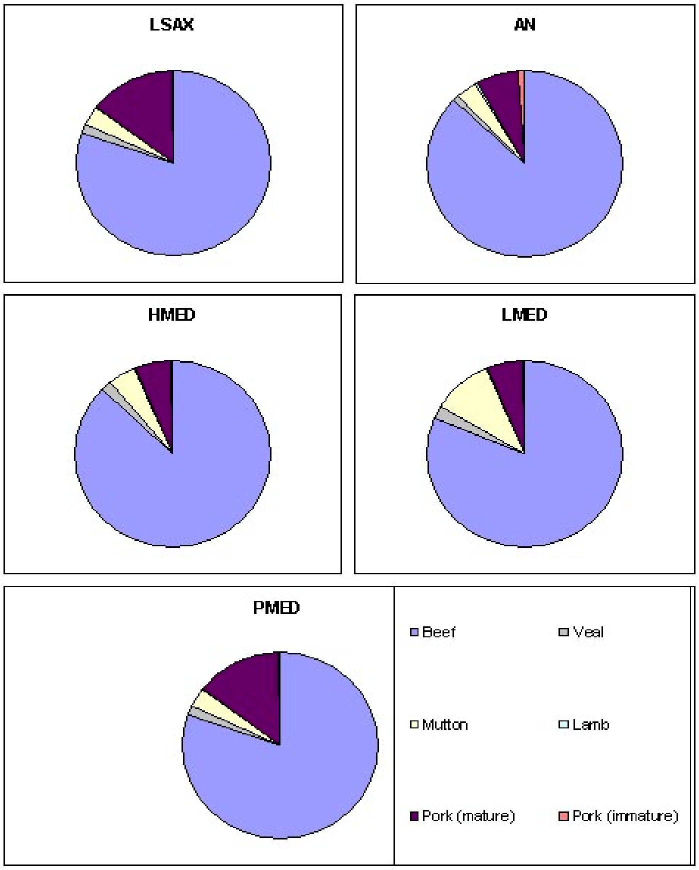

Figure 31: Estimated meat weights based on fused and unfused bones in Stage B (cattle and sheep), Stage A (pig)

Beef, in each period, was overwhelmingly the principal source of meat in the diet. Pork made a greater contribution to the diet than suggested by the frequency of its remains at the site, more so, in fact, than mutton, with the exception of the late-medieval period. This is no doubt due to the increase in available sheep during this period. There is, however, no evidence that veal or lamb were of any economic importance.

Disposal

The overwhelming majority of animal bone, in each period, was excavated from rubbish pits, and also from cess pits, presumably used as rubbish pits when backfilled. This reflects the general frequency of these features at the site in comparison to other features. Some larger collections of animal bones are present, in some instances producing large quantities of bone considered to have derived from a small number of individuals (*see distribution texts*). However, the deposition of most of the material was characterised by smaller quantities of bone per species per deposit within these features. Much of this material, therefore, appears have derived from animal bone included in midden material, subsequently deposited in pits.

Tenement 237 (Polymond's Hall), and Associated Tenements

The most evidence for difference in consumption between clearly high-status areas, such as Polymond's Hall, and other parts of the site, came from late-medieval deposits. Cattle remains excavated from tenements associated with the hall show a greater frequency of elements from the haunch of the animal. Of sheep/goat, an emphasis towards the fore-limb is suggested in the other tenements. In addition, the presence gyrfalcon is further indication of the wealth and status of the tenement.

Bibliography

Albarella, U, and Davis, SJ, 1994 *Medieval and post-medieval mammal and bird remains in Launceston Castle, Cornwall: 1961-1982 excavations,* AML**18-94**, unpubl rep

Allison EP 1985 *An archaeozoological study of bird bones from seven sites in York*, Unpubl PHD thesis, Univ of York

Almond R 2003 *Medieval Hunting*, Stroud

Andrews AH and Noddle B 1975 Absence of Premolar Teeth from Ruminant Mandibles found at Archaeological Sites, *Journal of Archaeological Science*, 2, 137-144

Armitage, P, 1982 A system for ageing and sexing the horncores of cattle from British post-medieval sites (with special reference to unimproved British longhorn cattle), in B Wilson, C Grigson, and S Payne (eds), *Ageing and sexing animal bones from archaeological sites,* BAR Brit Ser, **109**, Oxford, 37-54

Armitage, PL, and Clutton-Brock, J, 1976 A System for the Classification and Description of the Horncores of Cattle from Archaeological Sites, *J of Archaeol Sci*, **3**, 329-48

Bacher, A, 1967 Vergleichend morphologische Untersuchungen an Einzelknochen des postkranialen Skeletts in *Mitteleuropa vorkommender Schwäne und Gänse*, München

Baker, J, and Brothwell, D, 1980 *Animal Diseases in Archaeology*, London

Boessneck, J, 1969 Osteological Differences between Sheep (*Ovis aries Linne*) and Goat (*Capra hircus Linne*), in D Brothwell and E Higgs (eds), *Science and Archaeology,* **2**, London, 131-58

Bourdillon, J, and Coy, J, 1980 The animal bones, in P Holdsworth, *Excavations at Melbourne Street, Southampton, 1971-76*, Southampton Archaeological Research Committee, Southampton, 79-121

Burgess L A, 1976 The Southampton Terrier of 1454. Historical Manuscripts Commission. Her Majesty's Stationary Office. London

Cohen, A, and Serjantson, D, 1996 *A manual for the identification of bird bones from archaeological sites,* London

Cummins, J, 2001 *The Hound and the Hawk*, London

Davis, SJ, 1992 *A Rapid Method for Recording Information about animal bones from Archaeological Sites*, AML **19/92**

Davis, JM, 1995 *The Archaeology of Animals*, London

Dobney, KM, Jaques, SD, and Irving, BG, 1996 *Of Butchers and Breeders: Report on the vertebrate remains from various sites in the City of Lincoln*, Lincoln Archaeological Studies: **5**, Lincoln

Dobney, KM, Jaques, D, and Johnston, S, 1999 A Protocol for Recording Vertebrate Remains from Archaeological Sites, Environmental Archaeology Unit Rep, 99/15, unpubl rep

Evans, EJ, forthcoming The Animal Bones in C Howard-Davis (ed), *The Carlisle Millennium Project: Excavation in Carlisle 1998-2001, V2: The Finds*, Lancaster Imprints, Lancaster

Gaskell J 2000 Who killed the Great Auk, Oxford

Grant, A, 1982 The use of toothwear as a guide to the age of domestic ungulates, in B Wilson, C Grigson, and S Payne (eds), *Ageing and sexing animal bones from archaeological sites*, BAR Brit Ser, **109**, Oxford, 91-108

Grigson, C, 1976 The Craniology and relationships of four species of *Bos*, 3. Basic craniology: *Bos taurus*. Sagittal profiles and other non-measurable characters, *Journal of Archaeol Sci*, **3**, 115-36

Halstead, P, 1985 A study of Mandibular Teeth from Romano-British Contexts at Maxey, in F Pryor, C French, D Cowther, D Gurney, G Simpson and M Taylor, *Fenland Project, No 1: Archaeology and Environment in the Lower Welland Valley, V1*, Cambridge, 219-24

Halstead, P, 1992 Demi & DMP: faunal remains plus animal exploitation in late Neolithic Thassaly, *Annual of the British School of Athens*, **87**, 29–59

Halstead, P, and Collins, P, 1995 *Sheffield animal bone tutorial: Taxonomic identification of the principal limb bones of common European farmyard animals and deer: a multimedia tutorial,* Archaeology Consortium, TL TP, Univer of Glasgow

Hammond, PW, 1995 *Food and Feast in Medieval England*, Stroud

Harvey, B, 1993 *Living and Dying in England 1100-1540: The monastic experience*, Oxford

Heinzel H, Fitter R and Parslow J 1974 *The Birds of Britain and Europe with North Africa and the Middle East*, London

Kratochvil, Z, 1969 Species Criteria on the Distal Section of the Tibia in *Ovis Ammon F. Aries* and *Capra Aegarus F. Hircus L.* , *Acta Veterinaria* (Brno), **389**, 483-90

Lister, AM, 1996 The morphological distinction between bones and teeth of Fallow Deer (*Dama dama*) and Red Deer (*Cervus elaphus*), *Int J of Osteoarchaeology*, **6**, 119-43

Maltby, M, 1979 *The animal bones from Exeter*, Sheffield

Noddle, B, 1975 The animal bones, in C Platt and R Colman-Smith, *Excavations in Medieval Southampton: V1 The excavations*, Leicester, 332-7

O'Connor, TP, 2003 *The Analysis of Urban Animal Bone Assemblages: A handbook for archaeologists*, The Archaeology of York Principals and Methods, **19/2**, York

Payne, S, 1973 Kill-off patterns in sheep and goat mandibles: the mandibles of Asvan Kale, *Anatolia Studies*, **23**, 281-303

Payne, S, 1987 Reference codes for wear states in the mandibular cheek teeth of sheep and goats, in *Capra*, in *Journal of Archaeological Science*, **12**, 139-47

Payne, S, and Bull, G, 1988 Components of variations of measurements of pig bones and teeth, and the use of measurements to distinguish wild from domestic pig remains, *Archaeozoologia*, **2(1,2)**, 27-66

Platt, C, and Colman-Smith, R, 1975 *Excavations in Medieval Southampton: V1 The excavations*, Leicester

Prummel, W, and Frisch, H-J, 1986 A guide for the distinction of species, sex and body side in bones of sheep and goat, *J Archaeol Sci*, **13**, 567-77

Schmid, E, 1972 *Atlas of animal bones, for prehistorians, archaeologists and quaternary geologists*, London

Serjeantson, D, 1996 The animal bones, in S Needham and T Spence, *Refuse and Disposal at Area 16 East Runnymede: Runnymede Bridge research excavations, V2*, London, 194-223

Sykes, NJ, 2007 Taking sides: the social life of venison in medieval England, i*n* A Pluskowski (ed), *Breaking and Shaping Beastly Bodies: Animals as Material Culture in the Middle Ages*, Cambridge, 151-60

Trow-Smith, R, 1957 *A History of British Livestock Husbandry to 1700*, London

Trow-Smith, R, 1959 *A History of British Livestock Husbandry 1700-1900,* London

Vaughan, LC, 1960 Osteoartheritis in Cattle, *Veterinary Record* **72/27**, 534-38

von den Driesch, A, 1976 *A guide to the measurement of animal bones from archaeological sites*, Harvard

von den Driesch A and Boessneck J 1973 Kritische Anmerkungen zur Widerristhöhenberechnung aus Längenmassen vorund Frühgeschichtlicher Tierknochen, *Säugetierkundliche Mitteilungen* 22, 325-48

Wilson, B, and Edwards, P, 1993 Butchery of horse and dog at Witney Palace, Oxfordshire, and the knackering and feeding of meat to hounds during the post-medieval period, *Post Medieval Archaeol*, **27**, 43-56

Woelfle, E, 1967 *Vergleichend morphologische Untersuchungen an Einzelknocken des postcranialen Skelettes in Mitteleuropa vorkommender Enten, Halbgänse und Säger*, München

Worley, F, forthcoming Animal bones from Northfleet, in P Andrews, E Biddulph, A Hardy, and A Smith, *Settling the Ebbsfleet valley. CTRL excavations at Springhead and Northfleet, Kent - the late Iron Age, Roman, Anglo-Saxon and Medieval landscape. Volume 2: The finds.*

Ytrehus B, Carlson CS and Ekman S 2007 Etiology and Pathogenesis of Osteochrondrosis, in *Veterinary Pathology* 44, 429-48