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Vertebrate remains from excavations at Tower 10, City Walls, York: Technical report

by

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Summary

Excavations at Tower 10, adjacent to Nunnery Lane, on the City Wall at York, produced a small assemblage of vertebrate remains of fifteenth/possible early sixteenth century date. The vast majority of the bones were of horse, and these provided an ideal opportunity to study an important domestic species so often under-represented in archaeological vertebrate assemblages.

Preservation of the remains and the inclusion of small amounts of other species (particularly the human bones) suggests that the bones were redeposited and probably represent fellmongers refuse. The low incidence of butchery marks implies that the horse bones are unlikely to be the remains of animals slaughtered for human consumption, the few knife and chop marks probably being associated with skinning and carcase dismemberment.

Biometrical data shows no evidence for the very large horses suggested by documentary records, although the height of individuals from Tower 10 is towards the upper end of the range of horse withers height values proposed for the medieval period.

Keywords: TOWER 10; CITY WALLS; YORK; LATE MEDIEVAL; VERTEBRATES; HORSES; BIOMETRY

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Introduction

In January 1996, the York Archaeological Trust (YAT) undertook an archaeological watching brief along the city walls between Micklegate Bar and Victoria Bar, York, whilst repairs were being carried out by York City Council. Deposits beneath the wall walks at either side of Tower 10 were such that repairs necessitated the digging of deeper trenches and the excavation of deposits within the Tower itself.

Investigations revealed a substantial layer (1006) containing numerous vertebrate bones (mostly horse) and a few sherds of pottery. The pottery, found towards the top of the deposit, is fifteenth/possible early sixteenth century in date. The excavators consider that it is highly unlikely that the pottery originated from a separate deposit, thus concluding that the bones are probably of late medieval date.

As far as the excavators are aware, a vertebrate assemblage of this nature has never previously been recovered from any other area along the walls: in fact, rarely have more than one or two bones been recovered from any single excavation in this area. However, it must be noted that most work undertaken along the city walls has been on a fairly small scale.

Methods

All the hand-collected animal bone was examined and records made regarding the state of preservation, colour, and the appearance of broken surfaces ('angularity'). Additionally, semi-quantitative information was also recorded (for all bones) concerning fragment size, dog gnawing, burning, butchery and fresh breaks.

Identification was carried out using the reference collection of the Environmental Archaeology Unit (EAU), University of York. Since fragments from species other than horse were so limited in number they were merely counted and brief notes were made on the elements present.

Detailed recording of the horse bones followed the diagnostic zones method described by Dobney and Rielly (1988). Evidence of butchery was noted where present, as was any pathology. Tooth eruption and occlusal wear for horse mandibles and maxillae were recorded using the stages outlined by Levine (1982) and measurements (unless otherwise specified) followed von den Driesch (1976). Withers height was estimated using calculations devised by Kiesewalter (in von den Driesch and Boessneck 1974). A record of all measurements taken can be found in the Appendix. Comparative biometrical data (both modern and archaeological) used in this report was taken from a recent comprehensive study of archaeological horse bones undertaken by Johnstone (1996).

Results

The small assemblage recovered from Tower 10 amounted to a total of 351 fragments, of which 292 were identified to species (Table 1). Also present were three complete horse crania, which, although originally recorded as unstratified, are

almost certainly from the same deposit and have therefore been included in this analysis.

As well as horse bones, a total of 44 fragments from other species were also identified (Table 1). Twenty-seven fragments were identified as cattle, a wide range of elements being present (Table 2). Sheep and dog bones were also noted, as were four human fragments (two tibiae, a humerus and a cranial fragment). The presence of human remains suggests that the material perhaps represents a secondary rather than a primary deposit.

Preservation

Preservation was rather variable and, although most bones were scored as 'fair', some were rather fragile, with areas of the surface cortical bone flaking off. A very small proportion were extremely well preserved and a few were almost greasy in appearance. Many of the main elements (e.g. long bones) were coated with a black sooty/ashy layer which covered varying amounts of the bone, whilst a small number of fragments showed characteristic damage caused by scorching or burning at high temperature. This was most apparent on three horse pelvis fragments, two horse phalanges and a single cattle radius shaft. It seems likely that the burning noted on the horse bones was accidental, perhaps a result of dumping hot ash since this burning appears to be random in its distribution. Information supplied by the excavators originally suggested that there may have been a fire against the wall face associated with the bone deposit. This theory was discounted as there appeared to be no heat damage to the limestone. If hot ash had been dumped into the deposit, it would probably not have produced the same intense heat as an actual fire.

Fresh breakage was prevalent, recorded on almost a third of all bones, most probably because of the rapid nature of excavation. Damage indicative of dog gnawing was also fairly widespread, being noted on 31 of the horse bones. Bones from other species showed little evidence of dog gnawing, but typically had evidence of extensive butchery. Chop and knife marks were only noted on eight horse bones, most being rather ambiguous. More conclusive evidence was recorded from two of the crania, which showed numerous parallel knife marks across the orbits, nasal and frontale bones which are suggestive of skinning.

The horse remains

Two hundred and forty-eight horse fragments were identified, of which 101 were vertebrae. In addition, 34 rib fragments were recorded, all of which are also probably horse. None of the bones were recorded as being articulated *in situ*, although it is probable that some of the elements derive from associated limbs. A minimum number (Table 3) of eight horses was represented in the deposit (based on diagnostic zone counts of humerus, radius and femur fragments).

As can be seen from Table 2, humerus, radius, pelvis, femur and tibia fragments were well represented, as were cervical, thoracic and lumbar vertebrae. Far fewer skull fragments, mandibles and lower limbs (i.e. metapodials and phalanges) were present.

Age and sex

On the basis of epiphyseal fusion data, all animals represented at this site were adult, i.e. over four years of age. Further data from the skulls and mandibles indicate that

most were aged between 4 and 12 years at death.

The presence of large and robust canine teeth from one of the maxillae is probably indicative of a male or a gelding (castrate), although such teeth can occur in older females. One of the other skulls has an additional tooth in front of the left and right second premolars. It has been suggested by Bökönyi (1974, 291) that these 'wolf' teeth are rare in modern domestic horses. However, examples from collections of modern and archaeological horse skulls have been noted by Armitage (1991) and Colyer (1936).

Biometry

Estimates of the withers heights were calculated from greatest lateral length measurements of complete elements (Table 4). These calculations produced a range of height values, from 1365.9 to 1631.5 mm, with a mean of 1470.9 mm. When converted to 'hands', these indicate the presence of ponies and horses of between 13.2 and 16 hh, with a mean height of 14.2 hh. Most of the equids represented from the Tower were therefore taller than the reconstructed mean height for medieval horses of 13.2 hh (1347.2 mm) calculated by Johnstone (1996) in an extensive study of material from seventeen archaeological sites. Comparison of the heights of animals from the Tower with data from three modern breeds show that the majority fall within the size range of Arab values, most of the remainder (bar one) overlapping with the larger Exmoor pony range (Figure 1).

This does not, of course, indicate that the horses from the Tower were the same confirmation (i.e. build) as these modern breeds, since we are only dealing with withers heights. They do, however, provide useful guidelines towards approximate size.

The largest individual, apparently standing at 16hh (calculated from a complete humerus), is tall for a medieval horse when compared with the more extensive data presented by Johnstone (1996). However, she states that it may be problematic to utilise withers height indices calculated from both the humerus and femur since values obtained from modern comparative specimens showed these elements provided inconsistent data in relation to other long bones (*loc. cit*., 70).

Size and conformation can be presented by the use of bivariate statistics, where related measurements (reflecting both size and shape) are plotted together.

Figure 2 shows greatest length and shaft diameter values of tibia from Tower 10, as well as data from other medieval assemblages and modern comparative specimens. It is interesting to note that values from Tower 10 cluster around the modern arab data point, as was indicated from simple withers height calculations. Plotting both GL and SD values, indicates the general similarity in confirmation of the Tower 10 specimens to the Arab breed. Additional bivariate plots (Figures 3 and 4), showing distal depth and breadth measurements from both tibiae and metatarsals, show similar distributions, although in this case several Tower 10 specimens fall near or within the values for Exmoor pony.

From the available information it would seem that the individuals from Tower 10 were mostly of medium height and medium to light build. Comparison with the material from Elverton Street, London (Johnstone 1996), thought to derive from the palace of Westminster, shows that

most of the Tower 10 values overlap with the larger animals from this site. These large individuals from Elverton Street were also shown to be taller than Johnstone's (1996) mean height for medieval horses, and were considered by her to reflect the 'high status' of the site, "... large horses [being] the prerogative of the upper classes" (*loc. cit*., 81-82).

Pathology

All four mandibles with teeth in situ show an interesting condition which appears to be a common phenomenon on archaeological horse teeth. This condition is manifested as a series of linear (parallel with the tooth crown) grooves or pits (on both buccal and lingual surfaces), of varying severity. They are similar in appearance to the developmental anomaly known as hypoplasia but, unlike this condition, do not show the characteristic rounded edges to the lesions, and thus do not indicate a developmental origin. The fact that individual lesions can also be traced through a series of chronologically unrelated teeth supports this conclusion. These grooves or pits may well have been formed by changes in the pH of the saliva as they show characteristic damage associated with acid etching. Since the cheek teeth are continually erupting these discreet events may imply periodic variations in the diet, possibly related to the provision of either high or low quality hard feed.

Several horse vertebrae from Tower 10 showed evidence of severe ankylosis (i.e fusion) as a result of the ossification of soft tissue. Three thoracic vertebrae were fully fused along the ventral aspect of each centrum, as well as along each mammillary and spinous process (mostly evident on the right-hand side of the column). In addition, two lumbar vertebrae (probably from the individual previously mentioned) also showed extensive new bone formation, again mostly concentrated on the right hand surface of the spinous process. Two lumbar vertebrae from a separate individual were again fused around the periphery of the centra and along both sides of the spinous processes, the most severe soft tissue ossification this time being on the left hand side. Several other single lumbar vertebrae showed similar evidence which, taken together, perhaps suggests that these individuals were utilised for traction purposes. The asymmetrical distribution of this condition implies that each individual was part of a larger team, since differential physical stress along either side of the spine would be expected.

Evidence of joint disorders, also possibly associated with traction, were noted from two calcanea and an astragalus (which articulated with one of the former). The two articulating elements showed local eburnation and joint surface destruction on the sustentacular facet of the calcaneum and the corresponding tibial-tarsal facet of the astragalus. In contrast, the remaining calcaneum showed severe joint destruction (in the form of pitting, and also affecting the sustentacular facet), of an arthritic nature.

Two metacarpals from separate animals produced convincing evidence of hobbling, manifested by chronic and localised inflammatory reactions around their proximal shafts. Grazing for working horses was more than likely limited within a major urban centre and therefore it is not surprising to find evidence for the tethering of beasts. However, it is clear that these particular animals were not highly regarded, since this chronic condition would have caused them obvious distress.

Discussion

The variability of preservation and the inclusion of some elements of other species (particularly the four human bones), suggests that the bones were redeposited within the Tower after originally being disposed of elsewhere. The high incidence of dog gnawing suggests that the bones were lying exposed for some time before being incorporated into the deposit.

As far as the authors are aware, large deposits of animal bone have never been found during excavations along the city walls in York. This raises the question as to how this deposit was formed, i.e. was this merely a convenient dump for unpleasant refuse in the semi-derelict Tower or a deliberate episode of infilling which served a structural purpose. Armitage (1989) has documented many examples of the use of animal bone as building material, although none of these examples date any earlier than the 17th century. Most of the bones, in these cases, were butchery or tanning waste, being mainly from cattle or sheep because of the sheer numbers of bones available. These examples also showed clear evidence for being deliberately placed, in contrast to the more random nature of the material from Tower 10. There are, however, examples where horse bones (particularly skulls) have been incorporated into structures i.e. to ward off evil (Armitage 1989) or used as 'acoustic vessels' for improving the sound effects in a room (Mann 1934; Armitage 1989). Quite clearly the material within the Tower does not fit these patterns.

Archaeological information from Tower 10 shows that the bones were not incorporated into the wall as hard core or building materials. The most probable explanation, therefore, appears to be that the Tower was used as a convenient refuse dump for a fellmongers' waste. Evidence from London suggests that most dumps of horse bones occur where complete or part carcasses could easily be disposed of with the minimum of effort (Rackham 1995). It is also apparent from ordinances during the 13th and 14th centuries that there was some concern in London regarding the dumping of horse carcasses in ditches and within the City walls, and these activities appear to have become illegal after about 1300 (Clarke 1995).

The low incidence of butchery marks on the bones from Tower 10 suggests that these bones were probably not the remains of animals which had been slaughtered for human consumption. Other medieval assemblages of horse bones, such as Ludgate, London (Rackham 1995), Market Harborough (Baxter 1996), and Castle Ditch, Newcastle upon Tyne (Rackham 1981) have also produced little evidence of butchery. In contrast, the site at West Cotton, Northamptonshire (Albarella and Davis 1994) shows a high frequency of chop and cut marks on horse bones from the medieval period, providing clear evidence for the exploitation of horse flesh. In this case, it is suggested that dogs were the main recipients of the meat. Similarly the large post-medieval assemblage of horse bones from Witney Palace in Oxfordshire (Wilson and Edwards 1993) was also interpreted as the remains of animals butchered to feed hounds. It must be noted, however, that butchered horse bones were recovered from Anglo-Scandinavian deposits at Coppergate, York, suggesting that horse meat was an occasional element of the inhabitants diet during the early medieval period (O'Connor 1989, 183-4).

The few knife and ?chop marks that were noted on bones from Tower 10 are more likely to represent activities associated

with skinning or dismemberment. The use of horse hides is known in the medieval period (Barclay 1980; Langdon 1989), but records show that during the post-medieval period the utilisation of horse carcases was more intensive, with all parts of the body being exploited by a variety different industries (Edwards 1987).

There is much discussion as to the size of horses in the medieval period, and although documentary evidence suggests an increase in size and the advent of the 'Great Horse' (Davis 1989) of 17 - 18 hands in the 14th and 15th centuries, there is little real evidence for large, robust horses from the archaeological record. The material from Tower 10 provides no further support for this theory. However, reconstructed withers heights show the horses from Tower 10 to be at the upper range of values noted from numerous other sites, with the mean value being higher than that quoted for the medieval period (Johnstone 1996).

On the basis that size may perhaps reflect status the horses from Tower 10 may well have been owned and ridden by the wealthier inhabitants of York. However, the pathological conditions noted on the spine and metacarpals (see above) of several of these individuals suggest that these animals were more likely to have been 'urban workhorses' (Clarke 1995, 5).

The size range of individuals from Tower 10 is more restricted than those recovered from the City Ditch at Ludgate, London, which shows a broad range of heights from a small animal of Shetland pony size, (10.1 hands) to a horse of almost 16 hands (Rackham 1995). In contrast, the medieval equids from the rural site of West Cotton were all ponies of approximately 11 - 13 hh (Albarella and Davis 1994).

In conclusion, the horse remains from Tower 10 have provided a rare glimpse of an important domestic species so often under-represented in archaeological vertebrate assemblages, from a period which in York has been little studied.

Archive

The vertebrate assemblage from Tower 10, Nunnery Lane, is stored at the Environmental Archaeology Unit, University of York. The paper and electronic records pertaining to the work described here will be deposited with the material, and with YAT.

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Table 1. Mammal taxa from Tower 10.

Species		**Total**
Canis f. domestic	dog	2
Equus f. domestic	horse	248*
Bos f. domestic	cattle	27
Caprine	sheep/goat	11
Human		4
Total		**292**

*includes vertebra but not rib fragments

Table 2. Skeletal element counts per species from Tower 10.

	Horse	**Cattle**	**Caprine**	**Dog**	**Human**
Horncore	-	2	-	-	-
Cranium	3	1	-	-	1
Maxilla + teeth	1	1	1	-	-
Mandible	4	2	3	-	-
Isolated teeth	15	1	-	-	-
Scapula	5	2	1	-	-
Humerus	15	3	2	1	1
Radius	18	3	4	-	-
Ulna	1	-	-	-	-
Metacarpal	4	1	-	-	-
Pelvis	14	2	-	-	-
Femur	20	3	-	1	-
Tibia	12	2	-	-	2
Astragalus	2	-	-	-	-
Calcaneum	3	1	-	-	-
Metatarsal	7	2	-	-	-
Phalanx 1	6	-	-	-	-
Phalanx 2	3	-	-	-	-
Phalanx 3	4	-	-	-	-
Sacrum	4	-	-	-	-
Axis	1	-	-	-	-
Atlas	3	1	-	-	-
Cervical vertebra	28	-	-	-	-
Thoracic vertebra	36	-	-	-	-
Lumbar vertebra	29	-	-	-	-
Vertebra fragments	10	-	-	-	-

Total	**248**	**27**	**11**	**2**	**4**

Table 3. Minimum number of individuals per element for horse.

Element	***Zones**	**MNI**
Mandible	1	3
Scapula	2345	3
Humerus	6	8
Radius	6789	8
Metacarpal	12345678	2
Innominate	1	7
Femur	6	8
Tibia	78	7
Astragalus	1234	1
Calcaneum	2345	2
Metatarsal	1256	3

*after Dobney and Rielly (1988).

Table 4. Horse withers heights

Element	**Measurement**	**Value (mm)**	**Withers height**	**Height in hands**
humerus	GLl	335	1631.45	16
radius	Ll	318	1380.12	13.2
radius	Ll	363	1575.42	15.2
radius	Ll	335	1453.9	14.2
femur	GL	420	1474.2	14.2
femur	GL	405	1421.55	14
tibia	Ll	328	1430.08	14
tibia	Ll	345	1504.2	14.3
tibia	Ll	354	1543.44	15.1
tibia	Ll	339	1478.04	14.2
tibia	Ll	330	1438.8	14.1
metacarpal	Ll	242	1551.22	15.1
metacarpal	Ll	217.9	1396.739	13.3
metacarpal	Ll	213.1	1365.971	13.2
metacarpal	Ll	280.4	1494.532	14.3
metatarsal	Ll	261.2	1392.196	13.3
metatarsal	Ll	276.6	1474.278	14.2

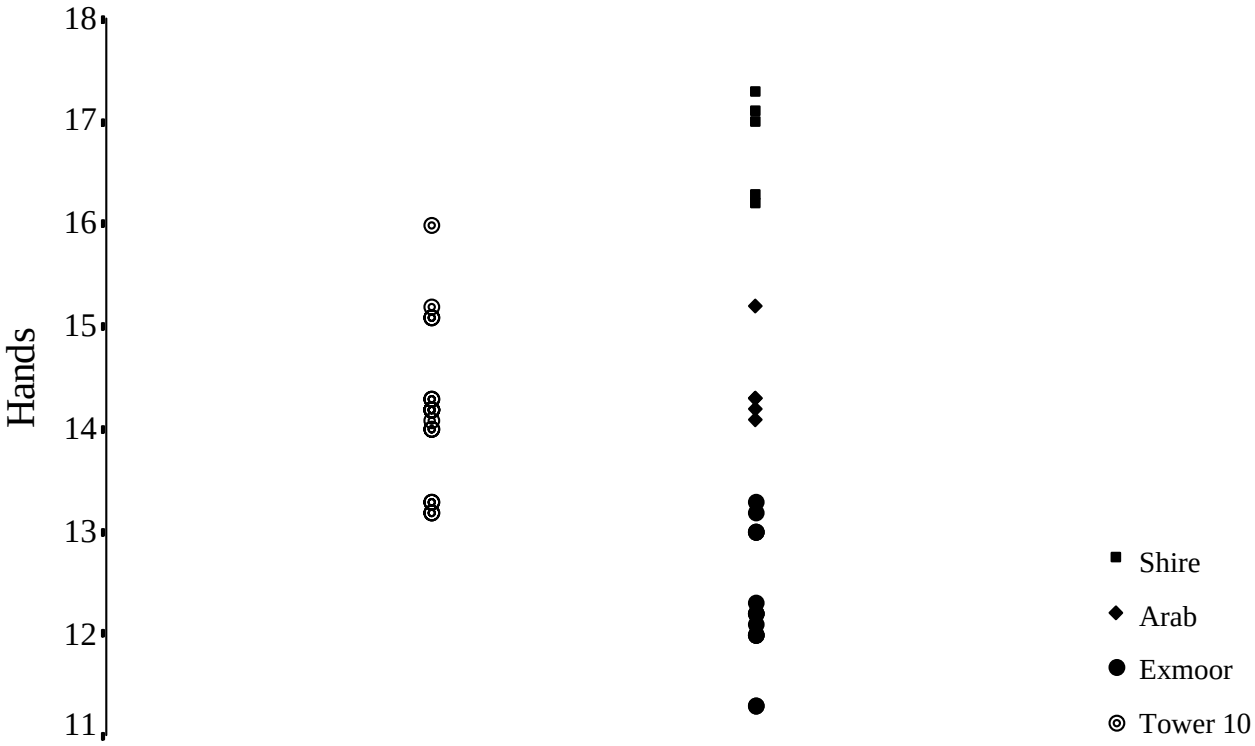

Figure 1. Comparison of the height (in hands) of horses from Tower 10 with data from modern breeds. Heights were calculated from the following elements: humerus, radius, femur, tibia, metacarpal and metatarsal. Measurements from three different Exmoor ponies were used.

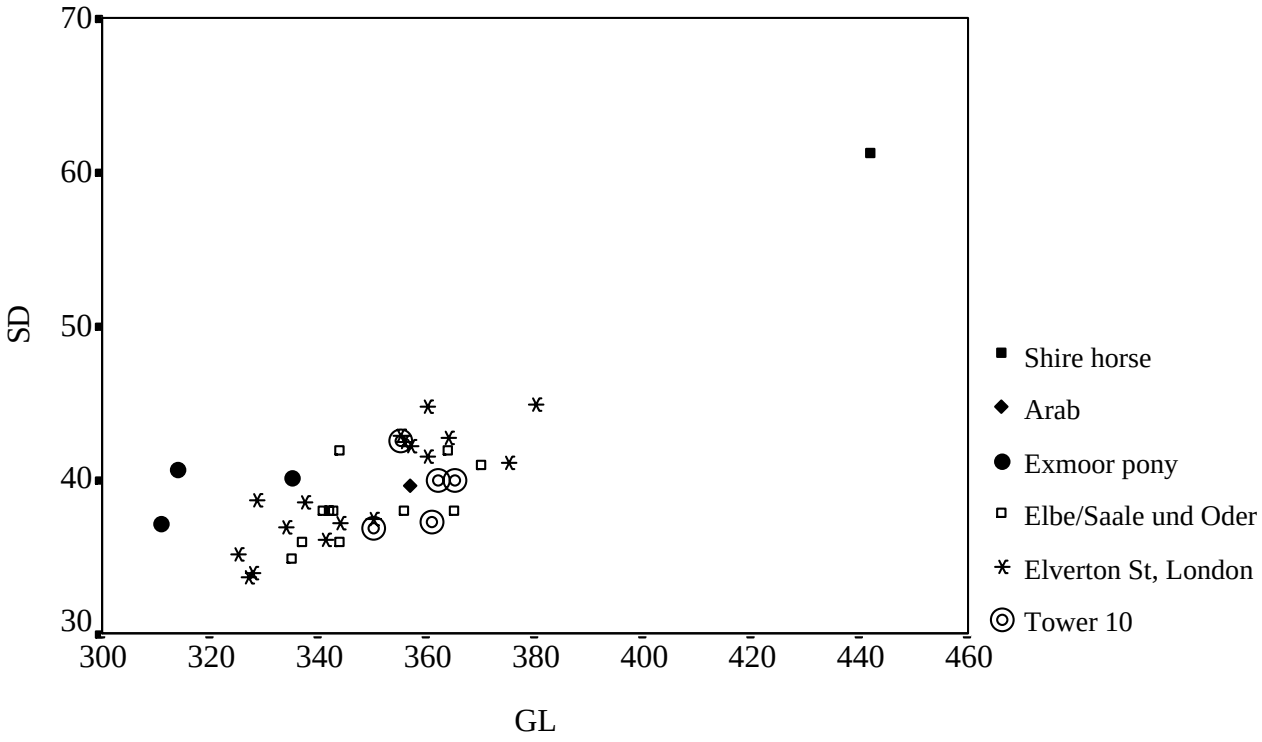

Figure 2. Size of horse tibiae from Tower 10, minimum shaft diameter (SD): greatest length (GL), including data from other medieval assemblages and modern comparative specimens.

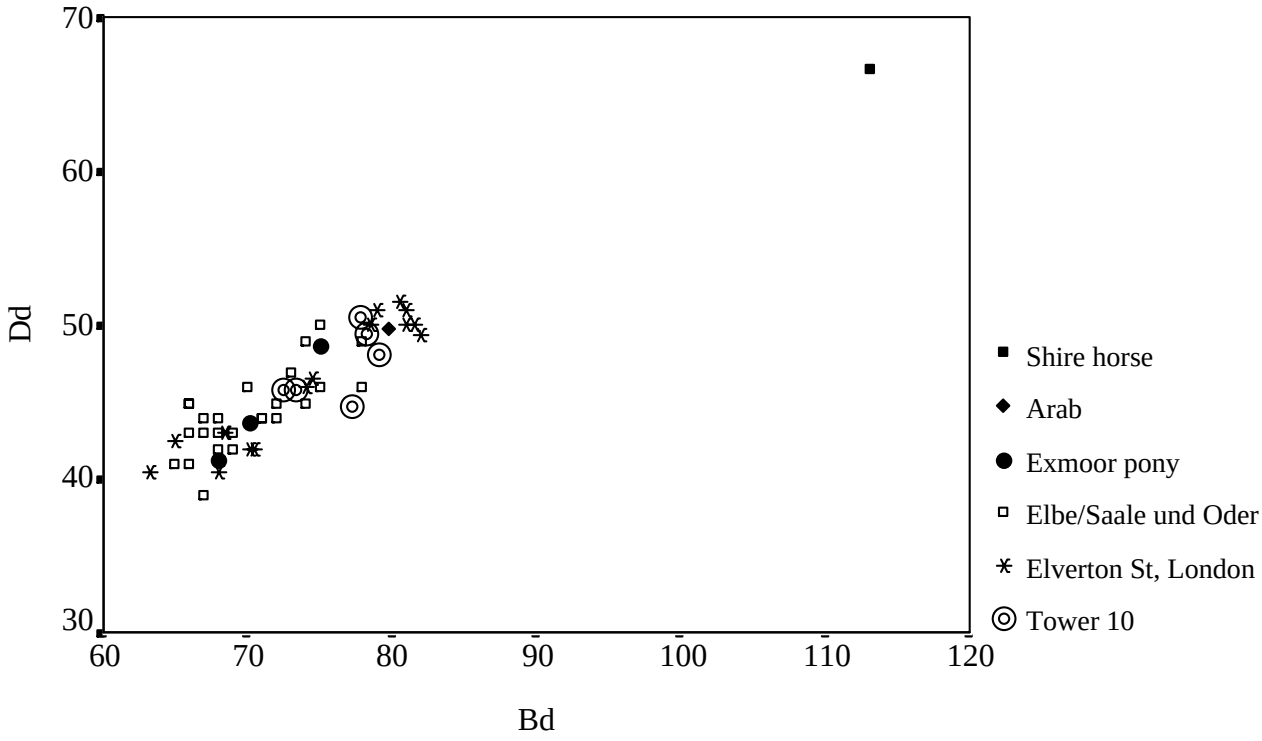

Figure 3. Size of horse tibiae from Tower 10, distal depth (Dd): distal breadth (Bd), including data from other medieval assemblages and modern comparative specimens.

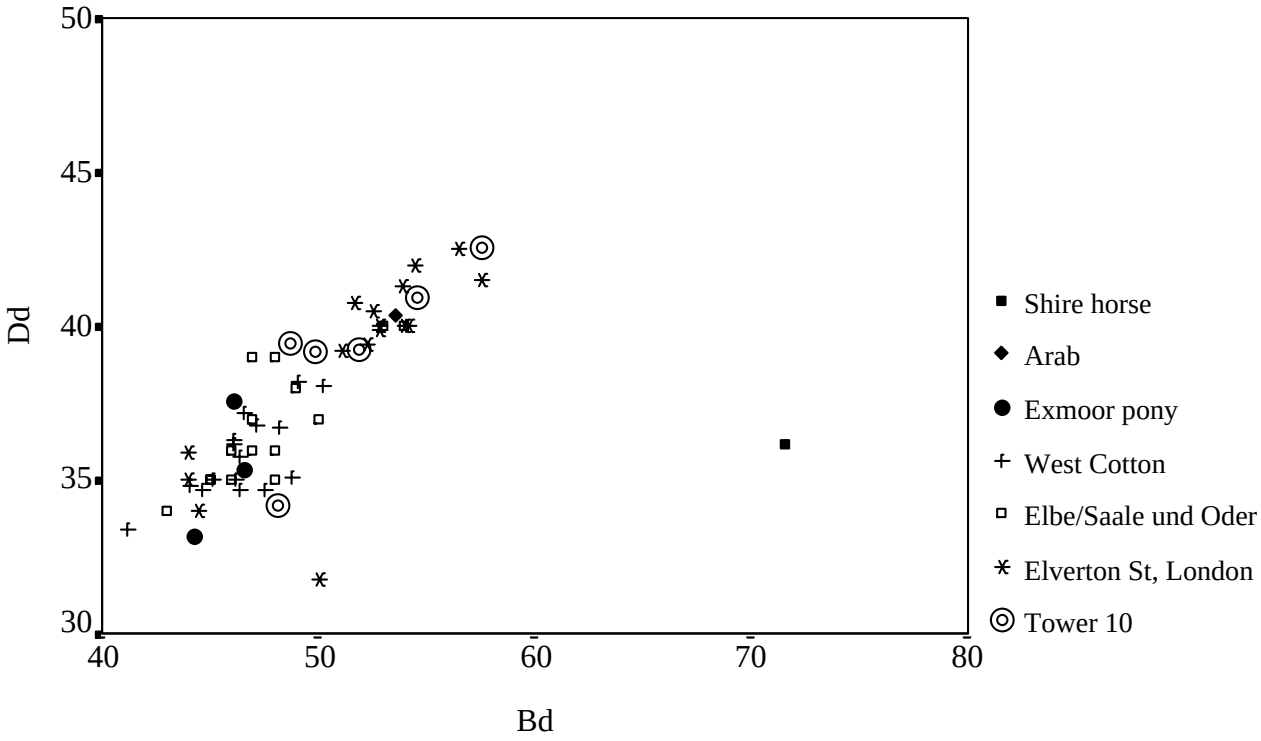

Figure 4. Size of horse metatarsals from Tower 10, distal depth (Dd): distal breadth (Bd), including data from other medieval assemblages and modern comparative specimens.

Appendix

Horse measurements (mm) following those outlined by von den Dreisch (1976), with the exception of L1 = length of M1; B1 = breadth of M1; L3 = length of M3; B3 = breadth of M3.

Bone no.	**Element**	**1**	**2**	**3**	**3a**	**8**	**9**	**10**	**22**	**23**	**24**	**34**	**38**	**41**	**43**	**44**	**45**	**50**	**L1**	**B1**	**L3**	**B3**
121	cranium														179.6	81.9	72.4		27.1	28	24.1	22.2
122	cranium	548	529	498	486		152	380	175	80.9	93.7		108.9	209.6	169.7	84.2	71.7	101.6	28.7	27.4	23.9	22
123	cranium	575	555	526	518	317	188.3	401	183.2	84.4	100.8	84.6	114	221.4	191.8	88.5	75.9	112.4	26.2	26.7	29.9	24

Bone no.	**Element**	**6a**	**7**	**8**	**22a**	**22b**	**22c**	**L1**	**B1**	**L3**	**B3**
117	mandible	163.9	81.7	79.6			56	23.7	18.1	33.1	14.7
118	mandible	162.9	80.9	85.4	90.2	65.4	48.9	24.1	14.4	29.6	13.7
119	mandible	170.7	86.4	88.9		72.4		24.4	18.3	33.7	15
120	mandible					73.9	52.3	25.2	18.2		

Bone no.	**Element**	**GLP**	**SLC**
2	scapula	105.1	72.7
3	scapula	97.7	72.1
4	scapula	90.2	64.9
5	scapula	94.7	63.4

Bone no.	**Element**	**GLC**	**GLl**	**BT**	**HT**	**HTC**	**SD**	**Bp**
7	humerus	262.4		70.8	50.4	34.8	32.9	
8	humerus			68.5	46.7	33		

9	humerus			75.2	52.7	39.2		
10	humerus			75.5	55.8	39	37	
12	humerus			70	50.9	37.9		
13	humerus			83.5	54.4	40		
14	humerus	315	335	81.9	58	41.8	41.9	
15	humerus			78	55.5	38.5		
16	humerus			77.7	54.4	37.5	36.4	
17	humerus				50		33.5	
18	humerus			73.8	49.9	35.5	36.5	
22	humerus							97.7

Bone no.	**Element**	**Bp**	**BFp**	**Bd**	**BFd**	**CD**	**SD**	**GL**	**Ll**
23	radius	79.6	73.7	75.3	63.1	110	37	344	318
24	radius	91.9	84.6	85.5	70.2	139	44.2	378	363
25	radius	80.5	71.5	74.1	64.5	115	39.9	347	335
26	radius			75.3	65.4		38.5		
27	radius			77.4	74.6				
28	radius			73.6	63.1				
29	radius			85	72.3				
30	radius			73.9	62.8				
31	radius	84	76.5						
32	radius			86.3	70				
34	radius	94.2							
35	radius	79.7	74.8				37.7		

Bone no.	**Element**	**Bd**	**Bp**	**CD**	**DC**	**GL**	**GLC**	**SD**
42	femur	91.9		158				44.9
43	femur				61.3			
44	femur		113.3		56.7			
45	femur	86.5						

Bone no.	Element	Bd	Bp	CD	DC	GL	GLC	SD
46	femur	102.3	129	177	59.7	420	400	49.1
47	femur	97.1		161				43.8
48	femur	84.1	118.1	154	55.5	405	365	41.4
49	femur	90.4		148				40.6
50	femur		111.3		55.6			
51	femur		108.6		54.8			
54	femur		120.7					
56	femur	88.2						
57	femur			159				43.7
58	femur				56			
59	femur				55.7			

Bone no.	Element	Bd	Bp	CD	Dd	GL	Ll	SD
62	tibia	72.5	96.6	116	45.9	350	328	37
63	tibia	78.3	99.1		49.5	362	345	40
64	tibia		107.3					44.3
65	tibia	77.2		121	44.8			39.2
68	tibia		91					
69	tibia	79.1	99	132	48.2	365	354	40.1
70	tibia		92.2	131				39.3
71	tibia	73.3	95.8	125	45.9	361	339	37.3
72	tibia	77.8		140	50.6	355	330	42.7

Bone no.	Element	BFd	GB	GH	LmT
99	astragalus	52.2	62.8	60.5	62
100	astragalus	49.9	59.7	56.6	57.7

Bone no.	Element	GL	SD
101	calcaneum	107.1	37.5

Bone no.	Element	Bd	Bp	DD	Dd	Dp	GL	GLl	Ll	SD
74	metacarpal	55.4	53.7	27.7	40.7	36.7	252.1	248.5	242	40.1
75	metacarpal	49.8	49.2	23.9	37	33.2	224.9	222.2	217.9	33.6
76	metacarpal	46.5	48.3	22.8	34.2		220.6	217.4	213.1	36.3
77	metacarpal		54.7			36.9				

Bone no.	Element	Bd	Bp	CD	DD	Dd	GL	GLl	Ll
78	metatarsal	54.6	53.9	112	28.3	41	293	289	280.4
79	metatarsal	48.7	50.4	109	27.2	39.5	273.2	264.2	261.2
80	metatarsal	51.9	52.2	112	28.6	39.3	281.4	278.8	276.6
81	metatarsal	49.9			26	39.2			
82	metatarsal	57.5			31.2	42.6			
83	metatarsal	48.1			24.5	34.2			
84	metatarsal		52.3						

Bone no.	Element	BFd	BFp	Bd	Bp	Dp	GL	SD
104	phalanx 1	49.9	58.4	51.2	60.7	44.6	97.5	39.4
105	phalanx 1	45.9	54.7	48.6	57.5	36.7	84.2	35
106	phalanx 1	40.8	48.5	44.5	52.1	34	83.7	32.7
107	phalanx 1	48.7	56.7	54.1	61.1	38.9	88.6	40.6
108	phalanx 1	45.1		46.7			85.5	37.1

Bone no.	Element	BFp	Bd	Bp	Dp	GL	SD
110	phalanx 2	52.1	54.8	60.1	35.7	52.5	48.9
111	phalanx 2	44.8	50	51.7		45.4	44.3
112	phalanx 2	45.7	45.9	52.4		48.6	42.1

Bone no.	Element	BF	GB	GL	HP	Ld
113	phalanx 3	55.2	92.2	72.3	45.3	58.3
114	phalanx 3	57.3	75.3	70.9	45.6	56.9
115	phalanx 3	60.7	89.1	66.4	37.7	56.5