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Technical report: The vertebrate remains from Kingsgate, Berkhamsted, Hertfordshire (site code: HAT183).

by

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Summary

Excavations on land adjacent to Kingsgate, Berkhamsted, produced a moderate animal bone assemblage from six phases of activity, relating to the occupation of four tenements, dating to the late 12th to 15th centuries.

The vertebrate remains constituted a fairly typical medieval assemblage comprising for the most part of the main domestic species (cattle, sheep and pig). Midden areas consisting chiefly of primary butchery and domestic waste were defined in three of the four tenements. The assemblage from Tenement B appears to be characterised by small amounts of possible hornworking, furrier and tanning waste, although these activities may not have been undertaken within the tenement itself.

Keywords: KINGSGATE; BERKHAMSTED; MEDIEVAL; TENEMENTS; VERTEBRATE REMAINS; CRAFT WORKING; MIDDENS.

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Introduction

Excavations were undertaken by Hertfordshire Archaeological Trust, at Kingsgate, Berkhamsted, in 1996, following an evaluation in 1995 (Walker 1995). Twelve 6 x 2 m trenches, divided into 1 x 1 m test pits, were excavated on waste land adjacent to Kingsgate, prior to development. The excavations revealed a sequence of medieval deposits, dating mainly from the late 12th to the 14th centuries.

Archaeological deposits uncovered at the site were grouped into six phases dated as follows:

Phase 1 - Pre-occupation - undated as yet.
Phase 2 - Alluvial deposition - late 12th-14th centuries.
Phase 3 - Occupation deposition including linear features - late 12th-14th centuries.
Phase 4 - Occupation deposition - late 12th-14th centuries.
Phase 5 - Occupation deposition including linear features - late 12th-14th centuries.
Phase 6 - Occupation deposition - 15th century.

In an attempt to identify any spatial patterns in the vertebrate assemblage which may reflect specific activities which took place within the various medieval tenement plots, the archaeological deposits encountered within each test pit were correlated across the site (where possible) and the finds from each kept separate.

The project as a whole had several specific research aims, three of which could be addressed by analysis of the vertebrate remains. The first was to try and establish the economic status of the occupants of the tenements. The second was to compare the evidence between the tenements to try and determine any differences and what they might mean. The third was to compare the evidence from Kingsgate with other sites of the same date in the region.

Methods

During the assessment phase 14 of the 40 bone-bearing contexts were examined (Jaques and Dobney 1996). These were the only contexts containing greater than 35 fragments. Data from these same fourteen contexts form the basis of this report.

Semi-subjective, non-quantitative data were recorded for each context within each trench, regarding state of preservation and colour of the bones and the appearance of the broken surfaces ('angularity'), as well as semi-quantitative data concerning fragment size, dog gnawing, burning, butchery and fresh breakage.

The fragments were examined and, where possible, identified to species using the reference collection at the EAU. All fragments not identified to species or species group were recorded as 'unidentified'; these included all skull, vertebra, rib and shaft fragments and other elements where species identification was unclear. For the separation of sheep and goats the criteria set out by Boessneck (1969) and Payne (1985) were used in addition to the reference material.

All measurements were taken in accordance with the guidelines set out by von den Driesch (1976) and additional measurements on caprovid bones were taken following guidelines given by the sheep / goat working party (Davis 1992; Dobney *et al.* 1996; and unpublished). Withers height estimates were calculated using the formulae given by Kiesewalter (Boessneck and von den Driesch 1974) and Johnstone (1996) for horses, Teichart (1975) for sheep and Fock (1966) for cattle.

Age-at-death was calculated using dental eruption and attrition. Wear stages were recorded according to Grant (1982) for pigs and cattle and Payne (1973, 1987) for caprovids. Detailed butchery information was noted for each fragment, where appropriate, as was any evidence of pathology.

Bones were recorded in trench and test pit order by context. During the assessment, detailed recording was only undertaken on a small proportion of the material. Subsequently, those records have been computerised and the material 'scanned' for the assessment has been recorded in detail. Although bone from Trench 30 was recorded, dating remains uncertain and the information gained is therefore of limited interpretative value.

The numbers of fragments per cubic metre of deposit were calculated by the following equation: No. frags m3 = no. frags recovered x (1 / volume deposit sieved).

Results

Preservation

Preservation was consistently 'fair' in 72% of the contexts and 'good' in 23%. Only 5% of contexts showed 'variable' preservation, possibly indicating that few contexts contained reworked or intrusive material. The angularity of the broken edges was recorded as 'spiky' in material from 64% of the contexts, mostly 'spiky' in the remainder, and only a few fragments were 'battered' or 'rounded'. Colour ranged from brown to dark brown, and bones from 38% of contexts showed some variation, possibly indicating a higher proportion of reworked material in these deposits.

The bones were fairly heavily comminuted, more than 50% of the fragments being less than 5 cm in length and most of the remainder being between 5 and 20 cm in length. Dog gnawing was present (on less than 10% of the fragments) in approximately 75% of the contexts. Evidence for butchery was noted on a similar proportion of the bones. Fresh breakage was noted in all contexts, although mostly affecting less than 20% of the fragments. Burning was noted at very low frequencies and in a small proportion of contexts.

Pathology and abnormalities

Only five fragments in the whole assemblage showed evidence of pathology or abnormalities. A single cattle lower third molar had a markedly reduced third cusp (hypoconulid), thought to be a genetic trait, and a single caprovid lower molar showed signs of slight calculus deposits.

An arthropathy was noted on a cattle second phalanx where the margins of the proximal articular surface showed slight exostoses, possibly indicating stress to the joint caused by the animal's use for traction. A single goat horncore exhibited a characteristic 'thumbprint' impression on one side, the aetiology of which is still little understood (O'Connor 1991).

The last fragment was a small piece of cattle cranium with a single circular perforation, approximately 4 mm in diameter, in the occipital region. This phenomenon has been seen in several assemblages, most notably in late Roman material from Lincoln (Dobney *et al.* 1996). The aetiology of this phenomenon is not yet known but several theories have been put forward, the most likely explanation, at present, suggests it may be of congenital origin (Brothwell *et al.* 1996).

Species Representation

Table 1 shows the number of fragments of each species recovered, by phase. A total of 5475 fragments (31.688 kg) were recovered, of which 1127 (17.563 kg) were identified to species. The three main domesticates (i.e. caprovid, cattle and pig) not surprisingly contributed the largest number of identified fragments (1000) to the assemblage. When the unidentified large and medium mammal fragments (assumed to be mostly from the main domesticates) are considered, they represent 82 % of the entire assemblage.

Caprovid fragments were by far the most numerous (608 fragments including 19 fragments attributed to sheep (*Ovis* f. domestic), nine to goat (*Capra* f. domestic) and one probable goat fragment), followed by cattle (302 fragments) and pig (90 fragments).

Of the other species identified, horse (*Equus* f. domestic) and cat (*Felis* f. domestic) fragments were the most frequent mammal species, with domestic fowl (*Gallus* f. domestic) and goose (*Anser* sp.) the most numerous bird species.

It is unclear whether the goose fragments are the remains of wild or domestic geese. In terms of size, four fragments could be from domestic geese, whilst a further eight represent greylag-size individuals. One fowl tarsometatarsus was spurred, indicating a cock bird.

Other mammal and bird species less well represented included dog (*Canis* f. domestic), rabbit (*Oryctolagus cuniculus* (L.)), hare (*Lepus* sp.), red deer (*Cervus elaphus* L.), fallow deer (*Dama dama* (L.)), turkey (*Meleagris gallopavo* L.), duck (cf. *Anas* f. domestic), coot (*Fulica atra* L.) and plover (Charadriidae).

Butchery

The quantity of direct butchery evidence was not large, only 114 identified and thirteen 'unidentified' fragments showing it. Of these 104 were from the three main domesticates. The vast majority of the evidence was consistent with jointing carcasses and filleting meat from the bones. In addition, several caprovid skulls had been split longitudinally, presumably to facilitate removal of the brain.

There were three goat and six cattle horncores with chop or knife marks at the base, and one goat, one sheep, one cow and 5 caprovid cranial fragments with the horncores removed. In addition a single dog ulna had been chopped and seven cat fragments showed knife marks. This suggests that the animals were being utilised for other purposes in addition to providing meat. There were also butchery marks on a few bones of fowl, goose, hare and horse.

Skeletal Element Representation

Table 2 shows the distribution of identified skeletal elements for the three main domesticates. Table 3 shows the numbers of meat-bearing and non meat-bearing bone fragments, including the unidentified material. Unidentified fragments recorded as ribs or vertebrae are shown as 'Torso' and considered to be meat-bearing elements. Those fragments recorded as 'shaft' were split in ratio of 1:2, lower leg : meat-bearing. This was to take into account the different elements represented. Figures 3 & 4 show this information spatially for the main phases of the site.

For all three species, the distribution of the identified elements showed a preponderance of non meat-bearing elements indicative of primary butchery waste. However, when the unidentified elements were added, the proportions changed to roughly equal quantities of meat-bearing and primary butchery waste fragments. There appeared to be no significant differences in the element representation between the four tenement plots through Phases 2-5 (Figure 3). However, there appears to be a slight shift towards non meat-bearing elements in Phase 6.

Age Structure

Table 4 gives the tooth wear stage data for the three main domesticates. As can be seen few data were available for cattle or pigs so the conclusions drawn must be very tentative. The cattle were mostly mature, with one younger individual represented. Pigs appear to have been killed fairly young, when they had reached a substantial bodyweight but were not yet mature. This is normal practice for rearing pigs for meat.

The caprovid teeth mostly represented mature individuals, with only 6 out of 26 teeth from subadult individuals. The emphasis on sheep rearing was perhaps more focused towards wool and/or mutton production.

Measurements

All the biometrical data are given in the appendix, and as can be seen there were very few measurable fragments of species other than caprovids. Withers height estimates for all species are given in Table 5. The two caprovid elements give estimates of 559 and 541 mm. Medieval sheep bones from Malmo Road, Hull (unpublished data held at the EAU) yielded a range of 440-600 mm with a mean of 540 mm whilst comparative Shetland sheep skeletons from the EAU exhibit a range of 470 -590 mm. The Kingsgate caprovid material thus falls well within the range of another medieval assemblage and was of a similar size to the modern unimproved Shetland breed.

Figure 1 shows the caprovid proximal metacarpal measurements for medieval bones from Kingsgate, Malmo Road and Lincoln (Dobney *et al.* 1996), and modern Shetland individuals from the EAU reference collection. The data from the three archaeological sites show similarities between the individuals represented, particularly between those from Kingsgate and Malmo Road. The archaeological data fell towards, and beyond, the lower end of the range supplied by the reference collection Shetlands indicating small, gracile individuals.

Figure 2 shows the distal tibia measurements for Kingsgate, Malmo Road, Lincoln and modern Shetland individuals from the EAU reference collection. The similarities noted for Figure 3 are also present in this data, but the smallest individuals are lacking.

Two cattle metapodials give estimations of 1032 and 1036 mm at the shoulder. Horse bones for which withers heights could be reconstructed were more numerous but many came from Trench 30 for which the dating evidence is uncertain. The horse withers heights range from 1290 to 1428 mm, (13-14.1 hh), well within the range given by Johnstone (1996) for medieval horses.

Distribution and concentration of vertebrate remains

Table 6 gives the number of fragments per cubic metre for each test pit and Figures 5 and 6 show this information graphically in relation to the tenement boundaries. The material from Phases 2-5 showed two areas of bone concentration, one in Tenement A and one in Tenement B. The material from Phase 6 shows three large and one smaller concentrations of bone, one in each of the four tenements. The concentration in Tenement A appears to have changed position slightly between the two phases whilst Tenement C has a consistently lower concentration of bone throughout the whole area and period.

There were few noticeable differences in the distribution of elements across the site, the only one worthy of note being the slight concentration of horncores (both cattle and goat) and skulls with horncores removed (cattle and caprovids) in Tenement B. The mix of species was also fairly even, the only exception being a slight concentration of cat bones in Tenement B.

Discussion

The main domestic food species dominate the Kingsgate assemblage. Caprovid fragments were most numerous, although the numbers of cattle, in terms of quantity of meat, are most significant. It has been suggested that mutton was more popular than lamb during the medieval period, although beef still remained the most important meat source (Hammond 1993, 8). Goat was present in the assemblage and was supposedly a popular source of meat, particularly during the thirteenth century (Hammond 1993, 7).

The proportions of cattle, sheep and pig, and the list of other species represented, are comparable to other contemporaneous assemblages, such as St. Peter's Street, Northampton (Harman 1979), Stert Street in Abingdon, Oxon (Wilson 1979), Quilter's Vault, Southampton (Bourdillon 1979) and Orchard Street, Newcastle-upon-Tyne (Dobney and Jaques 1993). In addition three slightly earlier Saxo-Norman tenements from Durham showed a similar range of species, although in the earliest phases pigs appeared more important (Rackham 1979).

Fallow and red deer, rabbit, hare and plover may be to have been considered high status foodstuffs during the medieval period. However, the very small quantities of bones recorded, and the fact that most were non meat-bearing elements, renders any interpretation of socio-economic status of limited value.

The complete absence of fish bones in the assemblage, in spite of an extensive sieving program, is significant. Taphonomic factors can probably be ruled out. Most medieval urban excavations, where sieving has been undertaken, have produced characteristic assemblages of fish bones, often dominated by herring, eel and gadid. Possible specialised activities, particularly in tenement B, may explain their absence from the Kingsgate assemblage.

Analysis of the distribution of skeletal elements revealed a rather confusing picture There appeared to be a mixture of domestic refuse, primary butchery waste and possible industrial craft working debris. The same combination occurs at many sites and O'Connor (1991, 247) summarises this problem in his report on material from Fishergate, York as follows:

"Carcass element distribution data are often unsatisfactory in that they show moat assemblages to include what could theoretically be a mixture of debris from several different stages of butchering and carcass utilisation. This may in itself be informative in terms of disposal practice, but does not contribute usefully to any interpretation of the use of different areas of the site."

In relation to tenement sites, Wilson (1979, 198) found a similar distribution of elements at the Hamal, Oxford: "undifferentiated domestic debris, or the remains of less specialised butchery, or more complete usage of carcass materials."

One possible explanation of this mixture of waste is that households slaughtered and butchered their own animals; pigs, chickens and geese were often kept on tenements, unlike sheep and cattle which require more extensive grazing. At George Street, Aylesbury, Jones (1981) suggests that "possibly richer households were handling the live beast, whether from the market or more probably from their own land or rented pasture, whereas in other households meat was brought in smaller amounts and the primary butchery waste deposited elsewhere." However, this may not always be the case. So many medieval tenement assemblages appear to contain primary butchery as well as domestic waste that perhaps more butchery was done within households than has previously been thought.

Analysis of the distribution and relative concentration of vertebrate material between the tenements (Figures 5 and 6) shows apparent concentrations of bone in all the tenements, probably the result of deposition of waste in one area, i.e. midden deposits. Perhaps the midden area in Tenement C was not revealed during the excavation or the waste may have been spread over a larger area, hence the slightly higher 'background level'. The shift of the midden in Tenement A may simply be a matter of logistics; as one area became full, another was used.

Although the assemblage from Kingsgate was small and fragmented, several interesting observations can be made, particularly regarding details of possible activities occurring in the different tenements.

The practice of splitting skulls longitudinally to remove the brain was noted on at least five caprovid skulls, some of which had also had the horncores removed. Similar examples were noted from a site at the Hamal, Oxford (Wilson 1980).

The butchery noted on the other species is more worthy of note. A single dog ulna had been chopped and the cat bones displayed very clear evidence of skinning, which included a cranium with knife marks horizontally across the vault and a mandible with knife marks on either side. Medieval assemblages containing cat bones quite often display evidence of skinning. One exceptional 13th century assemblage, from a well, at Bene't Court, Cambridge (Luff and García 1995) contained a minimum of 79 cats. The skinning marks on the skulls from Kingsgate were very similar to those on the Bene't Court material.

Although it is usually thought that the cats killed for fur were generally wild individuals, the Bene't Court material throws this into doubt as the cats there were very small. "The pedlar of whom Langland wrote (in the 13th century) was even ready to kill cats, if he could catch them, for the sake of their skins" (quoted in Veale 1966, 59), suggesting that these were feral if not domestic cats. Whichever species was used, they must have been quite numerous as cat fur was allowed to be worn by the lower classes of society (Veale 1966). This is perhaps another indicator that the inhabitants of the tenements were not the social elite!

There is no documentary or definitive archaeological evidence that cats were eaten, but they may have been sold as hare by unscrupulous butchers (Luff and García 1995). Knife marks on a cat pelvis and humerus from Kingsgate may lend a little credence to this theory.

The presence of chopped horncores and skulls with the cores removed suggests that there was at least some utilisation of non meat-bearing carcass components in these tenements.

When the spatial distribution of the species was analysed, it was found that ten of the twenty-three cat bones (four with skinning marks) were from Tenement B, and two canid bones (possibly fox) were also recovered from this tenement. Together with the concentration of horncores and skulls with horncores removed, these could indicate that small-scale craft activities were taking place in Tenement B.

The skins and horns may have been used directly by those occupying the tenement or they may indicate a small-scale butcher selling by-products on to others. Evidence of possible small-scale butchery was also noted at the Hamal, Oxford (Wilson 1980, 198) "Small scale utilisation of minor carcass products is shown by several groups ... of horncores, and a greater incidence of worked bone".

The turkey (*Meleagris gallopavo* L.) fragment was found in Trench 30, in a Phase 1 deposit. Turkeys were not introduced into the British Isles until the 16th century, and this, together with records of 18th and 19th century pottery sherds, indicates that the deposits in Trench 30 were contaminated.

Conclusions

The small but rather well preserved vertebrate assemblage from Kingsgate yielded only a modest amount of zooarchaeological information. However, as a result of the excavation methods employed, the assemblage was able to provide information relevant to the spacial interpretation of the site.

Midden areas, consisting chiefly of a combination of primary butchery and domestic waste, were defined in three of the four tenements (A, B and D). Specific activities were difficult to determine except in the assemblage from Tenement B, which appeared to be characterised by small amounts of hornworking, furrier and tanning waste. These activities may not necessarily have been undertaken within the tenement itself.

Archive

All the bone material is currently stored in the Environmental Archaeology Unit, University of York, along with paper and electronic records pertaining to the work described here.

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Table 1. Number of bone fragments by phase for Kingsgate, Berkhamsted.

Species	**Taxon**	**Phase 1**	**Phase 2**	**Phase 3**	**Phase 4**	**Phase 5**	**Phase 6**	**Total**
Rabbit	*Oryctolagus cuniculus* (L.)						1	1
Hare	*Lepus* sp.				2	1		3
Canid	Canidae				4			4
Dog	*Canis* f. domestic		1					1
Cat	*Felis* f. domestic		3		11		9	23
Horse	*Equus* f. domestic	9	1		8		7	25
Pig	*Sus* f. domestic	2	7	12	48	1	20	90
Red deer	*Cervus elaphus* L.				2			2
Fallow deer	*Dama dama* (L.)	3			1		1	5
Cattle	*Bos* f. domestic	3	27	25	142	10	95	302
Sheep/Goat	Caprovid	3	77	31	288	19	161	579
?Goat	cf. *Capra* f. domestic		1					1
Goat	*Capra* f. domestic		1	1	5		2	9
Sheep	*Ovis* f. domestic		6		6		7	19
Goose	*Anser* sp.		2	2	7		7	18
Duck	*Anas* sp.			1				1
?Fowl	cf. *Gallus* f. domestic		1		2		1	4
Fowl	*Gallus* f. domestic	1	9	2	13	6	5	36
Turkey	*Meleagris gallopavo* L.	1						1
Coot	*Fulica atra* L.				2			2
Plover sp.	Charadriidae		1					1
Sub-total		***22***	***137***	***74***	***541***	***37***	***316***	***1127***
Large mammal		33	117	71	598	84	540	1443
Medium mammal		17	327	122	1006	136	429	2037
Bird			1	2	6		7	16
Unid		10	51	4	341	40	406	852
Sub-total		***60***	***496***	***199***	***1951***	***260***	***1382***	***4348***
Total		**82**	**633**	**273**	**2492**	**297**	**1698**	**5475**

Table 2. Distribution of elements for the three main domesticates from Kingsgate, Berkhamsted.

Element	**Cattle**	**Caprovid**	**Pig**	**Total**
Horncore	40	14		54
Maxilla + Teeth	1	3	1	5
Mandible	14	55	8	77
Isolated teeth	74	197	25	296
Scapula	2	10	8	20
Humerus	18	31	7	56
Radius	9	29	1	39
Ulna	8	12	4	24
Carpal	7	1		8
Metacarpal	15	51	4	70
Pelvis	8	24		32
Femur	5	6	2	13
Tibia	10	15	4	29
Astragalus	5	6	3	14
Calcaneum	3	14	4	21
Tarsal	2	3		5
Metatarsal	9	57	2	68
Metapodial	16	7	7	30
Phalanx 1	25	54	5	84
Phalanx 2	21	10		31
Phalanx 3	8	8	2	18
Carpal / tarsal	2			2
Patella		1		1
Lateral phalanges			3	3
Total	**302**	**608**	**90**	**1000**

Table 3. Numbers of meat-bearing and non meat-bearing bone fragments from Kingsgate, Berkhamsted.

Species	Head	Lower leg & feet	Torso	Meat-bearing	Total
Cattle	129	113		60	302
Large Mammal	391	251	281	518	1441
Caprovid	271	210		127	608
Pig	34	30		26	90
Medium Mammal	336	348	608	713	2005
Total	**1159**	**952**	**889**	**1444**	**4444**

Table 4. Age categories for cattle, caprovid and pig mandibles and isolated teeth from Kingsgate, Berkhamsted. Age categories after O'Connor (1991). The numbers represent the number of teeth, mandibles being counted as single teeth.

Age category	Cattle	Caprovid	Pig
Neonatal			
Juvenile			
Immature		1	
Immature 1			
Immature 2			2
Subadult 1	1	2	1
Subadult 2		3	
Adult		7	
Adult 1			
Adult 2	2		
Adult 3	1	13	
Elderly			
Total	5	26	3

Table 5. Withers height estimations from Kingsgate, Berkhamsted.

Element	**Species**	**Measurement**	**Value (mm)**	**Withers height (mm)**	**Withers height (hh)**
Metacarpal	Cattle	GL	168.6	1032	
Metatarsal		GL	199.3	1086	
Metacarpal	Caprovid	GL	115.5	559	
Radius		GL	135.3	541	
Femur	Horse	GL	380	1334	13.1
Radius		Ll	327	1419	14.1
Radius		Ll	329	1428	14.1
Metacarpal		Ll	221	1417	14.1
Metacarpal		Ll	216.5	1388	14.0
Phalanx 1		GL	77.6	1290	13.0

Table 6. Volume of deposit sieved from each test pit with the number of bone fragments recovered and the calculated numbers of fragments per cubic metre from Kingsgate, Berkhamsted.

Context	**Trench**	**Test pit**	**Volume sieved (m^3)**	**Number of fragments**	**Number of fragments per m^3**
100	20	A & B	0.06	121	2017
		E & F	0.10	200	2000
		I & J	0.32	99	309
100	21	A & B	0.14	45	321
		E & F	0.14	32	229
		I & J	0.16	31	194
100	22	A & B	0.10	24	240
		C & D	0.16	48	300
		E & F	0.14	22	157
		I & J	0.10	14	140
100	23	A & B	0.12	58	483
100	24	A & B	0.14	126	900
		E & F	0.14	56	400
100	25	A & B	0.28	117	418
		E & F	0.18	24	133
		I & J	0.16	30	188
100	26	A & B	0.20	40	200
		E & F	0.24	7	29
		I & J	0.30	34	113
100	27	A & B	0.30	15	50
		E & F	0.32	25	78
		I & J	0.44	40	91
100	30	A & B	0.30	93	211
		E & F	0.32	68	155
		I & J	0.44	231	1777
100	31	A & B	0.40	38	95
		E & F	0.28	23	82
		I & J	0.16	38	238
101	20	A & B	0.36	11	31
		E & F	0.40	107	269
		I & J	0.32	246	769
101	21	A & B	0.36	138	383
		E & F	0.14	60	429
		I & J	0.28	80	293
101	23	A & B	0.35	111	317

Context	Trench	Test pit	Volume sieved (m^3)	Number of fragments	Number of fragments per m^3
101	24	A & B	0.16	153	956
		E & F	0.40	209	523
101	25	A & B	0.30	33	110
		E & F	0.30	49	163
		G	0.16	12	75
		I & J	0.34	62	182
101	26	A & B	0.36	84	233
		E & F	0.40	75	188
		I & J	0.40	81	203
101	27	A & B	0.44	35	80
		E & F	0.50	110	204
		I & J	0.40	52	130
101	28	A & B	0.24	55	229
		E & F	0.28	158	207
		I & J	0.28	120	429
101	29	A & B	0.60	60	100
		E & F	0.54	72	133
101	30	I & J		70	
101	31	A & B	0.36	77	214
		E & F	0.36	46	128
		I & J	0.40	58	145
102	20	E & F	0.11	5	45
		I & J	0.16	17	106
102	28	E & F	0.34	13	38
102	31	A & B	0.30	3	10
		E & F	0.36	43	119
		I & J	0.20	12	60
103	25	A & B	0.40	2	5
		E & F	0.44	1	3
		I & J	0.50	2	4
103	28	A & B	0.40	12	30
		E & F	0.32	18	56
		I & J	0.56	6	11
103	30	A & B	0.60	10	17
		E & F	0.48	31	65

Context	Trench	Test pit	Volume sieved (m^3)	Number of fragments	Number of fragments per m^3
138	27	A & B	0.24	67	279
		I & J	0.24	59	246
139	24	A & B	0.28	93	332
140	24	E & F	0.32	90	281
147	29	A & B	0.12	9	75
		E & F	0.10	36	360
148	24	A & B		67	
149	24	E & F	0.28	59	211
162	22	I & J	0.17	68	400
165	21	A & B	0.38	65	171
		E & F	0.38	122	321
		I & J	0.32	81	253
165	23	A & B	0.13	29	223
167	22	BDEF	0.56	79	141
168	22	BDEF	0.19	22	116
		I & J	0.16	34	213
195	21	A & B	0.24	40	166
		E & F	0.12	27	225
		I & J	0.28	24	86
195	23	A & B	0.24	52	217

Figure 1. Scatter plot of caprovid metacarpal proximal breadth (Bp) against proximal depth (Dp) for three medieval assemblages and modern Shetland specimens from Kingsgate, Berkhamsted.

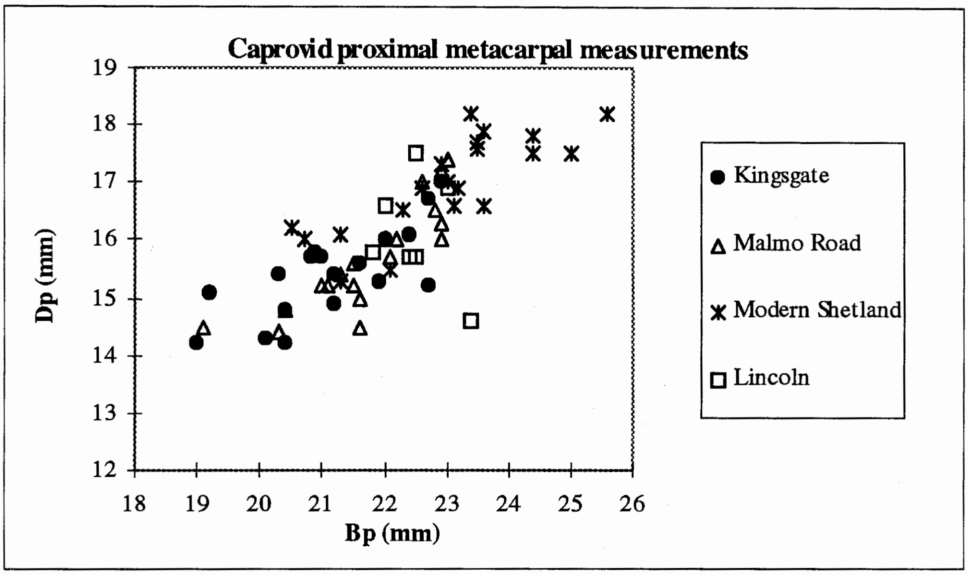


Figure 2.Scatter plot of caprovid tibia distal breadth (Bd) against distal depth (Dd) for three medieval assemblages and modern Shetland specimens from Kingsgate, Berkhamsted.

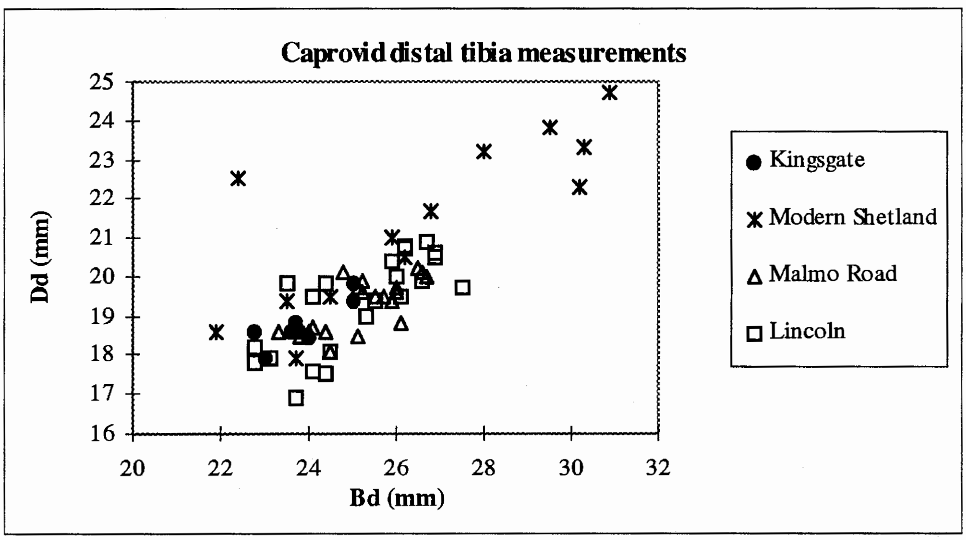
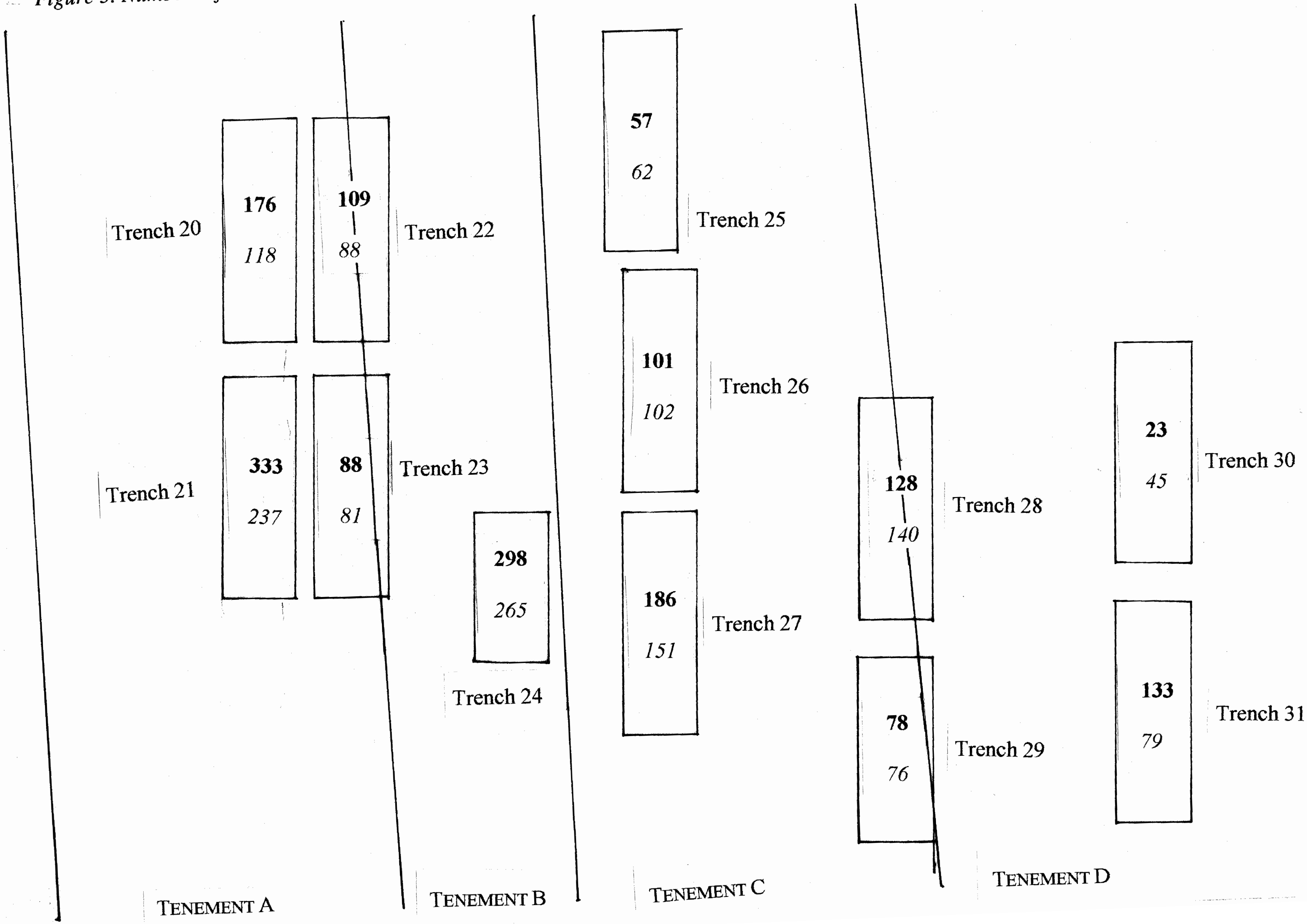


Figure 3. Numbers of meat-bearing (bold) and non meat-bearing (italics) fragments for Phases 2-5 from Kingsgate Berkamsted.



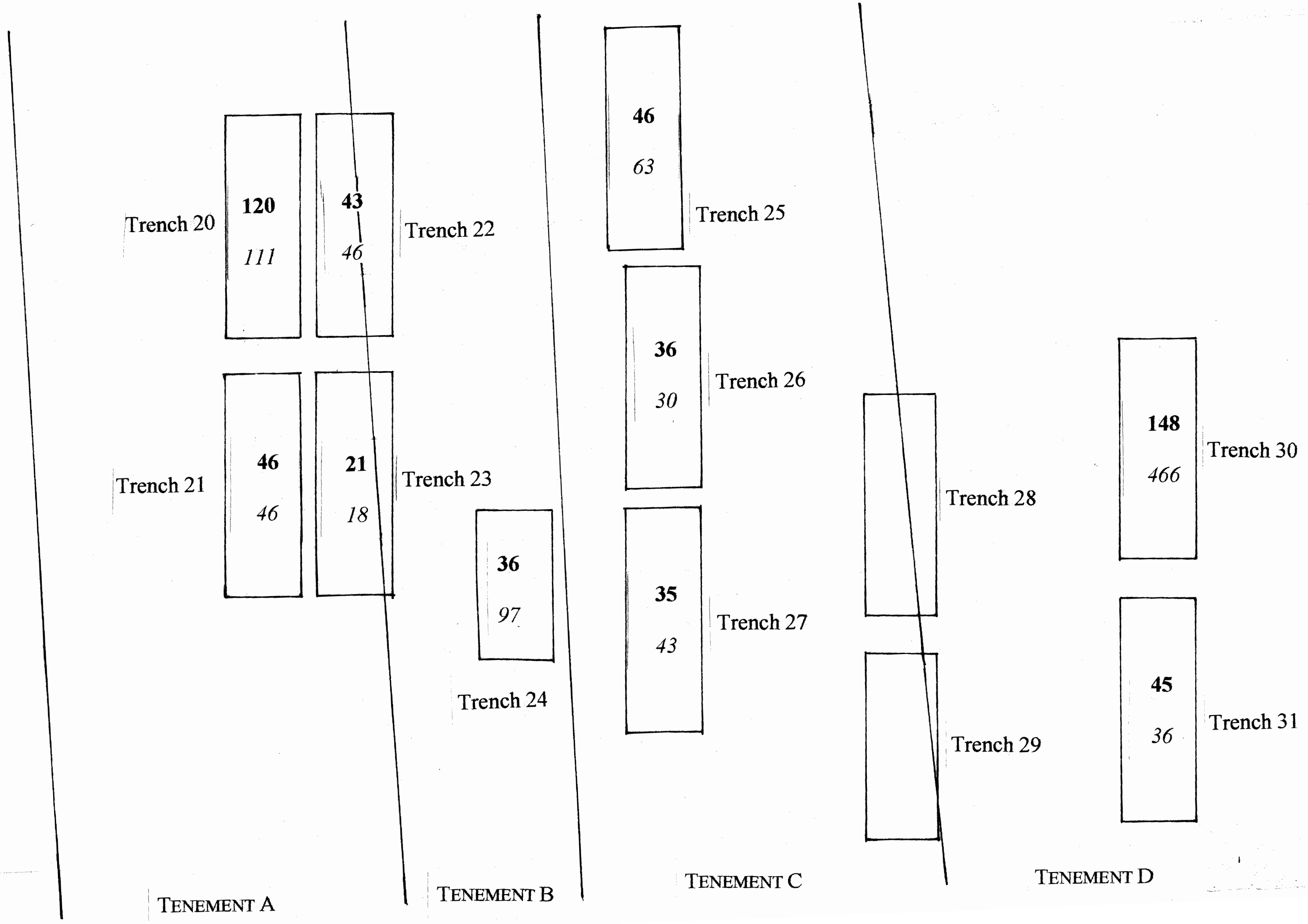


Figure 4. Numbers of meat-bearing (bold) and non meat-bearing (italics) fragments for Phase 6 from Kingsgate Berkamsted.

Figure 5. Numbers of fragments per cubic metre of deposit for Phases 2-5 from Kingsgate Berkamsted.
(dots represent areas of midden deposits)

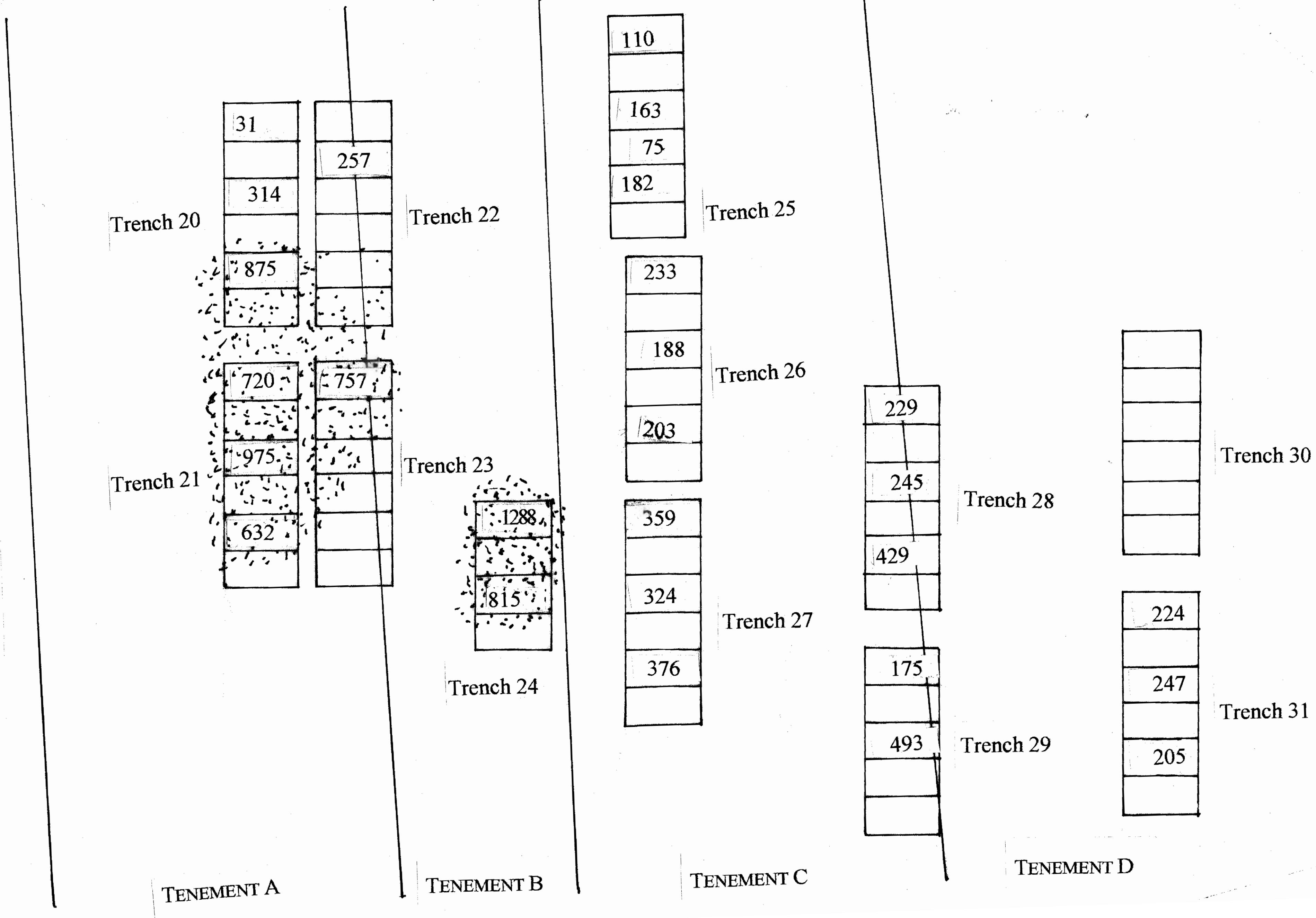
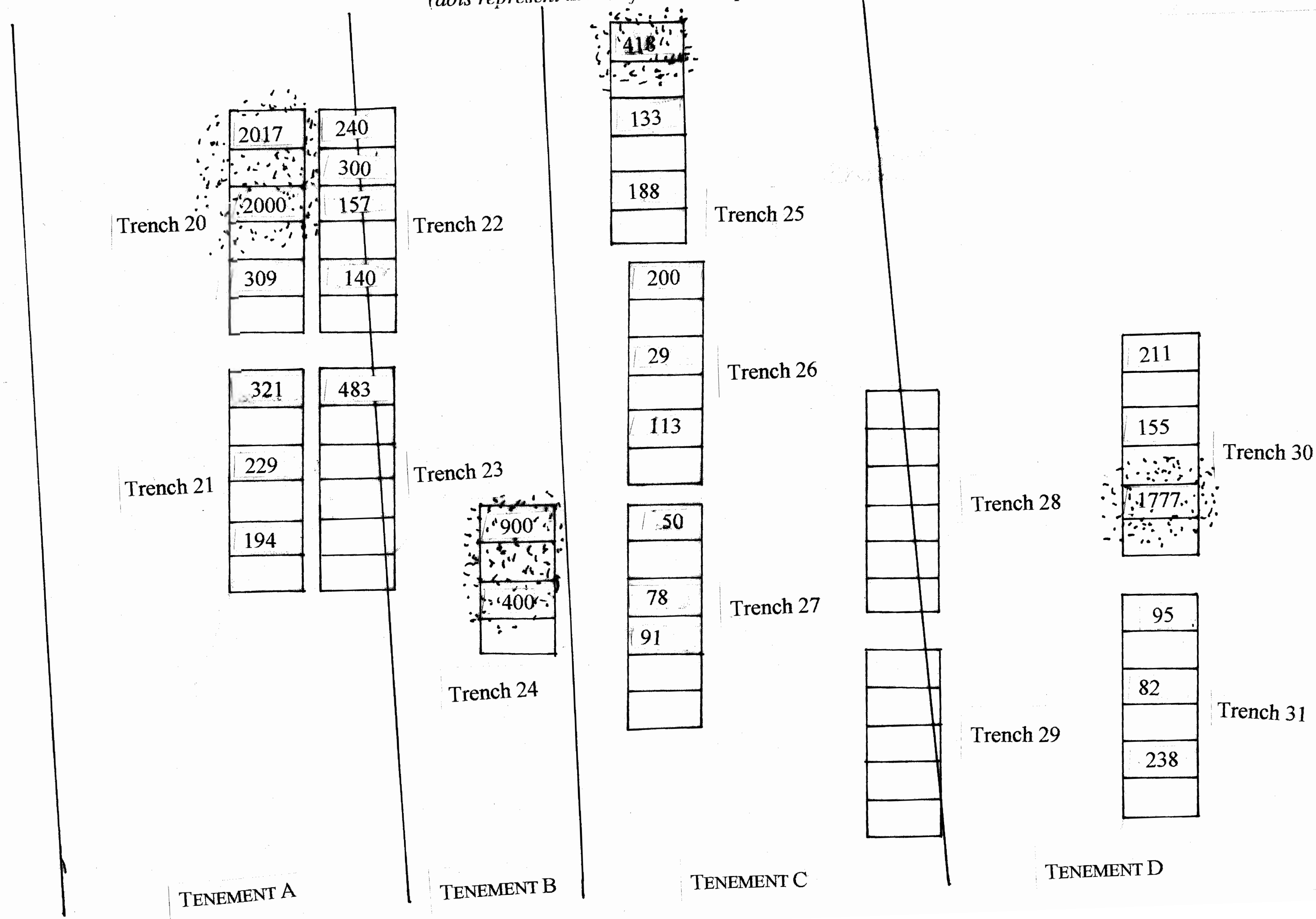


Figure 6. Numbers of fragments per cubic metre of deposit for Phase 6 from Kingsgate Berkamsted.
(dots represent areas of midden deposits)



Appendix.

Biometrical data from Kingsgate, Berkhamsted

Abbreviations after von den Driesch (1976) except as follows: HT - height of trochlea; HTC - diameter of trochlea at central constriction; Dem - diameter of external trochlea, medial condyle; Dvm - diameter of verticillus, medial condyle; Dim - diameter of internal trochlea, medial condyle; C and C + D after Boessneck (1969).

	Context	Test pit	Measurements			
Cattle						
Astragalus			*GLl*	*DL*	*Bd*	
	100	20J	(56.2)	31.7		
	101	28E	57.9		38.3	
	101	28I	66.0	37.4	44.1	
	138	27I	57.4	33.1	36.0	
Calcaneum			*GL*	*DS*	*C*	*C + D*
	101	26B	115.3	42.1	44.9	25.6
Femur			*Bd*			
	100	30A	82.4			
Horncore			*41*	*42*	*43*	*BC*
	100	24A	67.2	49.5		186
	100	24B	41.1	33.2	130	126
	100	27B	42.3	33.4		129
	100	27J	40.2	31		119
	101	28I	42.9	30.1	(116)	123
	101	28I	39.8	25.5		111
	101	28J	39.2	22.4	86	87
	101	29A	40.4	33.0		122.0
	147	29E	47.2	37.1		142.0
	195	21B	34.2	26.0		102.0
Humerus			*BT*	*HT*	*HTC*	
	100	30I	73.6		33.0	
	101	28E	(65.4)		28.9	
	101	28E	(65.4)			
	101	22B + F		38.8	38.8	

Metacarpal			*GL*	*Bp*	*Dp*	*SD*	*Bd*	*Dd*	*Dem*	*Dvm*	*Dim*
	100	30F					(54.3)	32.3	28.4	32.8	
	147	29B	(168.6)	47.2	28.6	24.6	49.7	26.2	19.0	26.2	24.5
	101	30J		53.0							
	165	21E		54.4	33.2						
	165	21I					57.7	29.4	22.9	27.7	29.1

Metatarsal			*GL*	*Bp*	*SD*	*Bd*	*Dd*	*Dem*	*Dvm*	*Dim*
	101	23B	199.3	39.5	20.2	43.4	26.5	18.3	25.5	24.3
	102	31F		42.1						
	138	27I		41.9						
	165	21E				55.9	28.7	21.5	28.5	28.1

Radius			*BFp*	*Bp*
	162	22	59.9	63.7

Scapula			*GLP*	*ASG*	*SLC*
	101	28E	53.4	39.6	39.4

Tibia			*SD*	*Bd*	*Dd*
	100	30A	27.6	64.2	50.5
	101	24F		52.7	
	101	29A		50.5	39.2

Caprovid

Astragalus			*GLl*	*DL*	*Bd*
goat	100	23B	29.8	16.1	19.4
sh/g	100	21B	23.8	12.9	15.8
sh/g	101	21J	25.4	14.2	16.6
sh/g	101	25E	27.0	15.3	17.2
sheep	100	22I	27.7	15.3	17.9

Calcaneum			*GL*	*DS*	*C*	*C + D*
sh/g	100	20J			10.2	18.7
sh/g	100	24B		19.7	12.4	
sh/g	100	30A		17.5		
sh/g	100	30J		17.6		
sh/g	101	23B		17.3	11.9	21.3
sh/g	101	24E	51.5	17.6	11.9	20.8
sh/g	101	26J	49.0	15.7	11.6	20.3
sh/g	101	28I		16.0	10.3	20.0
sh/g	167	22D + F	47.0	14.6	11.5	19.5

Horncore			*41*	*42*	*43*	*BC*
goat	100	30I	40.2	25.3		107.0

Humerus			*SD*	*BT*	*HT*	*HTC*
goat	101	24E	15.5	29.3	18.4	13.4
sh/g	100	20C		28.6	17.0	12.9
sh/g	101	20I		27.7	18.4	13.9
sh/g	101	23A		25.9	17.8	13.8
sh/g	101	29F		26.5		13.7
sh/g	101	31E	12.2		15.7	12.4
sh/g	138	27E	12.5	27.1	17.0	13.1
sh/g	138	27B		25.8	15.3	12.3
sh/g	165	21I		25.4	15.8	12.7
sh/g	167	22B + F	12.9		18.0	14.1
sh/g	195	21I	13.1	26.5		13.6
sheep	100	31I		26.6	16.8	13.1
sheep	101	24E		27.5	18.4	14.4
sheep	101	25J		25.5	15.9	12.5
sheep	148	24A		29.0	18.0	13.9
sheep	148	24A		28.7	18.2	14.2
sheep	148	24A		26.1	16.2	12.6
sheep	148	24A				

Metacarpal			GL	Bp	Dp	SD	Bd	Dd	Dem	Dvm	Dim
?goat	138	27J		23.7	17.3						
goat	101	31F					20.7		8.0	(11.3)	11.4
sh/g	100	20C					23.2	(14.2)	9.9	(13.9)	12.2
sh/g	100	25A					24.1	14.9	9.4	14.3	12.7
sh/g	100	25B					25.6	15.1	9.6	14.6	13.2
sh/g	100	25E		21.6	15.6	13.1					
sh/g	100	31A		22.9	17.0						
sh/g	101	21B		22.0	16.0	12.5					
sh/g	101	24A		21.0	15.7	22.9		(14.2)	9.7	14.2	12.6
sh/g	101	24F		21.2	14.9	12.0					
sh/g	101	24F		21.9	15.3						
sh/g	101	25J		19.0	14.2						
sh/g	101	26A		20.4	14.2						
sh/g	101	26A	115.5	20.4	14.8	11.7	20.4	14.4	10.0	14.4	12.3
sh/g	101	27E					24.4	15.8	11.3	15.7	13.9
sh/g	101	27E					22.9	14.8	9.9	14.8	12.6
sh/g	101	27E		21.2	15.4						
sh/g	101	28E		20.3	15.4						
sh/g	101	31B		20.8	15.7						
sh/g	101	31I		19.2	15.1	11.4					
sh/g	147	29E		20.1	14.3	11.4					
sh/g	138	27B					24.2	15.0	10.8	14.9	12.6
sh/g	138	27E		22.7	16.7	12.9					
sh/g	138	27I		22.7	15.2						
sh/g	167	22B + F					23.2	16.6	10.4	15.5	13.8

sh/g	168	22F		20.9	15.8						
sh/g	195	23B		22.4	16.1						
sheep	100						24.5	15.2	10.5	(14.8)	13.1
sheep	100	21B				12.9	23.1	14.7	10.1	14.5	12.9
sheep	101	24E					23.8	15.3	10.1	15.0	13.1
sheep	148	24A				12.0	21.9	14.7	9.7	14.7	12.4
sheep	148	24A					24.6	15.2	10.9	15.2	13.7

Metatarsal			*GL*	*Bp*	*SD*	*Bd*	*Dd*	*Dem*	*Dvm*	*Dim*
sh/g	100	27B		18.8	11.2					
sh/g	100	27F				20.4	(12.7)	8.2	12.7	11.4
sh/g	100	27J		17.9	9.5					
sh/g	100	30I		19.2	12.0					
sh/g	101	20E		17.6	10.4					
sh/g	101	23B		19.5	9.8					
sh/g	101	24A		20.7						
sh/g	101	27F				21.7	15.0	9.7	15.0	12.2
sh/g	101	27F				24.4	14.3	9.3	14.1	12.4
sh/g	101	27F				22.6	15.0	9.2	14.2	12.3
sh/g	101	27J		19.8						
sh/g	101	28A		18.2						
sh/g	101	29F		19.1	11.7					
sh/g	101	31E		18.6	10.0					
sh/g	103	28J		17.7	9.9					
sh/g	138	27J		17.6						
sh/g	139	24B		17.9						
sh/g	139	24B				22.3	13.6	8.7	13.6	11.7
sh/g	139	24B				21.5		9.6		

Radius			*BFp*	*Bp*	*SD*	*GL*
sh/g	100	22E	27.3	29.4		
sh/g	100	30A	30.5	33.4	18.6	
sh/g	100	30J	30.0	32.4		
sh/g	100	31J	27.6	30.4		
sh/g	101	21F	26.6	30.4		
sh/g	101	23B	27.4	29.5		
sh/g	101	24B	25.1	27.1		
sh/g	101	24F	(27.3)	29.6		
sh/g	102	31E	26.1	28.8	13.6	135.3

Scapula			*GLP*	*ASG*	*SLC*
sh/g	100	20C	28.4		
sh/g	101	28J	29.2	17.9	17.7
sh/g			30.7		
sh/g	138	27B	29.3	16.7	18.4
sh/g	167	22B + F	30.6	20.7	17.9

Tibia			*SD*	*Bd*	*Dd*
sh/g	101	21E		22.8	18.6
sh/g		25E		23.8	18.6
sh/g		25F		25.0	19.4
sh/g		26I		25.0	19.8
sh/g		28E		23.0	17.9
sh/g		31B		23.7	18.8
sh/g	148	24A	10.5	23.6	18.6
sheep	100	22F	10.3	24.0	18.4

Pig

Astragalus			*GLl*	*GLm*
	101	26I	38.1	37.3

Calcaneum			*DS*	*C*
	139	24B	18.5	14.7

Scapula			*GLP*	*SLC*
	147	29F	33.7	21.6

Deer

Metacarpal			*GL*	*SD*	*Bp*	*Dp*
red			256.9	21.7	40.5	30.6

Tibia			*SD*	*Bd*	*Dd*
fallow			15.1	30.9	26.5

Horse

Femur			*GL*	*GLC*	*SD*	*Bd*
	103	30E	380.0	329.0	40.3	95.0

Humerus			*SD*	*BT*	*HT*	*HTC*
	100	30I		81.1	56.9	38.0
	101	28E	36.7	74.5	53.8	37.9

Metacarpal			*GL*	*Ll*	*SD*	*Bp*	*Dp*	*Bd*	*Dd*
	100	24A				47.4	29.9		
	103	30B	229.8	221.0	36.8	51.0	35.6	49.2	36.6
	103	30E	224.8	216.5	33.6	50.3	34.0	50.5	38.7

Metatarsal			*GL*	*Ll*	*SD*	*Bp*	*Bd*	*Dd*
	100	30E			28.8		48.1	38.1
	102	28F			31.7		48.8	37.1

Phalanx 1			*GL*	*SD*	*Bd*	*Dd*
	100	30I	77.6	31.6	42.9	24.0

Radius			*GL*	*Ll*	*BFp*	*Bp*	*SD*
	103	30B	353.0	327.0	77.0	84.0	40.8
	103	30F	341.0	229.0	75.1	83.1	39.4

Scapula			*GLP*	*SLC*	*BG*
	103	30B	93.9	66.0	50.7
	103	30E	93.5	55.1	48.1

Bird

carpometacarpus			*GL*	*Bp*	*Did*	*Did*
fowl	101	24F		13		646.0
fowl	138	27A	34.1	9.8	7.0	961.0
fowl	140	24F	38.2	11.8	8.5	1021.0
fowl	101	26A	38.7	11.6	7.9	689.0

femur			*SC*	*Bd*	*Dd*	*Bp*	*Dp*
fowl	101	29F	6.4	13.5	16.4		
fowl	101	28E	6.5	14.0	10.8		
fowl	100	30E	7.9	16.9	15.1		
goose	101	24F				20.1	12.4

Humerus			*Bp*	*Bd*	*SC*
fowl	202	20B	17.4		
fowl	101	26A		13.1	6.4

Tarsometatarsus			*GL*	*SC*	*Bp*	*Bd*
fowl	138	27E	65.0	5.7	11.6	11.8
fowl	165	23A		6.9	14.9	13.7

Tibiotarsus			*SC*	*Dip*	*Bd*	*Dd*
fowl	100	30E	7.3		12.5	13.7
fowl	149	24F			11.2	12.2
fowl	165	21J		15.1		
fowl	165	23A	4.9	17.4		