ANIMAL EXPLOITATION AT KÖRTIK TEPE : AN EARLY ACERAMIC NEOLITHIC SITE IN SOUTHEASTERN TURKEY

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Abstract : *In this paper the first results describing animal exploitation at the early Aceramic Neolithic site of Körtik Tepe, Batman, southeastern Turkey, are presented. The site is characterized by the intensive exploitation of sheep as well as that of red deer, cattle, gazelle, fallow deer, and pig. Metrical data indicate that sheep, the dominant taxa at the site, were morphologically wild and that both rams and ewes were well represented in the adult population. Age data indicate a kill-off focused on individuals between the ages of 1-3 years, which is interpreted to represent the hunting of juvenile rich female herds as well as bachelor herds of rams. This pattern of exploiting primarily young sheep is similar to patterns documented at sites including Hallan Çemi and Cafer and may be a precursor to strategies of herd management in the region. Metrical data for cattle indicate the presence of large, morphologically wild cattle in the upper Tigris basin in the 10th millennium cal. BC. The faunal remains from Körtik provide valuable information describing the mosaic nature of animal exploitation strategies in southeastern Turkey in the period just prior to the domestication of food animals.*

Résumé : *Sont présentés ici les premiers résultats relatifs à l'exploitation des animaux à Körtik Tepe, Batman, site néolithique acéramique du Sud-Est de la Turquie. Elle est caractérisée par une exploitation intensive des moutons, des bœufs, des gazelles, des cerfs et des daims (*Cervus elaphus *et* Dama *sp.) ainsi que des porcs. Les données métriques montrent que les moutons sont sauvages sur le plan morphologique et que mâles et femelles sont bien représentés dans la population adulte. L'âge des restes recueillis atteste d'une mortalité précoce se situant en général entre 1 et 3 ans (80 %) ; ce que nous pouvons interpréter comme une chasse privilégiant les troupeaux formés de jeunes femelles tout comme ceux composés de jeunes mâles. Ce modèle d'exploitation d'une population jeune est attesté également à Hallan Çemi et à Cafer, et paraît annoncer les stratégies de gestion des troupeaux retenues par la suite dans la région. Dans le bassin supérieur du Tigre, les données métriques concernant les bœufs montrent la présence au 10e millénaire cal. BC de bovins morphologiquement sauvages. Les restes fauniques recueillis à Körtik Tepe donnent donc une bonne image de la diversité des stratégies d'exploitation des animaux au Sud-Est de la Turquie précédant la domestication du bétail.*

Key-Words : *Aceramic Neolithic, Turkey, Animal exploitation, Metrical data, Kill-off,* Ovis, Capra, Bos, Cervus.
Mots Clefs : *Néolithique précéramique, Turquie, Exploitation animale, Données métriques, Âge d'abattage,* Ovis, Capra, Bos, Cervus.

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Recent research has provided valuable information concerning the nature of cultural adaptations during and immediately following the period of the Younger Dryas in southeastern Turkey. Data from sites such as Hallan Çemi[1], Demirköy[2], Çayönü Tepesi[3], and Göbekli Tepe[4] as well as sites such as Nemrik 9[5], Qermez Dere[6], and M'lefaat[7] in Northern Iraq have shown that cultural adaptations in the Taurus-Zagros arc during this period were more complex than had previously been imagined in terms of both social and economic organization.

Although the economic organization of these early communities is only beginning to be understood, studies of faunal and botanical remains from these sites are providing information concerning the nature of subsistence activities in this period just prior to the advent of widespread cultivation of plants and the domestication of food animals. In particular, new and recent faunal data from Hallan Çemi[8], the early phases at Çayönü Tepesi[9], and Göbekli Tepe[10] are showing that the systems of animal exploitation in the region were highly variable and dynamic and seem to represent a mosaic of exploitation strategies focused on different combinations of resources[11]. These data, together with trends from plant remains from across the Near East, indicate that subsistence strategies in this period were extremely varied and represent a multitude of experiments prior to the development of a more standard Near Eastern agro-pastoral system in later periods[12]. Understanding the organization and evolution of these early subsistence systems is crucial for our understanding of the nature of post-Pleistocene adaptations in southeastern Turkey and the greater Near East and the development of the agro-pastoral economy.

In this paper the first results from the analysis of fauna from Körtik Tepe are described and interpreted in a regional context. Although only a relatively small sample has been analyzed, the main objective of this paper is to disseminate the primary data describing the patterns of animal exploitation at the site during this crucial and poorly known period at the beginning of the Aceramic Neolithic in southeastern Turkey. To this end, the vertebrate fauna from Körtik are presented and comparisons are made with the relevant archaeofaunal assemblages in the region, particularly Hallan Çemi and Çayönü Tepesi.

THE SITE

Körtik Tepe is a small mound, approximately 0.5 hectares in area, located 14 km southwest of the city of Batman in southeastern Turkey (fig. 1). It is situated in the dissected foothills south of the Taurus mountains. The site is located just west of the Batman Çayı near its confluence with the Tigris River. This area forms an expanse of what is currently relatively flat, treeless terrain that extends to the north and northeast across the wide Batman floodplain and connects with the Raman plain on which the town of Batman is located. Two other important early Aceramic Neolithic sites, Hallan Çemi and Demirköy, are also located along the Batman drainage approximately 60 and 20 km north of Körtik respectively[13].

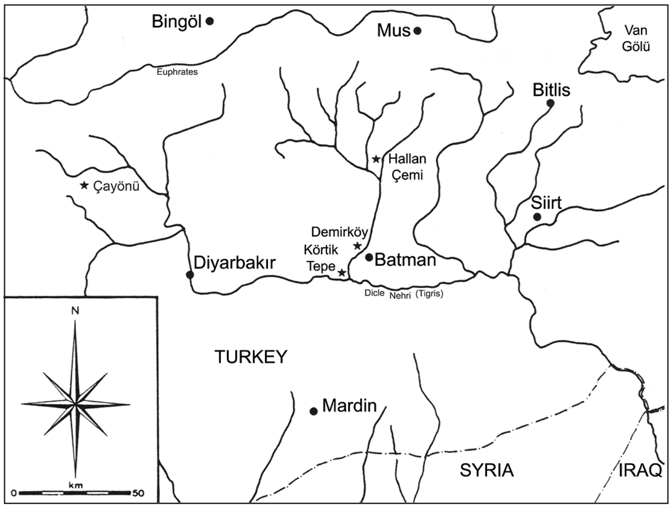

Fig. 1 : *Map showing the location of Körtik Tepe and other sites mentioned in the text (Rosenberg, 1994 : 133).*

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[1] Redding and Rosenberg, 1998 ; Rosenberg *et al.*, 1998 ; Rosenberg, 1994, 1999 ; Rosenberg and Davis, 1992 ; Rosenberg *et al.*, 1995.

[2] Rosenberg and Peasnall, 1998.

[3] Hongo *et al.*, 2004 ; Hongo and Meadow, 1998, 2000 ; Hongo *et al.*, 2002 ; Özdoğan, 1999 ; Özdoğan and Özdoğan, 1989.

[4] Schmidt, 2000, 2001 ; von den Driesch and Peters, 1999.

[5] Kozlowski, 1989, 1992 ; Lasota-Moskalewska, 1994.

[6] Watkins *et al.*, 1989.

[7] Kozlowski, 1996 ; Turnbull, 1983.

[8] Redding and Rosenberg, 1998 ; Rosenberg *et al.*, 1995, 1998.

[9] Ervynck *et al.*, 2001 ; Hongo *et al.*, 2004 ; Hongo and Meadow, 1998, 2000 ; Hongo *et al.*, 2002 ; Ilgezdi, 2000 ; Öksüz, 2000.

[10] Peters *et al.*, 1999 ; von den Driesch and Peters, 1999.

[11] Redding, 2005.

[12] Redding, 2005 ; Rosenberg *et al.*, 1998 ; Rosenberg, 1999 ; Weiss *et al.*, 2006.

[13] Algaze *et al.*, 2001.

To the west of the site, dissected foothills drained by north-south flowing rivers extend along the course of the Tigris. The early Neolithic site of Çayönü Tepesi is located along one of these western tributaries approximately 100 km NNW of Körtik. Directly to the east of the site, across the Batman Çayı and along the Tigris, the landscape consists of a more rugged, dissected plateau, and the course of the Tigris is restricted in this area to rocky canyons. To the north, this plateau is bordered by the rugged Raman Dagı. To the south is more rugged upland, which eventually drops down to the Mesopotamian plain near the city of Mardin.

The location of Körtik Tepe provides easy access to a variety of environmental and ecological zones. These include open grasslands in the area surrounding Batman and along parts of the Batman Çayı floodplain, open oak forest in the hills, riverine forest, and to the north and east more rugged mountainous terrain. Although there are few data from which to make detailed reconstructions of local environmental conditions, paleobotanical studies have indicated the presence of oak forests in the vicinity even during the Younger Dryas[14]. The region currently receives sufficient precipitation to support rainfall agriculture.

Excavations in 2000-2002 carried out by a team from Dicle University directed by V. Özkaya in cooperation with the Diyarbakır Museum revealed the remains of an early Aceramic Neolithic occupation just below the surface of the mound[15]. Cross-dating of chipped and ground stone with other sites in the region suggests the chronological placement of Körtik roughly at the beginning of the 10th millennium BP (end of the 10th millennium cal. BC). Körtik appears to fill the gap following Hallan Çemi and Demirköy at the end of the 11th and beginning of the 10th millennium BP, but pre-dating or overlapping with the early phases at Çayönü, although its precise location within this period is still an open question[16] (table 1).

Two radiocarbon determinations made on collagen derived from animal bone from the site provide dates of 8,370 ± 40 BP (7,440 ± 63 cal. BC) (Beta-178 241) and 9,870 ± 40 BP (9,290 ± 25 cal. BC) (Beta-178 242). The first date appears to be too late, as no artifacts or features characteristic of a later Aceramic occupation have been identified. The second date is thought to be more accurate and representative of an early 10th millennium BP occupation at Körtik.

Table 1 : *Approximate dating of early Neolithic sites in southeastern Turkey discussed in the text (HONGO* et al.*, 2004 ; ROSENBERG and PEASNALL, 1998 ; ROSENBERG* et al.*, 1995).*

Site	Cultural designation	Approximate date (radiocarbon years BP)
Hallan Çemi	Terminal Pleistocene	10 200 BP
Demirköy	Terminal Pleistocene	10 000 BP
Körtik Tepe	PPNA	9 900 BP
Çayönü Tepesi – Round phase	PPNA	10 000 – 9 600 BP
Çayönü Tepesi – Grill phase	Early PPNB	9 600 – 9 200 BP
Çayönü Tepesi – Channelled phase	Middle PPNB	9 200 BP

Although the stratigraphy and the exact nature of the occupation are not yet worked out in detail, three seasons of excavation have revealed architectural remains, including house floors and walls, circular paved stone features similar to those at Hallan Çemi, and intramural burials[17]. Some burials contain rich assemblages of grave-goods including hundreds of shell and bone beads, a variety of obsidian and flint tools, as well as ground stone implements including “mace-heads” and carved stone bowls, some of which are decorated in relief with geometric and animal motifs and have clear parallels with similar objects from Hallan Çemi, Demirköy, and the early levels of Çayönü[18] (fig. 2, 3 and 4).

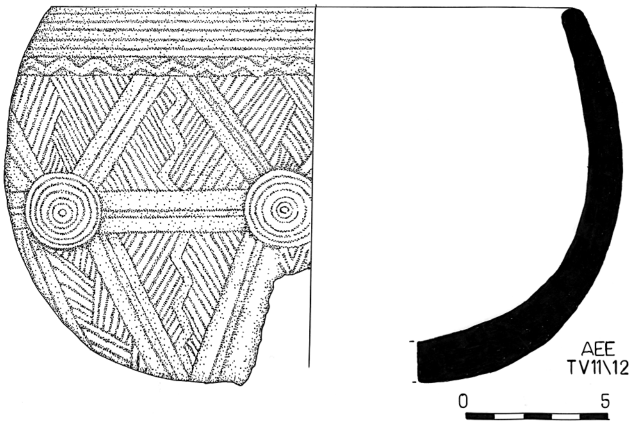

Fig. 2 : *Carved stone bowl from Körtik Tepe.*

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[14] ROSENBERG *et al.*, 1998.

[15] ÖZKAYA, 2003 ; ÖZKAYA *et al.*, 2002a, 2002b ; ÖZKAYA and SAN, 2001.

[16] ÖZKAYA *et al.*, 2002a, 2002b ; ÖZKAYA and SAN, 2001.

[17] ÖZKAYA, 2003.

[18] ÖZDOĞAN, 1999 ; ÖZKAYA, 2003 ; ÖZKAYA and SAN, 2001 ; ROSENBERG and DAVIS, 1992 ; ROSENBERG and PEASNALL, 1998.

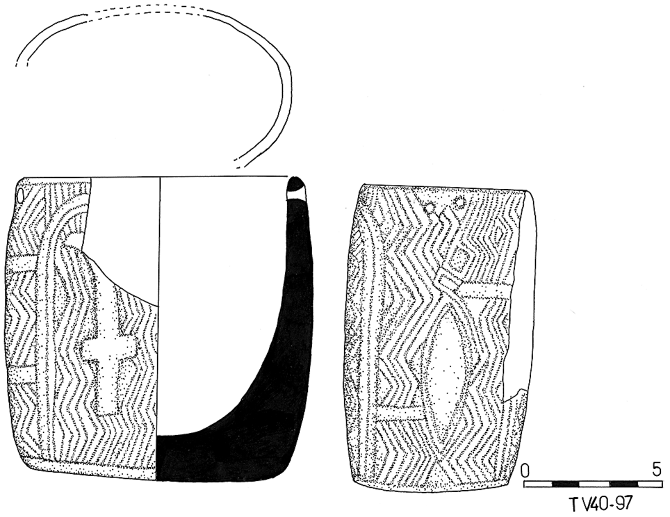

Fig. 3 : *Carved stone bowl from Körtik Tepe.*

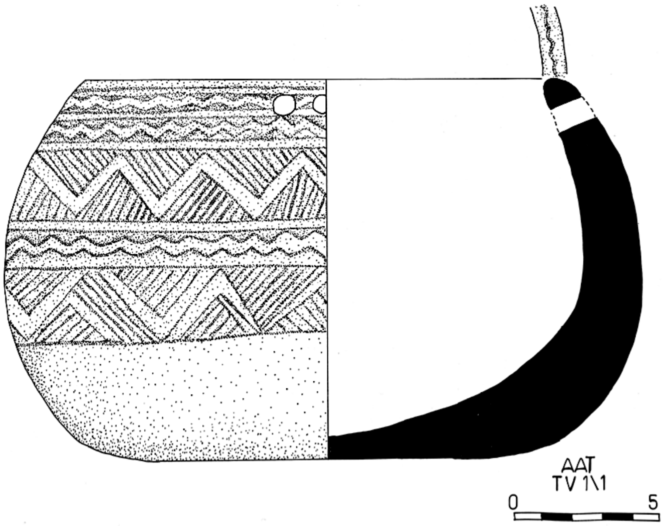

Fig. 4 : *Carved stone bowl from Körtik Tepe.*

METHODS

Faunal remains were initially examined in the field in Batman in 2001. Subsequently a sample of approximately 13 kilograms of bone was sent to the Zooarchaeology Laboratory, Peabody Museum, Harvard University, for more detailed analysis.

Specimens were gently washed in water and dried in the shade. Specimen weight was recorded to the nearest 0.1 gram and measurements were taken using 120 mm digital calipers to the nearest 0.1 mm. Larger specimens were measured on a measuring box to the nearest millimeter. Measurements were taken following von den Driesch[19] and also Davis[20].

The following information was recorded for each specimen following a protocol based on a modified version of *Bonecode*[21] : context information including unit, depth, and context type when applicable, skeletal element, taxonomic identification, certainty of identification, symmetry, skeletal part description, fracture size and origin of fracture, state of epiphyseal fusion, sex, evidence for modification, burning, and pathologies, weight, and biometrics. Although context information was recorded for each specimen, due to the preliminary nature of research at Körtik, all materials assignable to the Aceramic levels are treated here as one unit.

Screening was not used in the recovery of the animal remains. As a result, it is expected that the assemblage is biased in regard to the representation of small taxa and small skeletal elements such as carpals/tarsals and phalanges[22]. This has an obvious impact on the questions that can be addressed with this assemblage and precludes detailed analysis of skeletal part frequencies and the exploitation of small mammals, most birds, fishes, amphibians, and reptiles[23]. However, the relative proportion of large and medium taxa are probably relatively representative, as these taxa tend to be less affected by screening biases if hand-picking is done carefully[24].

THE FAUNAL ASSEMBLAGE

The most likely interpretation of the Körtik Tepe faunal assemblage is that it represents primarily consumption remains, as most specimens show evidence for intentional fragmentation, and cutmarks and burning are also present. Although the bulk of the assemblage appears to represent consumption remains, some of the remains represent behaviors not directly related to consumption and subsistence. A partial skeleton of a yearling sheep was identified in context AVD. These remains probably represent the intentional internment of a complete carcass, parts of which were subsequently lost as a result of later disturbance. As a result of the special nature

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[19] VON DEN DRIESCH, 1976.

[20] DAVIS, 1996.

[21] MEADOW, 1978.

[22] CASTEEL, 1972 ; CLASON and PRUMMEL, 1977 ; MEADOW, 1980 ; PAYNE, 1972 ; SHAFFER, 1992.

[23] CASTEEL, 1972 ; MEADOW, 1980.

[24] MEADOW, 1980.

of this deposit these remains are not included in the presentation of species frequencies and survivorship curves in the following sections. In addition, abundant bird remains in the assemblage, which include high frequencies of wing elements, may be related to the use of feathers for ornamentation rather than strictly representing the remains of past meals.

Burning was noted on approximately 3 % of specimens, although in some cases dark staining of the bones made identification of burning difficult. Evidence for carnivore and rodent modification was identified on less than 1 % of specimens. In addition, specimens in some contexts were encrusted in mineral deposits that made identification and measurement difficult.

As a general measure of exposure of the assemblage to taphonomic factors such as carnivore gnawing, abrasion, etc., an index of completeness for carpals, tarsals, and other small "blocky" bones was calculated. Based on a modified version of the tarsal completeness index used by Marean[25], the completeness of tarsals, carpals, petrosal, and second phalanges was recorded on a 1-5 scale, with 1 representing 0-25 % complete, 2 = 25-50 %, 3 = 50-75%, 4 = 75-99% and 5 representing a complete specimen. Since these elements are relatively small and do not contain much, if any, nutritional value it has been argued that they are generally not subject to regular damage during carcass processing. Damage to these small elements is likely to reflect natural transformation factors such as dog gnawing, abrasion, and chemical weathering within the soil rather than cultural factors such as butchery. The average value calculated for 18 medium mammal specimens is 4.06, indicating that most of the specimens that were recovered and analyzed were quite complete. This suggests, although provisionally, that natural transformation factors such as those mentioned above did not have a strong impact on the composition of the assemblage. The effects of anthropogenic transformation factors, especially carcass processing, on the composition of the assemblage have not been addressed in detail and must be dealt with in future work at the site.

THE MAMMAL REMAINS

Frequency of taxa

The relative frequency of taxa calculated based on NISP (number of identified specimens), diagnostic zones, and bone weight are presented in table 2. Based on NISP, caprines are the most common identified taxa, with sheep outnumbering goats 14:1. Caprines are followed in abundance by red deer, cattle, pig, fallow deer, gazelle, hare, and canids (including dog/wolf and fox). The remains of birds are fairly common in the assemblage (11.4 % based on NISP), and fishes, although likely severely under-represented due to recovery techniques, are present as well.

In addition to NISP, relative frequency was also calculated using diagnostic zones. Using this method[26] highly identifiable portions of elements are assigned a diagnostic zone if more than 50 % of that zone is present. In order to correct for differences in the skeletal composition of different taxa, diagnostic zones are not assigned to elements such as horncores, antlers, clavicles, or peripheral metapodials and phalanges.

The relative frequencies of mammals identified to genus based on diagnostic zones are presented in table 3. Based on those specimens identified to genus, caprines make up 41.5 % of the assemblage, followed by red deer at 28.8 %, and cattle at 17.9 %. Pigs represent 5.7 % of the assemblage and gazelle, fallow deer, hare, and carnivores each make up 2.4 % or less respectively. Based on the entire assemblage, birds represent a sizable 18.4 % of the specimens with diagnostic zones (table 2).

Relative frequencies were also calculated based on bone weight (table 2). This method has often been used as a rough proxy for the importance of taxa in terms of the contribution of meat to the diet[27]. Quantification of bone weight indicates that large mammals, including red deer and cattle, make up more than two thirds of the weight of the assemblage, while medium mammals, primarily sheep, make up about 22 %.

Below, specific taxa are described in order of abundance based on diagnostic zones.

*Sheep (*Ovis orientalis*) and goat (*Capra aegagrus*)*

Caprines are the most common taxa at Körtik Tepe representing 42.7 % of specimens identified to genus based on NISP and 41.5 % based on diagnostic zones. Sheep outnumber goats 14:1. Wild sheep and goat inhabited much of the Taurus-Zagros arc throughout most of the Holocene, and the location of Körtik in the southern foothills of the Taurus mountains is ideal sheep habitat[28]. Goats would have probably

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[25] Marean, 1991.

[26] Watson, 1979.

[27] Buitenhuis, 1985 ; Davis, 1987 ; Uerpmann, 1973 ; Zeder, 1998.

[28] Uerpmann, 1987.

Table 2 : *Relative frequency of taxa calculated using NISP, diagnostic zones, and bone weight.*

Taxa	NISP	%	DZ	%	Weight (g)	%
Unidentified	110	8.7	0	0.0	113.9	< 1.0
Very small mammal	5	< 1.0	2	< 1.0	0.9	< 1.0
Small mammal	230	18.1	1	< 1.0	291.0	2.3
Medium mammal	261	20.6	2	< 1.0	1,349.7	10.8
Large mammal	246	19.4	3	< 1.0	3,964.2	31.8
Medium artiodactyl	25	2.0	20	6.2	226.5	1.8
Large artiodactyl	23	1.8	22	6.9	411.5	3.3
Ovis/Capra	*46	3.6	*38	11.8	*531.4	4.3
Ovis orientalis	**42	3.3	**47	14.6	**573.5	4.6
Capra aegagrus	3	< 1.0	3	< 1.0	42.1	< 1.0
Gazella	4	< 1.0	5	1.6	20.5	< 1.0
Bos primigenius	36	2.8	38	11.8	1,940.0	15.5
Dama	4	< 1.0	2	< 1.0	59.3	< 1.0
Cervus	62	4.9	61	19	2,553.3	20.5
Sus	10	< 1.0	12	3.7	184.1	1.5
Canis sp.	1	< 1.0	1	< 1.0	29.3	< 1.0
Vulpes sp.	2	< 1.0	2	< 1.0	3.3	< 1.0
Lepus sp.	3	< 1.0	3	< 1.0	7.9	< 1.0
Bird	145	11.4	59	18.4	176.4	1.4
Fish	***11	< 1.0	–	–	10	< 1.0
Total	**1,269**	**100.0**	**321**	**100.0**	**12,479.8**	**100.0**

* Does not include 27 specimens including 13 DZs weighing 119.1 grams from context AVD.
** Does not include 5 specimens including 5 DZs weighing 36.0 grams from context AVD.
*** Does not include 26 vertebrae recovered from a burial.

Table 3 : *Relative frequency of mammals identified to genus from Körtik Tepe, Hallan Çemi, and the Round and Grill phases at Çayönü. Hallan Çemi data are from* Rosenberg et al., *1998 (sample size not reported) ; Çayönü data are based on specimens identified to genus from* Hongo *and* Meadow, *2000 : table 4a. Data for Körtik do not include 32 specimens of sheep and sheep/goat representing 18 DZs from a partial articulating carcass from context AVD.*

Taxa	Körtik Tepe DZ (n = 212) %	Körtik Tepe NISP (n = 213) %	Hallan Çemi %	Çayönü Round Phase (PPNA) (n = 457) %	Çayönü Grill Phase (EPPNB) (n = 335) %
Ovis/Capra	41.5	42.7	42.0	7.6	13.4
Cervus	28.8	29.1	25.0	8.1	6.6
Bos	17.9	16.9	< 1.0	29.8	17.0
Sus	5.7	4.7	17.0	50.1	55.2
Gazella	2.4	1.9	0.0	1.5	1.8
Dama	< 1.0	1.9	2.0	< 1.0	< 1.0
Other mammals	2.8	2.8	14.0	2.4	5.4
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

been available in the more rugged highland areas to the east of the site, although they may have also been present in the dissected uplands to the west and north of the Batman river.

Skeletal parts identified as caprine, sheep and goat are presented in table 4. All parts of the caprine skeleton are present although teeth, carpals, and phalanges – particularly third phalanges – are poorly represented, likely as a result of recovery methods.

The size of the caprines from Körtik were compared with those from other sites in the region using the LSI method[29] in which log transformed measurements are compared with those from a standard animal, in this case a female *Ovis orientalis* from Iran, and the averaged measurements of male and female *Capra aegagrus* from the Taurus mountains[30]. Although there are some potential problems with using animals from a different region as the standard[31], these standard animals are widely used in the literature and are used here to aid comparison with previous and future studies. In figure 5, mean and one standard deviation ranges are presented for LSI values for sheep from Körtik Tepe and six other Aceramic sites in the region. The Körtik results are based on a sample of 45 measurements that correspond to those measurements presented by Uerpmann[32] for the standard animal (see Appendix for measurements).

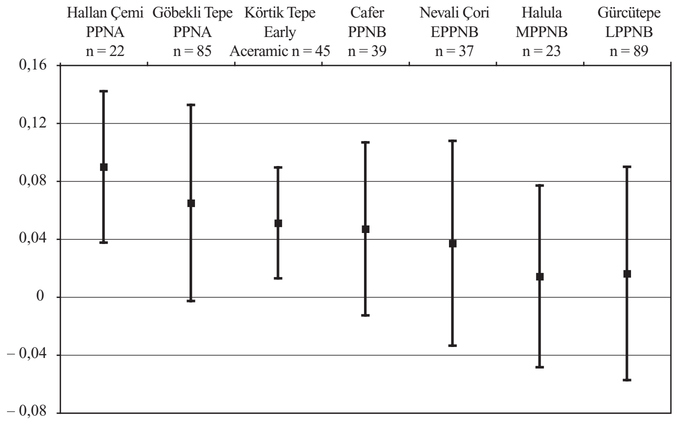

Fig. 5 : *Mean and one standard deviation ranges of LSI values for sheep size from sites in southeastern Turkey (*Peters *et al., 1999 : 36). Hallan Çemi data taken by the author and used with the permission of M. Rosenberg and R. Redding.*

This figure shows that the sheep from Körtik are comparable in size to other early Holocene populations in southeastern Turkey. Although the LSI mean for Körtik is less than that from a small sample taken by the author from Hallan Çemi and slightly less than that from PPNA Göbekli, it is still well within the one standard deviation range of sheep from those sites. In addition, the mean LSI value for Körtik sheep is larger than that from slightly later Aceramic period sites in the Euphrates drainage including Cafer, Nevalı Çori, Halula, and Gürcütepe II.

A histogram showing the distribution of LSI values for fused and unfused skeletal parts for combined sheep and sheep/goat is presented in figure 6[33]. The LSI is used here for this purpose since the small size of the sample of measurable specimens precludes comparison of the size of individual fused and unfused skeletal parts, which would be the preferred method. Comparison of the size of fused and unfused specimens can provide important insights into the nature of animal exploitation strategies, particularly in regards to differences in the age of the kill-off of males and females[34]. The unfused specimens used in this figure primarily consist of later fusing skeletal parts, including the distal tibia, distal metapodials, distal radius, and calcaneum, and one early fusing element, the scapula, which exhibits the smallest LSI value in figure 6. Later fusing skeletal parts are the most likely to reflect size differences between males and females, while unfused early fusing specimens tend to be small in both males and females.

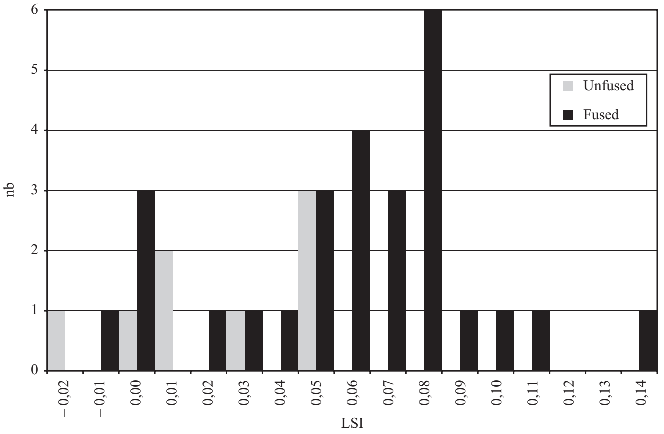

Fig. 6 : *Histogram showing the distribution of LSI values for fused and unfused specimens of sheep and sheep/goat from Körtik.*

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[29] Meadow, 1981, 1983, 1999.

[30] Uerpmann and Uerpmann, 1994.

[31] Meadow, 1999 ; Zeder, 2001.

[32] Uerpmann and Uerpmann, 1994.

[33] The measurements used in this figure are indicated in Appendix A with a $.

[34] Arbuckle, 2006 ; Hesse, 1978 ; Zeder and Hesse, 2000.

Table 4 : *List of identified taxa and skeletal elements ; 32 sheep and sheep/goat specimens from context AVD have been omitted from this table (see text).*

	Rodent	**Small mammal**	**Med mammal**	**Large mammal**	**Med Artiodactyl**	**Large Artiodactyl**	***Ovis/Capra***	***Ovis***	***Capra***	***Gazella***	***Bos***	***Dama***	***Cervus***	***Sus***	***Canis***	***Vulpes***	***Lepus***	**Bird**	**Fish**
Skull frag			4		1		0												
Mandible							1				2		2			1			
Horncore							8	1											
Antler												2	3						
Vertebrae		1	71	42														2	
Atlas							1				1								
Axis								1					1						
Rib		1	58	31														1	
Scapula				2	6	1	1	3			3	1	7	2				2	
Coracoid																		17	
Clavicle																		4	
Humerus				2	2	1	4	4	1		2		3	1	1			21	
Radius	1				2	3	3	4			1		1	1				2	
Ulna				1		3					2		1	2			1	4	
Carpal																			
Metacarpal					1	3	5	2		1	2	1	5						
Carpo-metacarpus																		4	
Pelvis					2	1	3			1	3							1	
Femur		1			4	1	4			1						1	2	5	
Tibia	1		1		2	2	2	4			1		4	2					
Tibio-tarsus																		5	
Astragalus					2		4	4	2		1		9						
Calcaneum								6			2		1						
c+4 tarsal						1	1				1		3						
Metatarsal						1	1	6					4						
Tarso-metatarsus																		4	
Distal sesamoid											1								
Metapodial						1		1					3	1					
Phalanx 1					1		5	2			6		4						
Phalanx 2					2	4	1	2		1	4		5	1					
Phalanx 3						1		2			3		2						
Loose tooth							1				4		1						
Tooth fragment							1												
Long bone fragment	3	27	127	168														48	
Unidentified		200																25	11
Total	**5**	**230**	**261**	**246**	**25**	**23**	**46**	**42**	**3**	**4**	**39**	**4**	**59**	**10**	**1**	**2**	**3**	**145**	**11**

Figure 6 shows that the distribution of LSI values for fused specimens is skewed to the right with a modal value well above the standard animal. The unfused specimens, however, are much smaller and cluster around the standard animal on the left side of the graph. Although sheep exhibit less sexual dimorphism than goats, it can be suggested that the larger measurements from fused specimens, particularly those above 0.07 on the LSI scale, primarily represent rams whereas the smaller measurements primarily ewes, although there is no clear division between the two groups. In addition, the small size of the unfused specimens suggests that the majority of these represent ewes, although it is often difficult to separate rams from ewes based on unfused, late fusing skeletal parts[35].

The measurement with the largest sample from a single skeletal part is the greatest length of the astragalus (n = 8). These measurements are presented in figure 7 where they are compared with equivalent measurement data from three morphologically wild sheep populations in the Near East including PPNB Cafer Höyük[36], located along the upper Euphrates ; Ganj Dareh[37], a PPNB period site in western Iran ; and Asıklı Höyük[38], a PPNB period site in Central Turkey. Each of these three populations shows a bimodal distribution of astragalus length strongly suggestive of sexual dimorphism. Importantly, these data indicate regional variations in size with the populations from western Iran and Central Anatolia exhibiting smaller values than those from southeastern Turkey, including both Cafer and Körtik. The Cafer measurements, thus represent the best comparison with Körtik and can be used to suggest that astragalus greatest length measurements exceeding 33.5 mm probably represent rams, while those below this value probably represent ewes. When this 33.5 mm boundary is applied to the Körtik measurements it suggests that both ewes and large rams are well represented in the faunal assemblage.

Only three measureable specimens were identified as goat. These specimens include a distal humerus and two astragali, and are on average slightly larger than the LSI standard. When compared to LSI data from Aceramic Neolithic sites in southeastern Turkey (fig. 8) the goats from Körtik appear similar in body size to the large bodied early Aceramic populations along the Euphrates. Given the small sample size it can only be said that the size of the goats from Körtik is consistent with that of wild bezoar goats, *Capra aegagrus*, although it is certainly within the range of early, presumably domestic goats such as those from LPPNB Gürcütepe II[39].

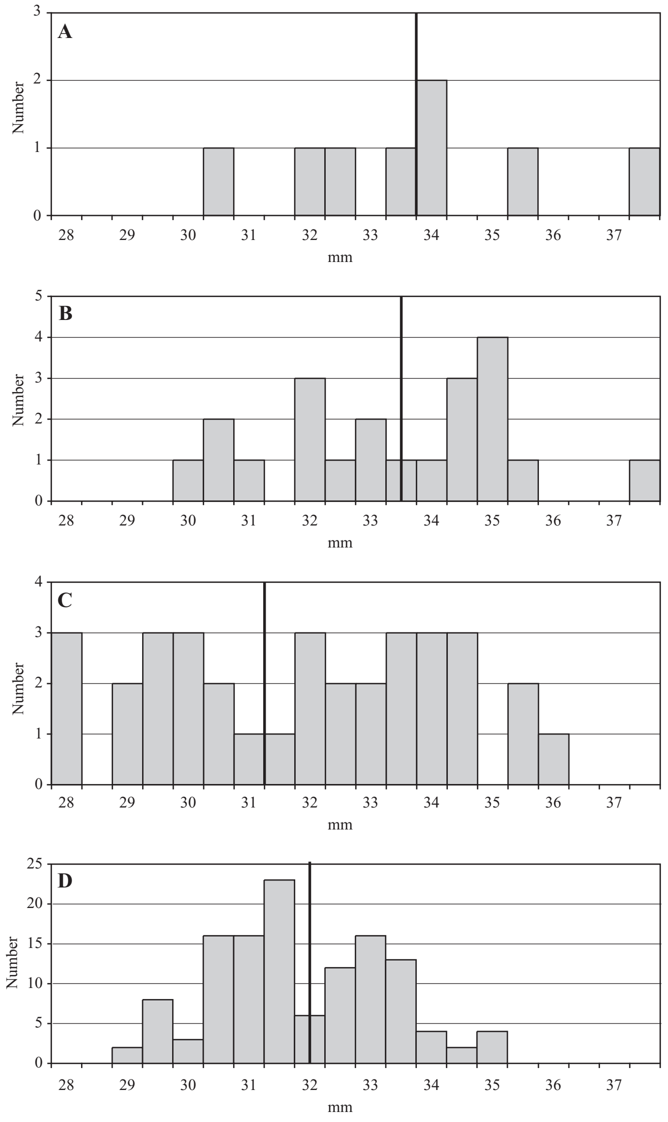

Fig. 7 : *Histograms showing the distributions of the greatest length of the astragalus measurements for sheep and sheep/goat from Körtik Tepe (A), sheep from Cafer (B), sheep from Ganj Dareh (C), and sheep from Asıklı Höyük (D). The grey line indicates the probable division between males and females in each population.*

Kill-off data are available for sheep but not goats. Due to the lack of mandibles with teeth[40] kill-off data are generated based on epiphyseal fusion. Fusion data for each skeletal part

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[35] ARBUCKLE, 2006.

[36] HELMER, 1985, 1988, 1991.

[37] HESSE, 1978 ; ZEDER, 2001.

[38] BUITENHUIS, 1997.

[39] VON DEN DRIESCH and PETERS, 1999.

[40] Here is only one mandible with teeth aged to Payne's (1973) Wear Stage D.

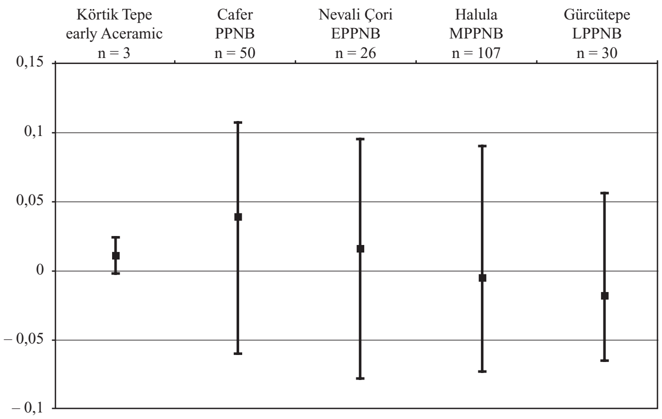

Fig. 8 : *Mean and one standard deviation ranges of LSI values for goats from sites in southeastern Turkey (*PETERS *et al., 1999 : 36).*

are presented in table 5 for combined sheep, sheep/goat, and medium artiodactyl and graphed according to four grouped fusion stages in figure 9[41]. Given the predominance of sheep among artiodactyl remains it is expected that the vast majority of specimens identified as sheep/goat and medium artiodactyl represent sheep.

Age data from one unit, AVD, includes the partial remains of a yearling sheep. Because including the fusion data for these specimens would result in a significantly younger kill-off profile, these specimens are omitted from the survivorship data presented in table 5 and figure 9. Overall, the fusion data indicate a focused and rather young kill-off for sheep. Survivorship is high in the first fusion stage (96.8 %) indicating a general paucity of evidence for the consumption of the youngest lambs. However, unfused specimens in this fusion stage are extremely fragile and are highly susceptible to taphonomic destruction[42]. As a result of the potential loss of the youngest unfused specimens due to taphonomic factors and in combination with the lack of screening at the site, the survivorship value for this youngest age category is probably the least reliable.

Survivorship declines dramatically to 53.8 % in fusion stage II indicating that only about half of the Körtik sheep survived past the age of fusion of phalanges, distal tibia, and metapodials, which take place between *ca* 12-28 months. In the third fusion stage, representing animals that survived past the age of *ca* 30 months, survivorship drops to 33.3 % and continues to decline in the final fusion stage indicating that

Table 5 : *Long bone fusion data for combined sheep, sheep/goat, and medium artiodactyl. Fusion ages from* SILVER*, 1969 and* HONGO*, 1998. Px = proximal. Ds = distal. This table does not include the fusion data for a partial skeleton of a yearling sheep from context AVD.*

Fusion Stage (age of fusion in months)	Element	Unfused	Fused	% Fused
I (6-12)	px Radius	0	7	100.0
	ds Humerus	1	9	90.0
	ds Scapula	0	5	0.0
	Acetabulum	0	4	100.0
	px Phalanx 1	0	5	100.0
	Stage I Total	1	30	96.8
II (12-28)	px Phalanx 2	2	2	50.0
	ds Tibia	0	6	100.0
	ds Metapodial	4	5	55.6
	Calcaneum	2	1	33.0
	Stage II Total	12	14	53.8
III (30-36)	px Femur	2	1	33.3
	px Tibia	2	1	33.3
	Stage III Total	4	2	33.3
IV (36-42)	ds Femur	4	1	20.0
	ds Radius	3	0	0.0
	px Humerus	0	1	100.0
	Stage IV Total	8	2	20.0

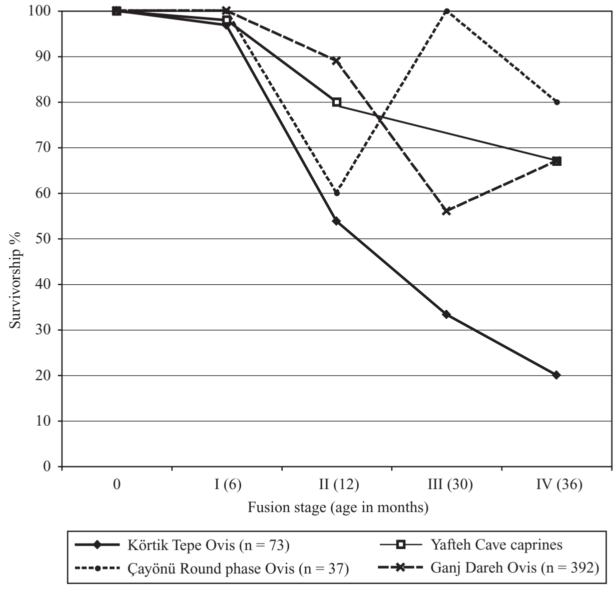

Fig. 9 : *Survivorship curves based on epiphyseal fusion for combined sheep, sheep/goat, and medium artiodactyl for Körtik, sheep from the Round phase of Çayönü (*HONGO *et al., 2002), sheep from Ganj Dareh (*HESSE*, 1978), and caprines from Yafteh Cave (*HOLE *et al., 1969).*

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[41] After HONGO, 1998 ; SILVER, 1969.

[42] BINFORD and BERTRAM, 1977 ; MUNSON, 2000.

only 20 % of sheep survived past *ca* 36 months to the fusion of the latest fusing skeletal parts.

Overall this pattern suggests that exploitation was strongly focused on animals late in their first year and into their second and third years of life with older animals playing only a minor role. The role of the very youngest age group is difficult to judge given potential taphonomic and recovery biases.

*Red deer (*Cervus elaphus*)*

The remains of red deer are common at Körtik Tepe representing 29.1 % and 28.8 % of specimens identified to genus based on NISP and diagnostic zones. Red deer are found in a wide range of habitats from forest to forest-steppe throughout the Near East[43] and it is likely that this taxon was common in the foothills surrounding the Batman floodplain in all directions.

All parts of the red deer skeleton are present including cranial, axial, forelimb, hindlimb, and extremities, although carpals, phalanges and teeth are under-represented compared to the rest of the skeleton. Astragali and scapulae are the most common elements represented in the assemblage. LSI values were calculated from measurements using a modern female from northwestern Turkey as the standard animal[44]. These data are presented as a histogram in figure 10 along with comparable data from Çayönü[45]. The distribution of red deer LSI values from Körtik exhibits a peak at 0.03 on the scale, a gap at 0.06, and a smaller peak at 0.07. Metrical data from Çayönü exhibit a similar pattern and it seems likely that measurements with LSI values < 0.06 represent females while those > 0.06 represent males. If this pattern holds true then it suggests that the majority of the red deer recovered at the site were females.

Kill-off data based on long bone fusion are presented in table 6[46]. These data indicate that mature animals were the primary targets of hunting and are very similar to the kill-off identified for red deer at Çayönü[47].

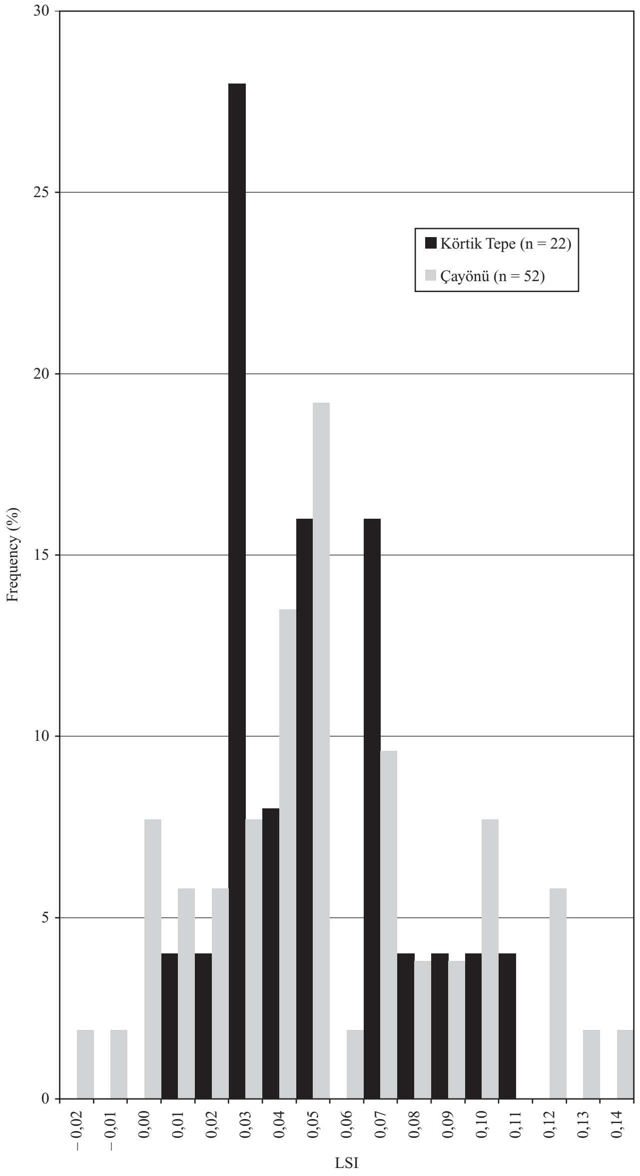

Fig. 10 : *Histogram showing distribution of LSI values for red deer from Körtik Tepe and Çayönü (Çayönü data from Ilgezdi, 2000).*

*Cattle (*Bos primigenius*)*

Cattle are the third most commonly encountered mammal in the Körtik assemblage representing 16.9 and 17.9 % of the mammal remains identified to genus based on NISP and diagnostic zones. Like red deer, wild cattle were widespread throughout the Near East for much of the Holocene and likely utilized forest and forest-steppe as favored habitat[48].

All skeletal regions are represented although cranial remains, excluding mandible, are absent. Measurements indicate that the cattle from Körtik are relatively large for an early

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[43] Perkins, 1964 ; Perkins and Daly, 1968 ; Uerpmann, 1987.

[44] Ilgezdi, 2000.

[45] This figure includes measurements from skeletal parts corresponding to those presented for the standard animal in Ilgezdi, 2000.

[46] *Ibid*.

[47] *Ibid*.

[48] Uerpmann, 1987.

Table 6 : *Red deer long bone fusion data. Fusion stages following* ILGEZDI, *2000. Px = proximal, Ds = distal.*

Fusion stage	Element	Unfused	Fused	% Fused
I	Ds Scapula	0	5	100.0
II	Ds Humerus	0	3	100.0
	Px Radius	0	1	100.0
	Px Phalanx 1	0	4	100.0
	Px Phalanx 2	0	5	100.0
III	Ds Tibia	0	3	100.0
	Ds Metapodial	4	4	50.0
IV	Px Ulna	0	1	100.0
	Px Tibia	1	0	0.0

Holocene population (appendix). In order to generate LSI values for cattle, the female Ullerslev aurochs from Denmark was used as the standard animal[49]. Although this presents similar, if not greater, problems to using sheep from Iran as the LSI standard animal, the Ullerslev aurochs is a rare example of a complete aurochs skeleton and has become the standard for comparison in discussions of the size of Near Eastern as well as European aurochsen. Although the problems of geographic and chronological distance from Körtik are acknowledged, the standard is used here to maximize comparability.

Based on these data, the cattle from Körtik appears similar in size to those from early Aceramic sites on the Euphrates such as Göbekli Tepe and Nevalı Çori (fig. 11)[50]. The LSI values from Körtik are slightly larger than those from the earliest levels of Çayönü[51] and the later Euphrates basin Aceramic sites of MPPNB Tell Halula and LPPNB Gürcütepe II.

Histograms showing the distribution of LSI values for cattle from Körtik and the early phases of Çayönü are presented in figure 12. Although the sample size is small, the distribution of LSI values from Körtik indicates that most specimens are similar in size to the standard female aurochs, although larger specimens, possibly representing bulls, are also present. The lowest LSI value of – 0.09 was derived from an unfused first phalanx and therefore represents an immature individual.

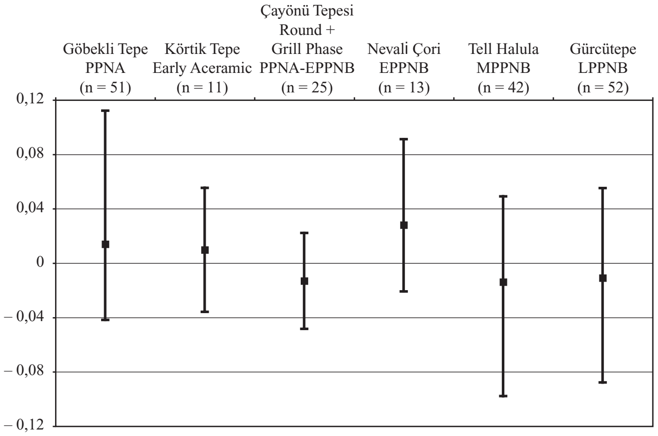

Fig. 11 : *Mean and one standard deviation ranges of LSI values for cattle from southeastern Turkey (*PETERS *et al., 1999 : 36).*

Although interpretation of sex based on a standard animal that is separated from the study population in time and space is problematic, recent data from the Neolithic site of Çatalhöyük, located in Central Turkey, generally support the efficacy of using the Ullerslev aurochs as a model for differentiating between bull and cow aurochsen in the Near East, at least on a general scale[52]. Thus, broad scale generalizations concerning the proportions of males and females are suggested by the LSI values from Körtik.

The LSI values of most of the measureable cattle remains from Körtik fall in the wide area of overlap said by Grigson[53] to represent wild and domestic cattle in the Near East. The cattle remains from Körtik also include some specimens that are in the upper size range given by Grigson for Near Eastern aurochsen and are comparable in size to specimens from PPNA Göbekli Tepe. No specimens fall below the range given by Grigson for wild cattle in the Near East.

The kill-off data based on epiphyseal fusion of long bones are presented in table 7[54]. In contrast to the kill-off of red deer, these data indicate that young cattle were exploited at Körtik. Although sample size is very small, particularly in the later fusing skeletal parts, these data indicate that cattle as young as < 1 year were exploited. In addition, three specimens from which tooth wear could be documented indicate the presence of young cattle (M/1 with tooth wear stage "c"[55]), as well as older individuals (M/1 with tooth wear stage's "e" and "k").

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[49] GRIGSON, 1989.

[50] PETERS *et al.*, 1999.

[51] The difference in LSI values between Körtik and the early levels of Çayönü is significant at the 0,10 level based on the Student's t-test.

[52] RUSSELL and MARTIN, 2005 : 49-50.

[53] GRIGSON, 1989.

[54] HONGO, 1998.

[55] GRANT, 1982.

Table 7 : *Cattle long bone fusion data. Fusion stages following HONGO, 1998. Px = proximal, Ds = distal.*

Fusion stage (fusion age in months)	Element	Unfused	Fused	% Fused
I (6-12)	Ds Scapula	1	1	50
	Acetabulum	1	1	50
II (12-18)	Ds Humerus	1	1	50
	Px Phalanx 1	1	5	83
	Px Phalanx 2	0	4	100
III (24-42)	Ds Tibia	1	0	0
	Ds Metapodial	1	0	0
	Calcaneum	0	2	100
IV (42-48)	Ds Ulna	1	0	0
	Ds Radius	1	0	0

*Pig (*Sus scrofa*)*

Pig remains are relatively rare at Körtik, consisting of only ten specimens representing 5.2 % of the mammal remains based on diagnostic zones. Among these specimens forelimb, hindlimb, and extremities are represented.

Four specimens yielded measurements and indicate the presence of large individuals comparable in size to the population from Çayönü and consistent with the size of wild boar[56] (appendix).

Although no dental remains of pig were identified some kill-off data are available from the state of fusion of the long bones. Unfused skeletal parts indicating the presence of immature individuals include distal scapula (two specimens), distal radius, proximal tibia, and proximal ulna. Fused skeletal parts include distal humerus, distal metapodial, and proximal second phalanx. The exploitation of young as well as older pigs is typical for early Holocene sites in the region and has also been documented at Hallan Çemi[57] and Çayönü[58].

*Fallow deer (*Dama dama *or* Dama mesopotamica*)*

There were two species of fallow deer present in Anatolia in the early Holocene : the European fallow deer (*Dama dama*) and the Mesopotamian fallow deer (*Dama mesopotamica*). Generally, European fallow deer have been identified from sites in western, central, and southern Turkey[59], whereas Mesopotamian fallow deer have been identified in Iran, the Levant, along the southern coast of Turkey, and along the upper Euphrates during the Aceramic Neolithic[60]. However, there is some confusion as to the location of the boundary between the ranges of these two species, and both species may have been present in parts of southeastern Turkey in the early Holocene[61].

Four specimens were identified as fallow deer, including a proximal metacarpus, two antler fragments, and one fused distal scapula fragment. The only measurable specimen, a fragment of a distal scapula, is within the range of the larger Mesopotamian fallow deer and provides some tentative support for the identification of the *Dama* remains as *Dama mesopotamica* (appendix). However, European fallow deer have recently been reported from the nearby site of Hallan Çemi[62]. Due to the small number of the remains and the lack of diagnostic specimens such as of the basal portion of the antler, the taxonomic identification of the fallow deer at Körtik is unclear.

*Persian gazelle (*Gazella subgutterosa*)*

Four specimens were identified as belonging to gazelle including a fused distal metacarpal, a pelvis fragment, a proximal femur, and a complete second phalanx. Based on the size of the measurable, as well as unmeasurable, specimens and the geographic distribution of gazelle in the Near East[63], these remains probably represent the Persian gazelle, *Gazella subgutterosa*.

Other mammals

In addition to the taxa described above the skeletal remains of several medium and small mammal taxa were also identified. Dog/wolf (*Canis* sp.) is represented by a fused proximal humerus. Fox (*Vulpes* sp.) is represented by two specimens, including a mandible and a proximal femur. Hare (*Lepus capensis*) is represented by an ulna and two fragments of a proximal and distal femur.

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[56] HONGO and MEADOW, 1998, 2000.

[57] REDDING and ROSENBERG, 1998.

[58] HONGO and MEADOW, 1998, 2000.

[59] BUITENHUIS, 1997 ; UERPMANN, 1987 ; VOLGER, 1997.

[60] REDDING, 1981 ; UERPMANN, 1987 ; VOLGER, 1997 ; VON DEN DRIESCH and PETERS, 1999.

[61] UERPMANN, 1987.

[62] ROSENBERG *et al.*, 1998.

[63] HELMER, 2000 ; UERPMANN, 1987 ; VON DEN DRIESCH and PETERS, 1999.

Fishes

Eleven specimens were identified as the remains of fish. One specimen was identified as Cyprinidae, and the other specimens have not yet been identified. It is expected that fish remains are highly under-represented due to the lack of fine screening and flotation during recovery. Of interest is a group of 26 fish vertebraes recovered in a burial[64]. These specimens were apparently used as part of a necklace and have not yet been studied.

Birds

Bird remains are quite common at Körtik Tepe and make up 17 % of the vertebrate fauna based on diagnostic zones. Preliminary analysis of the bird remains has resulted in the identification of a variety of taxa including mallard (*Anas platyrhynchos*), goose (*Anser* sp.), and at least two other members of Anatidae possibly including the genus *Aythya* spp. In addition, the remains of great bustard (*Otis tarda)*, chukar (*Alectoris chukar)*, owl (*Bubo/Athene*), and raven (*Corvus*) were also identified. Goose and bustard make up the majority of the bird remains.

Of the identified birds, geese and most ducks are typically winter visitors to eastern Turkey, mallard appears to be a summer visitor, whereas bustard, owl, and raven are likely year round residents[65]. Thus**,** the bird remains suggest a multiseasonal occupation at Körtik Tepe.

The remains of wings and the shoulder girdle, particularly the humerus and coracoid, are well represented in the assemblage whereas other skeletal parts, although present, are poorly represented (table 4).

DISCUSSION

Although the faunal assemblage from Körtik is small, it nonetheless provides valuable information concerning the organization of animal exploitation during the early Holocene in southeastern Turkey and can be compared to other sites in the region. It has been observed that up through the Middle PPNB, animal exploitation at early Neolithic sites in southeastern Anatolia can be characterized as reflecting a broad-spectrum strategy combined with intensive exploitation of one dominant taxon[66]. At the slightly earlier site of Hallan Çemi, located up the Batman Çayı from Körtik, it was sheep (at 42 % of identified specimens) that were the major focus of exploitation with red deer (25 %) and pigs (17 %) also playing an important role in the subsistence economy (table 3). During the Round and Grill phases at Çayönü pigs were the focus of exploitation (50-55 %) while cattle (29-17 %) played a secondary role**,** and red deer (8-6 %) and caprines (7-13 %) were more minor contributors. Finally, Körtik presents a slightly different pattern. Like the pattern at Hallan Çemi, sheep were the focus of exploitation at Körtik (43 % based on NISP), followed by red deer (29 %). Unlike Hallan Çemi, however, cattle are relatively important at Körtik (17 % based on NISP) and pigs are rare (5 % based on NISP). Thus at each of the three early Aceramic sites in the upper Tigris drainage for which faunal data are available, there are three different patterns of animal exploitation focusing on a combination of sheep, red deer, and pigs at Hallan Çemi ; sheep, red deer, and cattle, at Körtik ; and pigs and cattle at Çayönü. This pattern of localized variability complements recent studies of botanical remains across the Near East that indicate early Neolithic subsistence practices were highly localized and often highly variable[67].

In terms of access to ecological zones, Körtik is similar to Çayönü where fauna from steppic, open forest, and riverine habitats were exploited[68]. The presence of gazelle, cattle (to some extent), as well as birds such as chukar and great bustard indicate that steppe environments were exploited by the inhabitants of Körtik as well as open woodlands and riverine areas, indicated by the presence of caprines, cervids, pig, and waterfowl. Interestingly, steppe taxa are absent or very rare at Hallan Çemi, where the fauna indicates that riverine areas and open forests were the focus of hunting. This difference is presumably the result of site location with the inhabitants of Körtik Tepe having easy access to steppe environments on the Batman plain, although the almost complete lack of cattle remains at Hallan Çemi is surprising.

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[64] ÖZKAYA and SAN, 2001.

[65] HARRISON, 1982.

[66] HONGO *et al*., 2004.

[67] ROSENBERG *et al*., 1998 ; WEISS *et al*., 2006.

[68] HONGO and MEADOW, 2000 ; HONGO *et al*., 2002.

EXPLOITATION AND DOMESTIC STATUS OF SHEEP AND CATTLE

Although the samples are small, the data from Körtik Tepe provide a rare window into the nature of animal exploitation in the early Neolithic in Anatolia. The nature of the exploitation of sheep and cattle are discussed here in further detail. Since there are relatively few data describing exploitation practices of these "pro-domestic" taxa from the earliest Neolithic, the Körtik Tepe data provide a valuable, if limited, source of information concerning the nature of the animal economy and the domestic status of these taxa during this important and transitional period.

Sheep exploitation at Körtik Tepe

Körtik Tepe is a rare example of an early Aceramic Neolithic site characterized by the intensive exploitation of caprines. Although not unique in this respect, intensive exploitation of caprines is relatively rare in the early Holocene of southeastern Turkey where gazelle and pig were often the focus of exploitation[69]. Other sites that exhibit intensive exploitation of caprines include Hallan Çemi, where morphologically wild sheep are the dominant taxon, and Cafer, located along the northern slope of the Taurus mountains on the upper Euphrates, where wild goats are the dominant taxon[70].

The size of the sheep and goat remains suggests that the caprines at Körtik Tepe represent a morphologically wild population. Work by Hesse[71] and more recently by Zeder[72] has shown that a decrease in size and other morphological changes, long thought to be initial markers of animal domestication, occur considerably after herd management and are not "leading edge" indicators of the domestic status of an animal population. As a result, the large size of the sheep from Körtik in and of itself does not answer any questions concerning how they were exploited, whether through hunting or herding practices.

However, the distribution of LSI values of fused and unfused skeletal parts presented in figure 6, the size of astragalus measurements presented in figure 7, and the survivorship data from figure 9 and table 5 do provide some clues as to how sheep were exploited in the early Neolithic at Körtik. This combination of metrical and survivorship data provides an interesting combination of evidence that suggests that sheep were subject to complex and potentially intensive hunting strategies.

At first glance, the survivorship data from Körtik might be interpreted to suggest that the site represents the initial domestication of sheep in the Near East. These data show that slaughter was focused on individuals between 1-3 years of age with only *ca* 20 % surviving past three years. Flannery[73] and Lawrence[74] have argued that this type of profile is characteristic of a domestic, managed population.

However, the metrical data do not fit the interpretation of the survivorship curve as a domestic, herded population at Körtik. One of the primary differences between a herding and hunting economy is that while hunters are primarily concerned with the products of the dead animal, herders focus on the living animal, and more particularly, on "the principle product of the living animals, its progeny"[75]. As a result, herders tend to slaughter a disproportionate number of young males in order to maximize the resources available for reproductive females. This often results in an archaeologically visible pattern in which the larger males are slaughtered in their first or second years, while the smaller females exhibit prolonged survivorship[76].

However, at Körtik there is no evidence for this expected herding pattern of young male kill-off and prolonged female survivorship. Instead of a pattern in which unfused skeletal parts exhibit large LSI values (representing large, young males) and fused skeletal parts exhibit smaller values (representing older but smaller females), the LSI values presented in figure 6 indicate that unfused specimens are uniformly small, while fused specimens exhibit a wide range in size. In addition, astragalus measurements (fig. 7) indicate that both large males and smaller females are well represented in the slaughtered population. These results suggest that both young and older females, as well as young and older males were slaughtered with little evidence that a specific sex was targeted at any age. This provides no support for the argument that sheep were herded at Körtik Tepe and instead suggests that sheep were hunted.

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[69] PETERS *et al*., 1999.

[70] HELMER, 1985, 1988, 1991.

[71] HESSE, 1978, 1982, 1984.

[72] ZEDER, 2001, 2006a, 2006b ; ZEDER and HESSE, 2000 ; ZEDER *et al*., 2006.

[73] HOLE *et al*., 1969.

[74] LAWRENCE, 1982.

[75] MEADOW, 1989 : 81.

[76] HESSE, 1978 ; ZEDER, 2001 ; ZEDER and HESSE, 2000.

Hunting practices can produce a wide variety of demographic profiles. In many cases, hunting practices result in a high frequency of adult individuals[77], although some hunting strategies may produce so-called “catastrophic” mortality profiles that include all age and sex groups or they may target particular demographic groups such as prime age adults, lone males, or inexperienced young[78].

In figure 9, survivorship curves are graphed for sheep from Körtik along with sheep from the Round phase (PPNA) of Çayönü, sheep from the Aceramic site of Ganj Dareh, and caprines from Yafteh Cave, an Upper Paleolithic site in Iran. All of these survivorship curves are thought to represent hunting strategies. The curve from Körtik diverges noticeably from those from Yafteh Cave and Ganj Dareh, with much lower survivorship values beginning in fusion stage II, representing *ca* 12 months of age. The curve from the earliest phase of Çayönü is similar to that from Körtik in fusion stages I and II, but then increases sharply in the later stages suggesting major taphonomic problems in that assemblage. Thus the survivorship curve from Körtik with its relatively young kill-off appears somewhat anomalous when compared with these other sites where hunting took place.

The presence of a high frequency of juveniles and young adults at Körtik can at least partially be explained as the result of an exploitation strategy that targeted juvenile and subadult rich female herds. In wild caprine populations, adult males tend to segregate from females and young for much of the year and form small groups of “bachelors” that tend to inhabit territories that overlap with but are separated from the larger female herds that consist of adult females and their juvenile and subadult offspring[79]. A hunting pattern that included the regular exploitation of these larger female herds might explain the presence of the high proportion of juvenile and young adult sheep at Körtik.

The low frequency of individuals younger than 1 year may indicate a seasonal exploitation pattern in which herds were not targeted in the spring birthing season, but rather in the winter or fall. However, the low frequency of very young sheep remains may also be related to taphonomic and recovery factors at the site. Finally, the presence of adult males, clearly present in the metrical data, indicates that hunting strategies did not focus solely on one demographic group but also targeted bachelor herds of males, or possibly mixed herds of males and females present during the rutting season. This suggests that sheep hunting at Körtik Tepe included multiple strategies that may have involved targeting entire herds as well as individual animals depending on the season and circumstance.

When mortality data from Körtik are compared with other sites in the region where caprine hunting was the focus of the animal economy rather than of secondary or tertiary importance, *e.g.*, Hallan Çemi and Cafer, some similarities emerge. Although survivorship curves are not presented, in the most recent description of sheep exploitation at Hallan Çemi, Redding[80] reports that the kill-off was focused on individuals between the ages of 1-3 years, similar to results from Körtik.

Although comparable long bone fusion data are not available from the PPNB site of Cafer, Helmer[81] has reported, based on tooth eruption and wear data, that the wild goats from this site also exhibit a young kill-off with close to 70 % of goats killed between the ages of 1-3 years. Again this pattern is very similar to that described at Körtik.

That survivorship patterns for sheep and goats from Hallan Çemi, Cafer, and Körtik – sites where caprines were the dominant hunted taxa – are very similar is important. Helmer has interpreted the focused slaughter of young individuals at Cafer as a form of highly selective hunting or “protoélevage”. This suggests that a pattern of intensive and selective hunting of caprines was present across southeastern Turkey in the Aceramic Neolithic, although it is acknowledged that intensive hunting of caprines is not the dominant pattern in the region. However, a more general trend towards more selective and intensive animal exploitation practices does seem to be present throughout the region at this time. At Çayönü Tepesi it has been argued that increasingly intensive exploitation may have led to the early husbandry and domestication of pigs, the dominant taxon at that site[82]. Similar trends have also been identified in the southern Levant where a reduction in the age of kill-off of gazelle from the Epi-Paleolithic to the Aceramic has been interpreted as representing intensification in gazelle exploitation[83]. This suggests broadly parallel responses to the ecological, economic, and social conditions of life in early Neolithic communities across much of the so-called Fertile Crescent.

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[77] HESSE, 1982 : 403.

[78] KLEIN, 1982 ; LEVINE, 1983 ; STINER, 1990 ; VOORHIES, 1969.

[79] BLEICH *et al.*, 1997 ; BUECHNER, 1960 ; GEIST, 1971 ; HAFEZ *et al.*, 1969 ; REDDING, 2005 ; SCHALLER, 1977.

[80] REDDING, 2005.

[81] HELMER, 1985.

[82] ERVYNCK *et al.*, 2001. Also see Redding’s argument for early pig husbandry at Hallan Çemi (REDDING and ROSENBERG, 1998).

[83] DAVIS, 1987.

Cattle at Körtik Tepe

Due to the limited nature of the sample, interpretation of cattle from Körtik is limited primarily to a comparison of metrical data with other sites in the region. However, it is clear that both young and old individuals, and cows as well as bulls were exploited at the site. This is in contrast to the exploitation of red deer, the other economically important large mammal at the site, which focused on adult animals.

Metrical data indicate that the cattle exploited at Körtik were morphologically wild. The cattle remains from Körtik are comparable in size to the PPNA and EPPNB populations along the upper Euphrates, but are somewhat larger than those from the PPNA and EPPNB levels of Çayönü (fig. 11). The smaller mean LSI value for cattle in the early levels of Çayönü is the result of the highly skewed distribution of LSI values at Çayönü, characterized by a large number of specimens that are smaller than the standard and relatively few large ones[84], whereas the majority of the specimens from Körtik are larger than the standard (fig. 12).

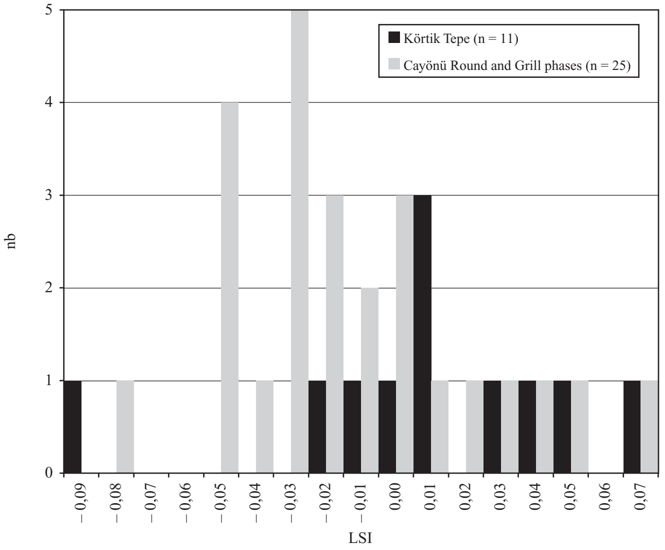

Fig. 12 : *Histogram showing the distribution of LSI values for cattle from Körtik and the Round and Grill phases at Çayönü (Çayönü data from* HONGO et al.*, 2002).*

Although the samples are small, the changes in cattle exploitation represented by these differences in the distribution of LSI values between Körtik and Çayönü may be related to an early stage in the process of cattle management, which may have taken place in the early phases of the occupation at Çayönü. It has been argued that small, morphologically domestic cattle first appear in the slightly later, MPPNB, Channelled Building Phase at Çayönü[85]. It is possible that the increase in the frequency of smaller individuals, representing females or young males, from Körtik to the Round and Grill phases at Çayönü may represent the beginnings of experimentation with cattle management, and a prelude to the appearance of morphologically domestic cattle in the later phases.

Although more data are needed in order to understand the evolution of cattle exploitation and domestication in southeastern Turkey, Körtik represents a unique source of data that can be compared with the long sequence at Çayönü. Since cattle were not exploited at Hallan Çemi, Körtik is an important source for understanding cattle exploitation practices just prior to, or possibly even in the earliest phases of the domestication process documented at Çayönü.

As research focusing on the early Neolithic of southeastern Turkey has increased, it has become clear that this region exhibited a mosaic of socio-cultural and economic adaptations to changing conditions at the end of the Pleistocene and the beginning of the Holocene[86]. The faunal data from Körtik further add a small piece to our understanding of one aspect of this process of cultural adaptation and raise further questions about the complex organization and evolution of animal exploitation in the region.

Potentially important findings from this study include the fact that the animal economy was organized towards the selective and potentially intensive exploitation of sheep between the ages of 1-3 years and that this exploitation may have included a mixed strategy of hunting female as well as bachelor male herds. Since sheep were likely domesticated in southeastern Turkey in the Early PPNB[87], these data from the preceding period are of great relevance to understanding the exploitation systems from which herd management strategies may have developed. It is possible that the selective hunting strategies documented at Körtik and probably also present at Hallan Çemi were the local precursors to true herd management practices in the region.

In addition, metrical data from cattle have indicated the presence of large sized cattle in the Tigris drainage in the early 10th millennium BP. These data provide a valuable comparison

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[84] HONGO *et al.*, 2002.

[85] HONGO *et al.*, 2002 ; ÖKSÜZ, 2000.

[86] ROSENBERG *et al.*, 1998 ; ROSENBERG, 1999.

[87] PETERS *et al.*, 1999 ; VON DEN DRIESCH and PETERS, 1999.

with the sequence at Çayönü and suggest that important changes took place in the organization of cattle exploitation between the occupation of Körtik and the early phases at Çayönü.

Although this report is the first to present paleobiological data from Körtik Tepe, the site has the potential to provide important information concerning the nature of post-Pleistocene adaptations in this region. Körtik appears to fill the gap between Hallan Çemi and the early phases at Çayönü and provides valuable data concerning the organization of subsistence strategies in this period. Although interpretations may change as more data are collected and our understanding of the stratigraphy and dating of the site improves, the results of the initial examination of Körtik Tepe represent a valuable addition to the dataset describing subsistence organization in the period following the Younger Dryas but preceding animal domestication.

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Appendix : Measurements

* Indicates estimated measurement ; uf = unfused ; f = fused. Measurements and abbreviations taken after VON DEN DRIESCH (1976). $ indicates specimens used in LSI graphs (Fig. 5, 6, 8, 10, 11).

Table a : *Scapula measurements.*

Fusion		Scapula	SLC	GLP	LG	BG	HC
uf	$	*Ovis/Capra*	16.2			21.0	
f	$	*Ovis/Capra*			29.4	25.1	
f	$	*Ovis*	29.9	39.0	29.8	26.6	
f	$	*Ovis*	27.0	39.3	29.9	25.7	
f	$	*Ovis*	17.9	34.6	27.1	21.3	22.6
f		*Dama*	34.5		*34.5	33.1	
f	$	*Cervus*	48.5	64.9	49.0	46.9	
f	$	*Cervus*	40.0	*57.5	*49.0	*41.5	42.5
f	$	*Cervus*			46.5	42.5	
?	$	*Cervus*				42.3	
f	$	*Cervus*		61.1	47.6	44.1	
uf		*Sus*		*24.5		*18.0	

Table b : *Humerus measurements.*

Fusion px/ds		Humerus	Dp	Bd	BT	HT	Dd
?/f	$	*Ovis/Capra*		*33.8	31.9	*19.6	30.1
?/f	$	*Ovis/Capra*			33.9	23.7	
?/f	$	*Ovis/Capra*		42.8	41.1	27.6	38.8
?/f	$	*Ovis*		37.4	*33.2	23.1	30.7
?/f	$	*Ovis*		39.0	37.4	24.6	34.4
?/f	$	*Ovis*		39.0	35.5	23.3	31.8
?/f	$	*Ovis*		39.3	35.9	23.8	34.8
?/f	$	*Capra*		40.0	36.2	24.8	33.8
?/uf		*Bos*		67.4	59.9	44.2	
?/f	$	*Cervus*		67.4	60.5	44.6	67.7
?/f	$	*Cervus*		*60.6	56.1	44.3	
?/f	$	*Cervus*		*58.6	*53.8	42.2	61.3
?/f	$	*Cervus*		72.0	62.5		
?/f		*Sus*		50.3	*37.7	34.9	47.3
f/?		*Canis*	50.9				

Table c : *Radius measurements.*

Fusion px/ds		Radius	Bp	BFp	Dp	Bd	BFd	DFd	Dd
f/?		*Ovis/ Capra*	40.1		21.5				
f/?		*Ovis/ Capra*	35.2	33.3	17.7				
f/?		*Ovis/ Capra*	37.2	35.5	*21.5				
?/uf	$	*Ovis*				31.0	28.3	16.4	23.1
f/?		*Ovis*	33.6	32.5	17.5				
f/?		*Ovis*	38.7	35.2	20.3				
f/?		*Ovis*	33.7	31	16.6				
f/?		*Ovis*	39.2	37.1	20.3				
?/uf	$	*Ovis*				31.9	27.1	17.6	22.1
f/?	$	*Cervus*	64.6	60.5	35.0				

Table d : *Ulna measurements.*

Fusion px/ds	Ulna	BPC
f/?	*Cervus*	35.0
uf/?	*Sus*	26.9

Table e : *Metacarpal III + IV measurements.*

Fusion ds		Metacarpal	Bp	Dp	Bd	DVM[a]	DEM[b]
uf	$	*Ovis/Capra*			*27.7		
?		*Ovis/Capra*	26.5	17.7			
uf		*Ovis*				18.1	12.4
f		*Ovis*				18.7	12.7
f	$	*Ovis*			32.0	20.4	14.7
f		*Gazella*				16.5	11.8
uf		*Bos*				44.8	34.8
?	$	*Cervus*	*45.0				
?	$	*Cervus*	45.4	32.3			
f		*Cervus*			57.0	36.7	27.8
uf		*Cervus*				*29.5	22.7
uf		*Cervus*				30.9	21.5

a. (DAVIS, 1996). DVM represents the antero-posterior diameter of the *verticillus* of the medial condyle of the distal end of the metacarpal.
b. (DAVIS, 1996). DEM represents the antero-posterior diameter of the external *trochlea* of the medial distal condyle of the metacarpal.

Table f : *Metatarsal III + IV measurements.*

Fusion ds		Metatarsal	Bp	Dp	Bd	DVM	DEM
uf	$	*Ovis/Capra*			*28.1		
uf		*Ovis*				18.8	13.1
f		*Ovis*				20.1	13.6
uf		*Ovis*				21.5	14.5
f	$	*Ovis*			32.2	19.7	13.8
uf		*Ovis*				19.9	13.6
uf		*Ovis*				19.3	13.0
f	$	*Ovis*			31.9	19.9	13.0
?	$	*Cervus*	39.7	44.7			
f		*Cervus*				31.8	23.0
uf	$	*Cervus*			45.3	30.4	22.3

Table g : *Femur measurements.*

Fusion px/ds		Femur	DC	Bd
?/f		*Ovis/Capra*		49.1
f/?	$	*Ovis/Capra*	23.7	
?/uf		*Ovis/Capra*		44.5
f/?		*Gazella*	18.8	
f/?		*Vulpes*	10.4	

Table h : *Tibia measurements.*

Fusion px/ds		Tibia	Bp	Dp	Bd	Dd
uf/?		*Ovis/Capra*	38.3	42.8		
?/f	$	*Ovis/Capra*			26.1	18.9
?/f		*Ovis*				25.1
?/uf	$	*Ovis*			30.2	23.4
?/f	$	*Ovis*			31.4	23.3
?/f	$	*Ovis*			31.6	24.4
?/f	$	*Ovis*			34.7	25.7
?/uf	$	*Cervus*				45.8
?/f	$	*Cervus*			58.0	45.2
uf/?		*Cervus*	82.7			
?/f	$	*Cervus*				48.0

Table i : *Calcaneum measurements.*

Fusion		Calcaneum	GL	GB
?		*Ovis*		26.5
f	$	*Ovis*	78.6	*26.8
uf	$	*Ovis*		23.2
uf	$	*Ovis*		23.3
f	$	*Bos*	156.0	56.0
f	$	*Bos*	178.0	64.0
?		*Cervus*		*33.5

Table j : *Astragalus measurements.*

	Astragalus	GLl	GLm	Dl	Bd
	Ovis/Capra	37.8	35.9	22.6	24.5
	Ovis/Capra	33.9		19.3	*20.8
	Ovis/Capra	32.1		18.3	*21.3
	Ovis/Capra	35.8	33.0	20.7	25.0
$	*Ovis*	34.0	32.2	19.3	21.0
$	*Ovis*	30.9	30.8	18.1	19.2
$	*Ovis*	34.4	33.3	20.4	23.4
$	*Ovis*		32.5	19.6	21.1
	Capra			21.0	
	Capra	35.4	33.4	20.2	22.7
	Bos		75.3	*43.8	53.4
$	*Cervus*	61.4	57.1	32.9	38.3
$	*Cervus*	59.6	56.2	29.2	37.3
$	*Cervus*	60.9	57.4	32.4	37.6
	Cervus		59.9	35.4	*38.0
$	*Cervus*	67.2	61.2	36.6	44.9
$	*Cervus*	63.1	58.5	35.1	42.1
$	*Cervus*	60.5	57.9	32.8	37.6
$	*Cervus*	57.8		32.3	
$	*Cervus*	60.7		32.4	38.0

Table k : *Central +4 tarsal measurements.*

	Central +4 tarsal	GB
$	*Bos*	65.8

Table l : *Phalanx 1 measurements.*

Fusion px		Phalanx 1	GLpe	Bp	Dp	SD	Bd	Dd
f		*Ovis/Capra*		14.2	16.3			
f		*Ovis/Capra*		15.0	17.4			
f		*Ovis/Capra*		14.9	18.8			
f		*Ovis/Capra*		14.5	18.6			
f	$	*Ovis*	49.0	14.5	17.7	10.8	13.4	11.4
?		*Ovis*					13.3	10.9
?	$	*Bos*					38.5	
f	$	*Bos*	73.3	43.5	48.5			
f	$	*Bos*		38.5	41.0			
f		*Bos*			37.3			
uf	$	*Bos*		29.9	36.3			
f		*Cervus*		22.7	25.7			
f		*Cervus*		25.1	28.6			
f		*Cervus*		23.8	29.1			
f		*Cervus*		26.3	30.1			

Table m : *Phalanx 2 measurements.*

Fusion px		Phalanx 2	Glpe	Bp	Dp	SD	Bd	Dd
f		*Ovis*	29.9	15.5	17.1	10.6	12.4	13.9
f		*Ovis*	31.2	13.5	13.7	9.4	10.5	12.4
f		*Gazella*	23.7	10.1	12.4	7.0	8.4	11.3
f	$	*Bos* (anterior)	50.0	34.5	37.5	29.1	26.5	33.5
f	$	*Bos* (anterior)	52.0	37.0	41.0	30.9	32.0	*33.0
f	$	*Bos*	52.0					
f		*Cervus*	50.5	26.5	33.8			
f		*Cervus*	46.6	24.5				
f		*Cervus*		24.1	31.2			
f		*Sus*	30.7	18.6	18.6	15.1	16.4	17.2

Table n : *Phalanx 3 measurements.*

Phalanx 3	DLS	Ld	H	MBS
Ovis	36.8	31.5	20.0	8.3
Ovis	35.6	30.4	18.5	7.8
Bos			48.0	
Bos	67.2	54.8	38.5	24.4
Bos	61.8	49.8	34.3	21.5
Cervus	57.0	54.0	33.5	15.4

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