Early Bronze and Iron Age Animal Exploitation in Northeastern Anatolia

The faunal remains from Sos Höyük and Büyüktepe Höyük

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Dedicated to

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Chapter 1
INTRODUCTION

1.1 The Research Problem

Faunal remains from Sos Höyük and Büyüktepe Höyük were analysed in order to establish characteristics of the previously unexamined economic patterns of the northeastern region of Turkey. Assemblages from Early Bronze and Iron Age contexts were analysed and compared in order to reconstruct subsistence patterns, and determine the characteristics of, and degree of variability within, the herding strategies for domestic species, as well as the forms of exploitation of wild taxa.[1]

1.2 The Background

Prior to extensive excavations of the mounds of Sos Höyük and Büyüktepe Höyük by the University of Melbourne, the archaeology of the northeastern region of Turkey was poorly understood (Sagona, Pemberton & McPhee 1991, 145; Sagona, Sagona & Özkorucuklu 1995, 193). This situation was even more pronounced in terms of an understanding of ancient economies. The lack of archaeozoological reports from the northeastern region stands in contrast to the number of published studies from elsewhere in Turkey and the Near East, which have enabled a fairly detailed impression of economic strategies throughout those regions to be established. Archaeozoological studies have been undertaken on assemblages dating from the Neolithic to Medieval periods from most regions in Turkey. Sites from the west include Troy and Fikirtepe (Uerpmann, Köhler & Stephen 1992; Boessneck & von den Driesch 1979b); central Anatolian sites include Aşikli Höyük and Alişar Höyük (Payne 1985a; Patterson 1937); southern Anatolian excavations include Çatal Höyük, Can Hasan III, Pinarbaşi, and Suberde (Perkins 1969; Payne 1991; Carruthers 1997; Perkins & Daly 1968), and sites from northern Anatolia include Ikiztepe and Demircihüyük (Tekkaya & Payne 1988; Boessneck & von den Driesch 1977). Comprehensive faunal reports have emanated particularly from the southeastern region. Material studied includes that from Çavi Tarlası, Çayönü Tepesi, Hassek Höyük, Hayaz Höyük, Lidar Höyük, Gritille Höyük, Norşun-Tepe, Pulur Höyük, Korucutepe, Arslantepe, Tültintepe and Tepecik (Schäffer & Boessneck 1988; Lawrence 1980, Meadow 1986a; von den Driesch & Boessneck, 1981, Stahl 1989; Buitenhuis 1985; Kussinger 1988; Stein 1989; Boessneck & von den Driesch 1976b, 1978b; Deniz 1975; Boessneck & von den Driesch 1975; Bökönyi 1993; Boessneck & von den Driesch 1976a; Boessneck & von den Driesch 1979a). Previous analyses of faunal remains have thus derived from sites remote from, or located around the periphery of, the northeastern region. As a clear gap in the corpus of animal bone reports from Turkey clearly exists, the present research was undertaken to investigate a previously neglected aspect of Anatolian archaeology.

Subsistence patterns and the nature of the pastoral economy exert a fundamental influence over the cultural and political fabric of a settlement or society. Whether the system is based upon pastoralism involving permanent nomadism or a trading economy focusing upon exchange and market potential has ramifications extending beyond the purely economic aspects of the society. The relationship between the agricultural economy and other facets of a society, including the political, religious and social spheres, is extremely complex, with no one characteristic necessarily dictating the nature of the others. Instead, subsistence systems contribute together with political, ethnic and religious factors to the character of a culture. An understanding of the economic strategies practised at Sos Höyük and Büyüktepe Höyük during the Early Bronze and Iron Age periods is thus equally as important as that of political or religious factors in characterising past human cultures in northeastern Turkey.

Various studies have utilised aspects of the archaeozoological data to elucidate specific facets of the subsistence economy. Redding's examination of the faunal remains from Tappeh Sarafabad and Tepe Farukhabad in southwestern Iran tested theoretical considerations of the parameters influencing decision making in the herding of ovicaprids (Redding 1981). Similarly, Stein examined specialist production in the village economy of Gritille in southeastern Turkey as an indicator of economic integration with larger, regional centres as part of a state based system (Stein 1989). While studies of this nature are of obvious worth in expanding the theoretical milieu within which faunal remains may be analysed and interpreted, an understanding of the essential qualitative and quantitative characteristics of an assemblage is required before more elaborate theoretical models can be applied. The current research therefore aims to provide an in-depth analysis of the fundamental taxonomic and morphological characteristics of the assemblages studied. These results not only provide an essential framework upon which further, more theoretical, investigations may be based, but also present the data in a comprehensive and accessible manner to permit the application of alternative techniques of investigation.

1.3 The Present Study

Faunal assemblages from Sos Höyük and Büyüktepe Höyük are examined in a variety of dimenions extending from basic identification, documentation and quantification to the application of more sophisticated modes and techniques of interpretation in order to permit a reconstruction of how animal resources were exploited. Analysis of the remains encompasses identification to species including: the separation of the bones of domestic stock from those of their wild relatives; determination of both temporal and geographical variation in size and morphology among the early forms of domestic stock; geographic variation in the representation of wild taxa; and the analysis of taphonomic and preservational factors including the influence of burning,

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[1] Iron Age deposits were chosen for comparison with the Early Bronze Age remains for three reasons. Firstly, both sites yielded assemblages dating to the Early Bronze and Iron Age periods. Secondly, differences between the architectural traditions of the two periods at both sites were clear and well documented. Finally, deposits closer in chronological date to the Early Bronze Age period, such as Middle or Late Bronze Age assemblages, were either lacking or not of substantial enough size to permit worthwhile investigation.

gnawing and recovery techniques. Extrapolation of herding strategies is based primarily upon mortality profiles constructed using age and sex data. Traces of butchery and pathological conditions permit further aspects of the nature of animal exploitation to be elucidated in terms of the utilised resources and the function and health of animals within the economy. Investigation of the relative representation of wild and domestic taxa and determination of seasonality permit fundamental characteristics of the herding economy to be established. The results carry important implications regarding future interpretations of the architectural and artifactual evidence from the sites in terms of such factors as the degree of sedentism of the community, the level of economic independence and the extent of trade practised at the sites. The environmental preferences of the exploited wild and domestic taxa reveal aspects of the habitats and ecosystems surrounding the sites, aiding in reconstruction of the palaeoenvironments in which the Early Bronze and Iron Age communities herded and hunted.

Both the geographical proximity and the number of detailed reports from southeastern Turkey qualify this region as the most suitable with which to compare the faunal remains from northeastern Turkey. Analysis of faunal remains from sites such as Korucutepe, Lidar Höyük, Hassek Höyük and Gritille have provided insight into economic strategies including herding systems and the exploitation of wild taxa in this region (Boessneck & von den Driesch 1975; Kussinger 1988; Stahl 1989; Stein 1988). These systems are characterised by an extremely low reliance upon wild taxa, with the corpus of exploited species being reasonably consistent both temporally and geographically. The main domesticates are represented, including cattle, sheep, goats and pigs, with the first three species being the most abundant. Exploitation of these taxa focused upon both primary and secondary products including meat, milk and traction. These sites have been interpreted as sedentary settlements, ranging from large urban,[2] and administrative district centres,[3] to villages (Stein 1989). As the sites of Sos Höyük and Büyüktepe Höyük are located in the remote northeastern region, in a context that is both climatically and environmentally distinct from that of sites further south, comparing the subsistence systems from sites in these two regions provides important insights into the degree of interaction or isolation of the regions involved. Comparison with sites located in different environments tests what influences, if any, the ecological contexts and geographical locations of the sites of Sos Höyük and Büyüktepe Höyük exerted over their pastoral economies and the exploitation of wild animal resources.

1.4 The Archaeological and Architectural Contexts.

The archaeological context of the excavated faunal remains, in terms of the physical manifestations of the culture with which the remains were associated, is clearly of importance to the interpretation and reconstruction of economic systems. Archaeologically, the four assemblages studied appear to illustrate some parallels, with the Early Bronze and Iron Age deposits respectively providing some evidence for cultural comparability that may, or may not, have extended into the realm of economic and subsistence patterns.

1.4.1 Early Bronze Age Sos Höyük.

Early Bronze Age deposits at Sos Höyük were excavated in three trenches, L17, M16 and M17, each of which yielded faunal remains. These excavations revealed an architectural sequence comprising five levels, ranging from free standing wattle and daub structures in the earlier deposits to mud brick rectilinear houses in the later (Sagona *et al*. 1996, 33). The wattle and daub architectural phases are characterised by rectangular structures with rounded corners and a central post hole. The exterior of one building displayed an annex and courtyard with a number of plaster lined basins. The round cornered buildings are comparable in plan to wattle and daub houses of Trans-Caucasian cultures, as exemplified by structures found in Georgia, and of the Upper Euphrates basin of Turkey (Sagona *et al*. 1996, 37). The lack of evidence for internal features has led the excavator to propose a temporary occupation in the form of a nomadic encampment. The later architectural phase is represented by a mud-brick rectilinear structure of at least two rooms with internal features including a plastered bench, built-in circular hearth, and a shallow circular plaster-lined basin (Sagona *et al*. 1996, 3).

Large quantities of pottery and obsidian were recovered from Early Bronze Age levels. The ceramic repertoire has revealed three main traditions. The majority of wares are of Trans-Caucasian style, with additional vessels reflecting parallels with the Trialeti and Marktopi cultures.[4] The calibrated radiocarbon dates from Early Bronze Age levels at Sos Höyük indicate occupation extending from the mid-third to mid-second millennium B.C.[5] This extends significantly beyond the termination of Early Trans-Caucasian period, and indicates that this culture may have persisted in northeastern Turkey for longer than had previously been thought.

1.4.2 Early Bronze Age Büyüktepe Höyük

Early Bronze Age deposits at Büyüktepe Höyüwere detected in trenches Q33b, Q37a, R35a, S35b, T35b, V37a, and V37b, with faunal remains recovered from each of these contexts. Early Bronze Age habitation was apparent in the

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[2] For example Early Bronze Age I-II Korucutepe and Early Bronze Age Hassek Höyük (Yakar 1985, 47, 292, 367).

[3] For example Early Bronze Age Lidar Höyük (Yakar 1985, 365).

[4] Sagona, Sagona & Özkorucuklu 1995, 202. Currently, information is largely lacking regarding the nature of the ceramic and lithic artifacts recovered from Sos Höyük and Büyüktepe Höyük as they may pertain to the pastoral economy, in terms of such factors as the range of exploited products and hunting patterns. Future analysis of the ceramic repertoire in addition to ongoing analyses of the obsidian assemblages should help to clarify the characteristics of the subsistence economies at the sites.

[5] The dates derived from charcoal samples from a portable hearth and pit in Trench L17b. Calibrated dates (two sigma, 95% probability) ranged from 2890-2555 to 2535-2495 cal. B.C., and 2120-2080 to 2050-1730 cal. B.C., from conventional radiocarbon ages of 4140 +/- 60 b.p. (Beat-84372) and 3570 +/- 70 b.p. (Beta-84371) respectively (Sagona *et al.* 1996, 37).

eastern half of V37b and in V37a in the form of a flimsy rectangular structure with a crude plaster floor, that formed the upper of two occupational floor levels (Sagona, Pemberton & McPhee 1991, 151). A circular deposit of ash was suggestive of a cooking area, although additional corroborative finds were not recovered. The building, which was constructed upon stone foundations built against a vertical face of bedrock, was destroyed by a fire, with the area subsequently remaining uninhabited until the Hellenistic period.

Another structure was uncovered in Q37a consisting of a series of stones arranged in a crescent and set directly on bedrock (Sagona, Pemberton & McPhee 1992, 29; Sagona, Pemberton & McPhee 1993, 69). Interpretation of this feature as the footings of a tent appeared to be corroborated by finds in neighbouring trenches. A structure in trenches S35b and T35b consisted of three 'circular and joining depressions dug out of the....bedrock' (Sagona, Pemberton & McPhee 1993, 69). Two of these pits have been interpreted as living areas while the third, in the northeastern corner, is thought to be a storage area. No evidence of placements for internal supports was detected although the intrusion of a Late Hellenistic/Early Roman pit into the Early Bronze level may have removed any trace of such features. An internal hearth was detected towards the front of the structure in association with fragmentary pottery. A row of stones adjacent to the hearth has been interpreted as the means by which the periphery of the tent was secured to the ground. A further structure of unclear plan in trench Q33b contained an internal plaster hearth. This feature appears to have been associated with an andiron fragment of a kind characteristic of Trans-Caucasian contexts and similar to examples from Pulur and Güzelova in the Erzurum plain (Sagona, Pemberton & McPhee 1993, 71). Pits and a burial cut into the bedrock were detected in trench R35a (Sagona, Pemberton & McPhee 1992, 29). These structures have been interpreted as tent sites, leading the excavators to postulate that nomadism comprised a feature of the Early Bronze subsistence economy at Büyüktepe Höyük.

Obsidian and pottery were recovered in quantity, with the majority of pottery types easily placed within the ceramic tradition of the eastern Anatolian highlands, the Trans-Caucasus and northwestern Iran (Sagona, Pemberton & McPhee 1991, 156). Radiocarbon determinations from trenches Q33b and R35a indicate that occupation extended from the third to second millennium B.C.[6] These dates would make occupation contemporaneous with Arslantepe VIB and Korucutepe D.

1.4.3 Iron Age Sos Höyük

Iron Age deposits at Sos Höyük were excavated from trenches L13, K14, J14, L16 and M15d (Sagona *et al.* 1996, 31; Sagona 1997, 183), with faunal remains coming from the last three deposits. The deposits from trenches L16, M15d and J14 are of Early Iron Age date. Architectural evidence from J14 and L16 includes a thick plaster floor overlain by a destruction layer of charcoal and mud brick debris (Sagona *et al.* 1997, 183). In M15d, beneath this destruction layer, a series of pits was exposed. A particularly large pit had been 'dug into a packing of limestone, containing much charcoal, chunks of vitrified limestone and many distorted and wasted pottery fragments' (Sagona *et al.* 1997, 183). The burnt pottery, lime and bone from this area implied an industrial zone with pottery or lime kilns. The excavated pottery exhibits stylistic parallels to ceramic traditions from central and eastern Turkey (Sagona *et al.* 1996, 32). Obsidian was recovered in quantity throughout the trenches and comprised the principal material for the manufacture of stone tools. Radiocarbon dates suggest that occupation extended from the mid second to early first millennium B.C.[7]

1.4.4 Iron Age Büyüktepe Höyük

Excavation detected widespread but shallow Iron Age deposits both on the summit and on the western side of Büyüktepe Höyük (Sagona, Pemberton & McPhee 1992, 30). Trenches U, V, W and X revealed the base of a circular stone tower with a diameter of approximately seventeen metres (Sagona, Pemberton & McPhee 1991, 151; Sagona, Pemberton & McPhee 1992, 30; Sagona, Pemberton & McPhee 1993, 74). Numerous stones scattered about the area implied that the foundations were originally higher than the two courses presently preserved, while a substantial mud brick superstructure has been suggested, based upon the extensive size of the foundations. A layer of field stones and loose earth overlying the foundation wall served as fill for a floor level but lacked occupational debris, probably due to the effects of ploughing and erosion (Sagona, Pemberton & McPhee 1991, 151). The main entrance was located in the eastern half of trenches W37b and W38a, while a further entrance was apparent in the southeastern region of the structure (Sagona, Pemberton & McPhee 1992, 32; Sagona, Pemberton & McPhee 1993, 76). The former opened onto a wide path which had been reinforced on either side by stone retaining walls to a maximum height of 1.2 metres. Two, or possibly three, semi-circular bastions were detected projecting from the periphery of the tower (Sagona, Pemberton & McPhee 1993, 74). Due to the absence of domestic architecture in the form of benches, storage areas, or hearths, the excavators assume a defensive function for the building which is further implied by its imposing size and location at the summit of the mound. The tower at Büyüktepe Höyük is comparable to a similar structure dating to the eighth century B.C. located on the summit of Değirmentepe in southeastern Anatolia (Sagona, Pemberton & McPhee 1993, 76). The tower at Büyüktepe Höyük was constructed in the Iron Age and remodelled in the Late Hellenistic/Early Roman periods, as shown by remains from the paved area at the eastern entrance (Sagona, Pemberton & McPhee 1993, 82).

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[6] The dates were derived from bone samples from the floor levels in Q33b and R35a. Calibrated dates (two sigma, 95% probability) range between 3303 and 2615 cal. B.C. and 2863 and 2330 cal. B.C., from uncalibrated dates of 4290 +/-100 b.p. (Beta-55338) and 3990 +/- 70 b.p. (Beta-55341) respectively (Sagona, Pemberton & McPhee 1993, 74).

[7] Dates came from charcoal samples from the floor layer in L16 and the latest pit in M15d. Calibrated dates (two sigma, 95% probability) range between 1200-855 cal. B.C., and 1500-1135 cal. B.C., from uncalibrated dates of 2860 +/- 60 b.p. (Beta 95214) and 3090 +/-70 b.p. (Beta-95215) respectively (Sagona *et al.* 1997, 183).

Interpretation of Iron Age levels detected along the western side of the mound was complicated by disturbance of these deposits during the Hellenistic period. Trenches R33b, R34a and R34b nevertheless revealed a large rectangular Iron Age building comprising a main room, measuring 8.75 metres by at least 6.25 metres, with an annex (Sagona, Pemberton & McPhee 1992, 32). The carefully constructed walls are generally 0.75 metres thick and preserved to one or two courses high. Internal features included a bench, a circular storage shaft, and a cooking area accompanied by benches and pits which had been worked into the bedrock (Sagona, Pemberton & McPhee 1992, 32; Sagona, Pemberton & McPhee 1993, 76). Radiocarbon dates suggest that the Iron Age occupation extended from the early to late first millennium B.C.[8] The ceramic finds could also be safely assigned stylistically and typologically to the first millennium B.C. and have stylistic parallels with pottery dating to the Achaemenid period from eastern Turkey and the Trans-Caucasus (Sagona, Pemberton & McPhee 1992, 34).

1.5 The Significance of the Current Study

In terms of the architectural evidence noted in the previous sections a dichotomy exists between the nature of the settlements of the Early Bronze and Iron Age periods at both Sos Höyük and Büyüktepe Höyük. The Early Bronze material is interpreted as coming from nomadic, temporary encampments in contrast to the permanent occupation implied by the Iron Age remains. Investigation of the faunal remains from the Early Bronze and Iron Age periods at both sites can thus help to determine whether the assemblages reflect comparable differences in the nature of occupations between the two periods.

The use of faunal assemblages from both the Early Bronze and Iron Age periods from the same site also enable determination of the degree of temporal consistency in subsistence strategies. These findings can be placed within the context of the temporal development of contemporaneous sites throughout Anatolia.

The use of assemblages from two sites in northeastern Turkey also permit inter-site comparisons, in order to characterise as a whole the subsistence economy of the region. Comparisons of the economic systems of Sos Höyük and Büyüktepe Höyük with those from other sites in Anatolia permit the former to be placed within the wider cultural and economic context of an environmentally and geographically diverse region of the Middle East.

The overall objective of the research is thus to characterise the economic and pastoral systems of Early Bronze and Iron Age deposits at Sos Höyük and Büyüktepe Höyük; to determine the degree of comparability between systems at the two sites insofar as this might relate to, and be representative of, the immediate region; and to place these systems within the context of wider trends and characteristics of eastern Turkey as a whole. Given the paucity of both archaeological and archaeozoological investigations from northeastern Turkey, it is intended that this work serve as a basis for further investigations of the faunal remains and economic and pastoral systems of this region.

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[8] Calibrated dates (two sigma, 95% probability) ranged from 910-540 to 400-90 cal. B.C., from conventional radiocarbon ages of 2610 +/- 70 b.p. (Beat-55335) and 2190 +/- 70 b.p. (Beta-52392) respectively (Sagona, Pemberton & McPhee 1993, Figure 7; Sagona 1998, pers.comm.).

Chapter 2
SITE DESCRIPTIONS

2.1 Introduction

A total of 12,052 animal skeletal remains from Early Bronze and Iron Age levels at Sos Höyük and Büyüktepe Höyük are included in this analysis. The bones from Sos Höyük derived from the 1994 to 1996 excavation seasons, while those from Büyüktepe Höyük were excavated during the 1990 to 1992 seasons. The former comprises a portion of the faunal remains that continue to be recovered from ongoing excavations at Sos Höyük, whereas the latter represented the entire corpus of animal bones excavated from Büyüktepe Höyük. The majority of the identified specimens from both Sos Höyük and Büyüktepe Höyük are currently stored in the Archaeology Laboratory at the University of Melbourne. Most of the unidentified fragments from both sites are stored at the University of Melbourne dig house, located at the site of Sos Höyük.

2.2 Environmental Setting

Sos Höyük and Büyüktepe Höyük are located in the northeastern Turkish provinces of Erzurum and Gümüşhane respectively. Sos Höyük lies at a longitude of approximately forty degrees north and a latitude of forty degrees east, while Büyüktepe Höyük is situated at forty-one degrees north, forty degrees east (Figure 1).

Sos Höyük is located some twenty-four kilometres east of the modern city of Erzurum, at an altitude of approximately eighteen hundred metres above sea level. The site is situated within the modern village of Yiğittaşı on the Erzurum plain (Figures 2, 4). The orientation of the Erzurum plain provides the principal east-west access of the region (Sagona, Sagona & Özkorucuklu 1995, 193). The plain is well irrigated by the tributaries of the Karasu and Aras rivers. Topographically, the region immediately surrounding the site includes 'rocky knolls, old tributary beds, flat arable land, river flood plain and shallow wetlands' (Sagona, Sagona & Özkorucuklu 1995, 196). The mound is located in relatively marshy environs directly adjacent to a tributary of the Aras river known as the Dere Suyu. Evidence of occupation at Sos Höyük extends from at least the third millennium B.C. until the modern day. Excavations are concerned, however, with the periods from the first occupation up until the Medieval period.

Büyüktepe Höyük lies on the Bayburt plain at an altitude of approximately fifteen hundred metres above sea level (Sagona, Pemberton & McPhee 1991, 145). The site is situated north of the village of Çiftetaş and thirty kilometres southwest of the town of Bayburt (Figure 3). An upland basin of the Kelkit-Çoruh trough, the Bayburt plain forms a natural corridor, linking regions to the east and west. The plain is well watered by the Çoruh river, its tributaries, and numerous underground springs. Büyüktepe Höyük, rising twenty metres above the plain, consists of two distinct natural hills linked by a saddle (Figure 5; Sagona, Pemberton & McPhee 1991, 149). Evidence of human occupation of the site dates to the Early Bronze Age, Iron Age and Late Hellenistic/Early Roman periods.

2.3 Vegetation

Both Sos Höyük and Büyüktepe Höyük are situated on sparsely vegetated plains within the rolling steppe and low mountains of the Anatolian plateau. The vegetational biomass of the plains is restricted almost entirely to that used for pasturage and cultivation, with the grasses, low ground covers and shrubs characteristic of the steppe confined to adjacent mountain slopes. Aside from the ubiquitous poplar stands associated with roadsides and villages, trees are virtually absent from the modern environment. Localised forests of stunted oak at altitudes of approximately 2500 metres near Erzurum, and apparently wild olive stands in the Çoruh valley (van Zeist & Woldring 1978, 263), imply a more complex vegetational community in the past than is indicated by modern distributions.

Due to the extensive modification of the landscape and to the lack of extant areas of undisturbed habitat, the natural modern vegetational composition of eastern Anatolia is unclear (van Zeist & Bottema 1991, 38). Zohary has suggested that the modern natural vegetation of regions to the north of Lake Van would have comprised predominantly steppe associated with oak woodland remnants restricted to mountain ridges (Zohary 1973, Map 7). In contrast, van Zeist and Bottema characterise the possible natural vegetation of regions to the north of Lake Van as predominantly cold deciduous broad-leaved montane woodland, comprising primarily open mixed-oak forest interspersed with isolated pockets of dwarf-shrublands or steppe (van Zeist & Bottema 1991, Figure 4). This is in agreement with the findings of Bobek and Walter who suggested a significantly more extensive natural forest cover than has been proposed by Zohary (Bobek 1951; Walter 1956). Arboreal species represented in southeastern Anatolian mixed-oak woodland include oak species (*Quercus brantii, Q. infectoria, Q. boissieri*), maple *(Acer monspessulanum cinerascens*), pear (*Pyrus syriaca),* pistachio *(Pistacia atlantica, P. khinjuk)* and juniper (*Juniperus oxycedrus),* with the upper tree line occurring at between 2500 to 2700 metres (van Zeist & Bottema 1991, 29). It is unclear however, as to what degree these species may be representative of the mixed-oak woodlands of northeastern Anatolia.

Given the degree of uncertainty surrounding the nature and distribution of the modern natural vegetation of northeastern Turkey, projection of the vegetational communities characteristic of the Early Bronze and Iron Age periods is extremely difficult. Palynological data are generally lacking from the region, with only one site, Sürmene Agaçbaşi, yielding pollen data, but as yet providing no radiocarbon dates (van Zeist & Bottema 1991, 101). Pollen cores from Lake Van in eastern Turkey indicate a gradual increase in tree-pollen values from 4425 to 1425 B.C., representative of increasing forest vegetation around the lake during this period (van Zeist & Bottema 1991, 60). According to van Zeist and Woldring this was coincident with an increase in precipitation throughout eastern Turkey which favoured the spread of tree species (van Zeist & Woldring 1978, 274). In addition *Gramineae* replaced *Chenopodiaceae* and *Artemisia* as the dominant ground covers. A forest steppe appears to have become established in the earlier part of this period with *Pistacia, Acer* and *Quercus* comprising the dominant arboreal taxa. The presence of pollen of arboreal species from the Euxinian forest belt in the Lake Van sequence is suggestive of a southward extension of these forests from the Black Sea coast of northeast Anatolia. The relative increase in *Pinus* pollen between 1425 B.C. to 925 A.D. suggests that *Pinus sylvestris* stands in northeastern Turkey reached their maximum expansion during this period (van Zeist & Woldring 1978, 270). The prevalence of oak also increased in the second millennium B.C. In the period from 1425 B.C. to the late first millennium A.D., steppe vegetation is also assumed to have been present in the areas to the north of the lake. A similar profile of increasing arboreal vegetation from 4425 B.C., peaking during the period from 1425 B.C. to the end of the first millennium A.D., was obtained from the site of Söğütlü thirty kilometres to the west of Lake Van (van Zeist & Bottema 1991, 60). The evidence from both sites argues for aforestation in the region of Lake Van during the Late Holocene period and through the Bronze Age until the end of the first millennium A.D. The pollen diagram from Kazgöl in north central Anatolia also implies aforestation during the Holocene, suggestive of a climatic history that essentially corroborates that indicated by pollen diagrams obtained from elsewhere in Anatolia (van Zeist & Bottema 1991, 100). An overall impression of woodland is suggested for the region around Büyüktepe Höyük and Sos Höyük from the time of the second millennium B.C., although the dearth of evidence at present dictates the necessarily broad nature of this classification.

The extent of anthropogenic influences on the development of the 'natural' vegetation of eastern Turkey is also unclear, although pollen diagrams from the region provide a generalised time frame for major modifications to the environment. Van Zeist and Bottema suggest that the vegetational communities postulated for the second millennium B.C. were probably largely natural, with the influence of humans, in the form of herding and harvesting of wood, remaining limited (van Zeist & Bottema 1991, 145). The modern vegetational communities apparent in eastern Turkey are postulated to be mostly the consequence of human activity commencing some eight hundred years ago, resulting in a simultaneous decline in tree pollen and increase in the percentage of herbaceous pollen. Human activity included grazing, the large scale propagation of walnuts, grape growing, olive cultivation, and the large scale harvesting of pine forests in northeastern Anatolia, the last leading to a decline in *Pinus* pollen (van Zeist & Woldring 1978, 271). While the influence of humans on the natural vegetation has increased steadily over the past four millennia, it is likely that forested and wooded areas would have remained largely intact until recent times. It thus is probable that the vegetational communities around Büyüktepe Höyük and Sos Höyük during the Bronze and Iron Ages were significantly more variable and diverse than is apparent today. These conditions would be expected to have exerted an influence over the subsistence patterns of the ancient inhabitants of the sites in terms of the faunal and botanical resources available for exploitation.

2.4 Climate

Both Sos Höyük and Büyüktepe Höyük occur in regions that are characterised by a continental climate, with dominant summer drought conditions (van Zeist & Bottema 1991, 20; Alex 1985b). This system is characterised by two rainy seasons, one occurring at the beginning of spring and the other at the end of autumn, with rainfall being generally higher during the former season. Autumn, winter and spring precipitation results from the prevailing southwesterly winds emanating from the Mediterranean (van Zeist & Woldring 1978, 250). Precipitation averages approximately three to four hundred millimetres per year (Alex 1985a). Drought conditions prevail in both winter and summer, with the latter being the more extreme and longer of the two due to the prevailing northerly winds that bring little or no rainfall. Winter, lasting from October to April, is long and severe in this region, with extensive snow falls accompanied by temperatures at low as minus forty degrees Celsius. Daily maximum temperatures recorded for January are consistently below minus fifteen degrees Celsius (Alex 1983a). Summer is generally short with daily temperatures averaging in the twenties and rarely exceeding thirty degrees Celsius (Alex 1983b).

2.5 Geology

The sites of Sos Höyük and Büyüktepe Höyük are situated within the east Anatolian highlands, which comprise high plateaus of 1500 to 2000 metres in altitude and mountain massifs. There is evidence of relatively recent volcanic activity as manifested in the presence of extensive lava flows and volcanic cones such as Mount Ararat and Tenduruk Dağ (van Zeist & Bottema 1991, 19). The Erzurum plain is surrounded by pyroclastic tuffs and subaerial volcanics, whereas the Bayburt plain exhibits submarine volcanics with sedimentary intercalations to the north (Bingöl 1985). The Erzurum plain is bordered to the north and south by hilly to steep, deeply dissected mountainous terrain (Erol 1982). The region around Büyüktepe Höyük is hilly, ranging from flat to undulating land with plateau relics and ridges, while the Bayburt plain as a whole is bordered by high, steep, mountainous areas to the north and southeast.

2.6 Agriculture

Examination of the modern agricultural systems practised in the Erzurum and Gümüşhane provinces may provide some insight into past subsistence activities in terms of the species and economic strategies most suited to the climatic, vegetational and topographical features of the regions concerned. Particularly fertile soils in these regions permit cultivation of up to ten percent of land, despite the characteristically harsh winters, with ninety percent of this comprising the cultivation of wheat. (Erinç & Tunçdilek 1952, 188). This is supplemented by crops such as potatoes and by the production of peppers, beans, lettuce and other vegetables (Sagona, Sagona & Özkorucuklu 1995, 215).

With large areas of pasturage in the plains and surrounding mountains, animal husbandry occupies an important position in the economy. More specific information on modern agricultural systems may be gleaned from census data collected for the Erzurum and Gümüşhane provinces (A.S.P. 1983).

According to these census data, sheep are the principal livestock reared in the Erzurum province, occurring in a ratio of 10:1:3.3 with goats and cattle respectively (A.S.P.1983, 104). Among the cattle, cows outnumber castrates and bulls in a ratio of 4.5:1. The ratio of mature to immature cattle is 2:1. Chickens are common, being the second most numerous species recorded. Buffalo, horse, mule, donkey and turkey are represented in significantly lower numbers than the main domesticates. Milk production from sheep, goats and cows occurs in a ratio of 11:1:45. Cattle are thus the prime milk producers in this province. Sheep are slaughtered twenty-six times and six times more frequently than goats and cattle respectively, although in terms of meat production sheep and cattle contribute approximately equal amounts. Wool, hair and hides comprise additional products obtained from the main ruminant species.

Sheep are similarly the most abundant domesticate in Gümüşhane province (A.S.P. 1983, 116). The overall relative representation of sheep, goats and cattle is 7.67:1:3. Among cattle, cows are approximately six times more common than either castrates or bulls, with castrates being slightly more abundant than bulls. Adult cattle again outnumber juveniles in a ratio of 2:1. Chickens are also abundant in Gümüşhane province, being raised principally for egg production. Further domesticated species represented include buffalo, horse, mule, donkey, and turkey, although in significantly lower numbers than the sheep, goats and cattle. As approximately equal numbers of sheep, goat and cattle are slaughtered annually, cattle, due to their larger size, comprise the principal contributor to meat production. Milk production also constitutes an important focus of animal husbandry. Milk production from sheep, goats and cows occurs in a ratio of 8:1:14, with cattle therefore contributing less milk relative to sheep and goats than is apparent for the Erzurum province. Hides, wool and hair comprise products of lesser importance derived from the principal domesticates.

Comparison of the data from Erzurum and Gümüşhane illustrates that the relative abundance of the domesticated species is reasonably constant despite topographical and geographical differences between the two provinces. Although similarities are evident between the relative representation of the main domesticates, milk production data clearly reflect differences in animal utilisation between the two regions. Although cattle are the main producers of milk in both provinces, this species contributes a greater volume of milk relative to sheep in the Erzurum province. Furthermore, although cattle are the prime meat contributors in Gümüşhane, sheep and cattle provided equal amounts of meat in Erzurum.

2.7 Excavation of the Faunal Remains

The sites of Sos Höyük and Büyüktepe Höyük were divided into grids of ten by ten metre squares, labelled numerically. These were further subdivided into five by five in the case of Sos Höyük and five by ten metre trenches in the case of Büyüktepe Höyük. These smaller units were labelled alphabetically (Figures 6, 7).[9] Strata at both sites were excavated by means of horizontal spits typically of five centimetre thickness. Different features such as architectural remains, pits, or changes in soil colour, were identified by locus numbers. The assigning of a new locus number subsequently involved a separate treatment of the stratum within the trench and the allocation of a new sample number for the faunal remains found in this context. A new sample number was also assigned to faunal remains found in association with a particular feature. A new sample number was also assigned to any faunal material that appeared, to the trench supervisor, to display any significant features or relationships. These included articulated bones or the association of unarticulated bones that might have been from a single animal.

In an ideal situation the 'exact provenance and three-dimensional co-ordinates' of each animal bone would be recorded (Klein 1980, 224). Excavations involving high bone densities and considerable fragmentation such as those at many Near Eastern sites, including Sos Höyük and Büyüktepe Höyük, clearly preclude the application of such time consuming procedures. The use of five centimetre spits in conjunction with locus and sample numbers at these excavations, however, will eventually permit the reconstruction of the stratigraphic context of samples.[10]

The basic tools of excavation at Büyüktepe Höyük and Sos Höyük were shovels, trowels, hand picks and hand brushes. The impracticalities of performing sieving for the entire excavated volume, including limitations of time and resources, meant that bone specimens were hand-collected at both sites. Recovery procedures are of primary importance in determining the quantitative and qualitative characteristics of the excavated sample, affecting such factors as the ultimate size of the sample and the relative frequency of identified remains (Greenfield 1991, 167). The percentage of the total number of excavated specimens identified to the genus or species level in a sieved sample will tend to be significantly lower than in hand-collected samples, due to the greater recovery of highly fragmentary remains in the former. Sieving can also drastically alter relative species abundance. Sieving experiments by Clason and Prummel on the faunal remains from early medieval Dorestad illustrated that the larger animals were significantly over-represented in hand collected samples (Clason & Prummel 1977). The percentage by weight of large bones, consisting of horse and cow, dropped from 80.24% in hand collected samples, to 56.08% after sieving with a ten millimetre mesh. By contrast, the relative representation by weight of medium-sized animals, such as pig, sheep and goat, more than doubled after sieving had been carried out. Further sieving with a four and then one millimetre mesh served to increase the relative representation by weight of birds and fish in the total sample, when compared to the hand collected sample, by factors of approximately twenty-four and seven hundred respectively! Hand collection of excavated samples can thus be expected to result in substantial bias against the recovery of small bone fragments and thus against small species, small bone elements, infant bones and highly fragmented larger bones (Payne 1972). The hand collection of the faunal assemblages at both Sos Höyük and Büyüktepe Höyük must be considered as a potentially biasing factor in the composition of the assemblages.

Manual labour at both sites was principally conducted by trained Turkish workers from the local villages under the

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[9] See Sagona, Sagona & Özkorucuklu (1995), and Sagona, Pemberton & McPhee (1991) for a description of the layout of trenches at Sos Höyük and Büyüktepe Höyük respectively.

[10] These data are as yet unavailable but will be incorporated into future analyses.

supervision of a skilled trench supervisor, although one untrained in faunal analysis. This might be expected to further bias the samples against less recognisable bone fragments. Efficiency in hand recovery would be also be expected to vary between trenches and indeed across the site as a whole, as the rate of retrieval would be dependent upon the ability of the worker to recognise bone specimens and the meticulousness with which they approached the excavation. These factors would obviously vary both within and between sites.

2.8 Cleaning

The bones were cleaned by means of hard and soft bristle brushes and probes. Generally, these cleaning techniques were adequate to remove excess dirt, thus allowing reasonably accurate estimations of bone weight. The use of water for cleaning was avoided as it is time-consuming and sometimes results in splitting of the specimens during the drying process. Only rarely did the nature of the specimen preclude complete cleaning, such as where extremely renitent incrustations of soil occurred in the region of the nasal bones. In such cases, the weight of the specimen, while recorded, was not incorporated into the data as it was significantly exaggerated. The weight of each specimen was recorded in grams using a portable electronic scale, accurate to one decimal place.

Chapter 3
METHODOLOGY

3.1 Post-excavation Analysis

All the fragments recovered during excavation were recorded and assigned a registration number. Specimens that exhibited either ancient or recent breaks were matched with other fragments from the same bone if possible. Bone fragments that were found to fit together were given the same registration number and the fragments designated alphabetically.

Each specimen was identified to the lowest taxonomic level possible. This involved extensive use of comparative skeletal collections including those of domestic animals available from the Faculty of Veterinary Science at the University of Melbourne in addition to the authors own collection. The skeletons of wild mammal and bird specimens were accessed through the Departments of Mammalogy and Ornithology respectively at the Museum of Victoria, and the collections of the Department of Archaeology and Prehistory at the University of Sheffield. Use was also made of skeletal atlases, especially those of Getty (1975), Schmid (1972), and Halstead and Collins (1994) for mammals, and Cohen and Serjeantson (1996) for birds, in addition to photographs, descriptions and measurements of individual specimens from numerous archaeozoological reports which have been cited in the text where used. A number of further studies provided details of use in the identification of specific taxa or genera. These included Uerpmann (1986) and Meadow (1986b) for equines, Vinogradov and Argiropulo (1968) for rodents, Wapnish (1984) for camels, and Niethammer and Krapp for carnivores and insectivores (1990, 1993a, 1993b). These works have been cited in the text where consulted. Where possible, the age and sex of the animal were also identified and recorded.

Unidentified fragments were categorised by size, as deriving from either a small-, medium- or large-sized animal. Small-sized animals comprise those from rodent to dog size. Medium-sized animals range from those at least as large as a sheep, up to the size of red deer. Large-sized animals range from the size of a red deer up to that of a horse or cow. A final category termed 'indeterminate' was used to classify bones that, due to poor preservation or the nature of breakage, could not be easily attributed to one of the three size categories. Furthermore, a degree of overlap occurs between the size categories. For instance, pig bones, despite the animal's classification as medium-sized, may be extremely robust. Some fragmentary pig bones may therefore be classed as coming from a large-sized animal. Similarly, the gracile and slender nature of red deer bones may result in some fragments being classed as medium-sized, despite the fact that red deer are defined as a relatively large animal. The three size categories are by no means discrete and it is recognised that a degree of unavoidable error will result in the classification of unidentified remains. For instance, long bone shafts of large-sized animals sometimes fragment in such a way that the resulting specimens appear to have come from a medium-sized animal in terms of the thickness of the shaft fragment (pers. observ.).

The information derived from the studied assemblages was recorded using a ClarisWorks© database. The system of recording was essentially that of Redding, Zeder and McArdle as outlined for their 'BONESORT II' coding system (Redding, Zeder & McArdle 1978). This included the parameters for taxonomic status, skeletal element, body size, state of fusion and fragmentation, pathology, modification, butchery, sex and domestication. This was integrated with information on the archaeological context of specimens including the site name, grid reference, locus, basket, sample and date of excavation. This system was also augmented in terms of the recording of various types of information including dental data and pathology. In each case the nature of the additional information recorded is specified in the appropriate sections of the text. Measurements were recorded separately and specimens displaying burning, pathology, carnivore gnawing or butchery marks were also described and illustrated in more detail in hard copy.

3.2 Measurements

Unless otherwise stated, measurements were taken following the definitions of von den Driesch, using a pair of Vernier callipers and a nylon one metre tape (Driesch, von den 1976). Measurements were taken and recorded in all cases where the preservation of the fragment permitted, with the remaining specimens termed 'unmeasurable'. As many definable measurements as possible were taken from the excavated sample as this permitted the greatest degree of comparison between fragmentary remains. Furthermore, the greater the number of different measurements taken, the higher the chance that a given fragment can be included within metrical analysis, and thus the greater the confidence with which any subsequent results can be regarded (Uerpmann 1978, 41). This is of obvious importance in the context of a small collection of faunal material. Measurement of faunal remains serves the important function of adding an objective quality to the otherwise highly subjective process of the description of skeletal morphology and interpretation (Boessneck & von den Driesch 1978a, 25). Boessneck and von den Driesch defined a variety of methods of analysis for which measurements may be utilised in order to yield 'zoological-systematic, ecological, and cultural historical information' (Boessneck & von den Driesch 1978a, 25). All the measurements that were taken are included in the corpus of data regardless of whether or not they are discussed directly in the text. This was prompted by the current paucity of published measurements on faunal remains from archaeological sites in Turkey and the Near East. In addition, inclusion of the full corpus of measurements provides the opportunity for other researchers, who may not have access to the original material, to study and analyse these data in the future. A record of the characteristics of the data, including measurements, also allows for the application of alternative analytical methods that will be developed by other researchers in the future.

3.3 Comparative Assemblages

Due to the few detailed published reports of faunal remains, inter-site comparisons between the data from Sos Höyük and Büyüktepe Höyük and those from other Turkish excavations were restricted to a limited number of sites for which extensive records are available. These include particularly Korucutepe, Lidar Höyük and Hassek Höyük (Figure 8; Boessneck & von den Driesch 1975; Kussinger 1988; Stahl 1989). Additional data were reviewed from a number of other sites that have yielded less comprehensive reports to date, including Çavi Tarlası, Demircihüyük, Fikirtepe, Gritille, Hayaz Höyük, Ikiztepe, and Karataş-Semayük (Schäffer & Boessneck 1988; Boessneck & von den Driesch 1987, von den Driesch & Boessneck 1987; Boessneck & von den Driesch 1977; Stein 1988; Buitenhuis 1985; Tekkaya & Payne 1988; Hesse & Perkins 1974).

3.4 Assemblage Stages

In the analysis of any faunal assemblage it is extremely important to define the target population about which information is sought. The ability to do this, however, necessitates a definition and appreciation of the stages through which faunal remains pass in their transition from the live animal to the analyst's collection. In order to clarify and simplify the description of this journey, various analysts have defined a number of broad stages of transition. The model adopted for this study is essentially that of Klein and Cruz-Uribe (1984), with various modifications based upon the definitions, and cultural and taphonomic factors, outlined by Gilbert and Singer (1982), Meadow (1980), and Rackham (1983).

The Life Assemblage comprises the community of live animals in their herds or natural systems, as appropriate to domesticated and wild animals, respectively. This stage may involve the influences of such factors as hunting and herding strategies, exchange systems and reproductive frequency. This is followed by the Death Assemblage, which includes all the carcasses available for collection by humans and other animals and incorporates such processes as disease, predation, slaughter and cultural influences over dietary habits.

The Deposited Assemblage comprises the next stage and encompasses the deposition of both entire and partial carcasses at the site. This stage may be affected by a particularly wide array of definable influences that include the distance of kill sites from the site under study, butchery patterns and the subsequent distribution of resources, food preparation, scavenging, industrial activities and refuse disposal. The Fossil Assemblage includes those faunal remains that are preserved in the site at the time of excavation. This stage is affected primarily by the physical and chemical properties of the substrate into which the bone is deposited and their subsequent influence over the preservation of specimens. The Sample Assemblage is that portion of the Fossil Assemblage that is subsequently excavated and collected. The transition to the final stage of Sample Assemblage is the only one which is largely controllable by the analyst in terms of the extent of excavation, the methods used, and the care taken by those involved. The Fossil and Sample Assemblages will be identical if excavation of the site is exhaustive and entire, although for various reasons this is typically not the case. Due to the complex taphonomic and cultural processes that may take place between the Deposited and Fossil Assemblages, the reconstruction of the former from the latter is much more difficult to assess. It is the Fossil Assemblage that forms the focus of research in terms of the information it may impart regarding earlier stages of the model. It is important to remember that the stages outlined in this model are not necessarily of equal duration and may involve varying degrees of complexity that will change depending upon the particular characteristics of the assemblages involved. Furthermore, each stage involves not only loss of information concerning the original population, but also the addition of information in the form of introduced biases such as differential preservation and anthropogenic influences.

3.5 Some Definitions

In order to obtain clarity in the discussion, various terms frequently used in the text require explicit definition. The terms element, bone and specimen are used in the sense defined by Ringrose (1993, 122). Thus an element is an anatomical part of the skeleton such as a humerus, whereas a bone can be any element from a particular animal. A specimen may be either a complete bone or only a fragment thereof.

3.6 Quantification

Methods of quantification of taxonomic abundance have been widely detailed in the archaeozoological literature (e.g. Allen & Guy 1984; Brewer 1992; Casteel 1977; Fieller & Turner 1982; Grayson 1973, 1978, 1984; Klein & Cruz-Uribe 1984; Meadow 1980; Rackham 1983; Ringrose 1993; Uerpmann 1973). Aside from the variety of methods used to quantify faunal abundance and the drawbacks of each, even the fundamental bases of many of these methods, in terms of what they actually measure and how that relates to the Life, Death, Deposited or Fossil Assemblages, remains obscure (Lyman 1994a, 47). Fundamental differences exist both in the nature of the approaches, and in what they intend to, or actually do, measure. Problems have also arisen with respect to terminology, with the result that inconsistencies and contradictions have emerged in the literature.[11] A review of the most common methods of quantification serves not only to clarify the various approaches, but permits assessment of which is the most suitable for use in the current study.[12]

3.6.1 Number of Identified Specimens (NISP)

One of the most common methods of quantification of archaeozoological assemblages is the Number of Identified Specimens or NISP. NISP simply represents the total

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[11] See Casteel & Grayson (1977) for a review of the range of abbreviations utilised for quantification within archaeozoology.

[12] The plethora of quantification techniques, including Minimum Number of Elements (MNE), Minimum Animal Units (MAU) (Binford 1978, 1981, 1984) and the Total Minimum Animal Units (TMAU) (Chase & Hagaman 1987), preclude an exhaustive analysis of the various methods. Only those approaches deemed most appropriate for the research questions of the current study are therefore considered.

number of specimens identified per taxon from the excavated assemblage. The principal benefit of NISP lies in the simplicity of its calculation and consequently the standardised nature of its application. It is also a direct reflection of the analysis and not a higher level of abstraction.

It has long been recognised however that NISP is plagued by a number of serious drawbacks (e.g. Brewer 1992; Daly 1969; Gautier 1984; Gilbert & Singer 1982; Grayson 1978, 1984; Klein & Cruz-Uribe 1984; Rackham 1983). The failure of NISP to deal with interdependence between elements constitutes an obvious problem when using the technique to interpret a faunal assemblage. The NISP value will be identical for both a collection of twenty bones from a single animal and twenty bones from different animals, despite the fact that the latter case constitutes nineteen more individuals than the former. Problems of interdependence also invalidate the application of some statistical analyses. Variation in the number of skeletal elements between taxa may also affect the use of NISP. For instance, pigs have four times as many metapodial bones as do cattle. Therefore, the metapodial bones of one pig would give an NISP of eight whereas those of one cow would give an NISP of four. This clearly affects the use of NISP for measuring relative species abundance. NISP values are also influenced by the degree of fragmentation; the greater the fragmentation of a skeleton, the higher the NISP. The method of excavation will also affect NISP counts as, for instance, the failure to perform sieving at a site has been shown to result in a substantial under-representation of small sized taxa (Payne 1972). Differential disposal and preservation, scavenging activities and butchery practices will also affect the relative numbers of specimens both deposited at, and recovered from, a site. NISP is thus affected by all the biases that occur throughout the transition from the Life to Fossil Assemblages (Ringrose 1993, 126).

3.6.2 Minimum Number of Individuals (MNI)

A widely discussed and applied abstraction of faunal data is the Minimum Number of Individuals (MNI) (Allen & Guy 1984; Brewer 1992; Casteel 1977; Gautier 1984; Gilbert & Singer 1982; Lyman 1994; Rackham 1983; Ringrose 1993; Turner 1980; Uerpmann 1973). MNI is defined as the smallest number of animals of a given taxon needed to account for the specimens represented in an identified sample. Initial calculations of MNI were based upon the most abundant excavated element of a taxon separated into left and right specimens. The MNI value was derived from the side that was most abundantly represented. Further refinements of the algorithm have taken into account matched pairs of skeletal elements. These approaches result in higher MNI estimates and operate on the basic premise that the number of both left and right specimens of a particular element can be included in the calculations as long as recognition of any matched pairs is incorporated into the analysis. The final results may be presented either as the MNI for each element of a given taxon or for the most abundant element only.

The principal benefit of the MNI methodology is that the effects of interdependence are eliminated. The recognition of matched pairs of skeletal elements within the calculations, or, alternatively, the use of counts based upon only the left or right elements, and the independent calculation of MNI for each skeletal element, precludes problems of interdependence. The technique also minimises the effects of differential preservation and recovery, as unbiased skeletal representation between taxa within the excavated assemblage is not necessary for comparable MNI counts.

This method is, nevertheless, plagued by many of the problems that affect NISP, with some additional drawbacks specific to the MNI approach. These problems include, once again, fragmentation and discrepancies in the degree of identifiability of skeletal elements between taxa. It is important to note, however, that various refinements of the technique have been developed in an attempt to remove, or at least minimise, some of these drawbacks. For instance, the integration of fragments into MNI analyses has been achieved by recording fragments as fractions of complete bones, the results of which are then summed and added to the number of complete bones (Klein & Cruz-Uribe 1984, 27). This approach has arisen in response to the fact that ignoring fragments will depress the final MNI counts, while treating fragments as whole bones will artificially inflate MNI counts. The problem remains, however, that specimens that cannot be definitely identified as either left or right cannot be accurately integrated into the calculations. In addition, the issue of interdependence emerges for any case where direct joins cannot be made between fragmentary specimens, thus reintroducing the very problem that MNI calculations seek to eliminate.

A further problem with MNI, which is attributable to the application of the method rather than a drawback inherent in the methodology itself, is the lack of a standardised approach. Various methods, involving modifications to the basic principals of MNI, have been developed. In some cases these methods have retained the MNI label, whereas in others it has been renamed (Casteel & Grayson 1977). Furthermore these methods may differ not only in their approach but often also in their desired objective (e.g. Grayson 1973, 1984; Payne 1972; Uerpmann 1973). As such, reports utilising this method may not be directly comparable due to these variations in methodology, while the pervasiveness of the procedure has resulted in many authors failing to state explicitly which version of the method they have employed, thus rendering meaningful comparisons between their results impossible.

An additional drawback to the method is that the value of the MNI is influenced by the manner in which samples are aggregated for quantification. If MNI values are calculated for discrete units such as specific trenches, stratigraphic layers or architectural features, and then summed to provide a total MNI for the site as a whole, the resulting value will tend to be significantly higher than if the samples are first aggregated into fewer units and then MNI calculated. The use of specific units within a site for MNI counts furthermore introduces a subjectivity and arbitrariness into the calculations, as the determination of MNI values using a particular archaeological or architectural feature at a given site cannot be easily replicated in the different contexts of another excavation. As a consequence, inter-site comparisons become extremely difficult. Different methods of aggregating samples will also result in different MNI values for a given species. It is therefore unclear which, if any, of the resulting MNI values might reflect the 'true' representation of any given species abundance at a site. Grayson has shown that MNI values derived from different aggregations of bone samples within a single site are not comparable either in terms of absolute or relative abundance (Grayson 1973).

MNI is also strongly correlated to sample size or NISP. In increasingly larger samples each bone contributes proportionally less to the overall count of the number of animals represented (Grayson 1973). Within an assemblage MNI counts therefore tend to exaggerate the importance of less abundant taxa. As a consequence, taxa represented by larger samples may be viewed as being under-represented by MNI counts, relative to those represented by smaller samples.

Even the use of matching pairs of skeletal elements contains problems of practical application. Matching pairs has typically been perceived as fairly straightforward (e.g. Nichol & Creak 1979). O'Connor (1985) has illustrated however, through an examination of known left and right pairs, that considerable asymmetry may exist within individuals. In response to these difficulties, a more rigorous process of pair matching 'by eye' has been suggested, utilising morphological features that include sex and age criteria such as the degree of epiphyseal fusion (Klein & Cruz-Uribe 1984, 27). In the case of specimens lacking diagnostic zones such as the epiphyses, however, the likelihood of a correct match is much reduced. Furthermore, given the possibility that comparable portions of a left and right specimen of a given element from an individual may not be preserved, not all matches will be detected. In addition, if matching is incorporated into the analysis, its effects over a series of MNI values may not be uniform throughout the assemblage, as matching exerts more influence over the MNI values of smaller as opposed to larger assemblages (Klein & Cruz-Uribe 1984, 26). Most approaches furthermore do not specify how to deal with specimens that cannot be identified to body side (Ringrose 1993, 127).

Various authors have highlighted the fact that MNI cannot be used to determine relative species abundance in the Deposited Assemblage, arguing that the method instead quantifies aspects of pre- and post-depositional biases including differential preservation and distribution (Allen & Guy 1984, 44; Fieller & Turner 1982, 50; Gilbert & Singer 1982, 32; Lyman 1994a, 51; Rackham 1984, 256). Consequently, some authors have rejected the use of MNI (Gautier 1984, 244). If, however, the method of aggregation results in the likelihood that bones from the same animal will be compared for visual matching, the MNI may in fact provide a reasonable estimate of the number of animals in the Fossil Assemblage, thus permitting assessment of the influence of various cultural and taphonomic factors upon the characteristics of the assemblages (Ringrose 1993, 134).

3.6.3 Petersen Index

Numerous authors have developed methods for estimating the number of animals originally in the Death Assemblage and thus have attempted to account both for specimens represented in the assemblages and those that have been removed through cultural, preservational and excavation factors (Allen & Guy 1984; Fieller & Turner 1982; Wild & Nichol 1983). This technique is unique for archaeozoological quantification insofar as it attempts to assess the *actual* number of carcasses present in the Death Assemblage, therefore permitting assessment of such factors as the relative abundance of different taxa and age groups, slaughter regimes and cultural influences over diet. The Petersen Index is calculated according to the formula LR/P for a given element where L and R equal the number of left and right specimens respectively and P denotes the number of matched pairs. This method is derived from the capture-recapture technique, originally devised to quantify population sizes in zoology. The Petersen Index also allows for confidence intervals to be calculated for the sample.[13]

Fundamental to this methodology is the assumption that loss of individual body parts occurred independently. A significant problem therefore emerges if any non-random or selective biases, such as differential distribution of left and right sides, operate at any stage between the Death and Fossil Assemblages (Grayson 1984, 88; Rackham 1984, 259; Ringrose 1993, 129). Furthermore, problems of interdependence emerge, as specimens may potentially remain interdependent throughout the transition from the Death to Sample Assemblages. If the index is calculated for different bone elements and yields different results for each, it is unclear which, if any, of the counts should be viewed as the most accurate estimation of population size, thus complicating estimates of relative species abundance in the Death Assemblage. The technique is hampered by biases in the form of both its lack of accommodation for unpaired elements in the skeleton such as vertebrae (Klein & Cruz-Uribe 1984, 36), and the difficulty of recognising or accurately assigning matched pairs. Fragmentation will contribute further to these biases as it typically reduces the number of matched pairs. Rather than reduce the final count of the number of animals, as was proposed by Klein and Cruz-Uribe, fragmentation will actually inflate this figure. The removal of complete carcasses from the site following the Death Assemblage stage will also invalidate the technique. This process is both extremely difficult to ascertain and impossible to remedy in terms of the calculations. The assumptions implicit in this approach clearly restrict its applicability and result in problems concerning inter-site comparisons (Ringrose 1993, 134; Grayson 1984, 88).

3.6.4 White's Method and the Weight Method

Two methods have been developed that attempt to quantify taxa in terms of their meat weights or relative contribution to the diet. The method developed by White (1953) employs a calculation using the MNI value multiplied by a factor based upon the 'average' available meat from an animal for a given taxon. In addition to the problems inherent in the MNI technique, this method suffers from further drawbacks. These include the difficulties associated with assigning one particular 'average' weight to all animals of a given species, irrespective of factors such as breed, sex, age, and seasonal fluctuations in body weight and condition, and the problems involved in choosing a weight that is representative of a taxon.

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[13] See Fieller and Turner (1982) for a description of the technique and its relationship to the original Petersen Index.

By contrast, the Weight Method involves multiplying the total weight of the bone remains of a given taxon by a factor deemed to represent the relative meat weight for the species under consideration. Inherent in the Weight Method is the assumption that bone weight bears a simple relationship to meat weight. The ratio of bone weight to meat weight is not, however, constant in all members of a species. Casteel found that among pigs the percentage of bone weight decreases as meat weight increases (Casteel 1978, 74). The gender, and nutritional status of the animal at the time of death, will also affect the relationship of bone to meat weight. In addition, the relationship between skeletal elements and associated muscle mass is not constant throughout the skeleton. For example, an identical weight of phalangeal and scapular bones would provide the same meat weight estimates although the muscle mass associated with the phalanges and scapula differs significantly. Processes such as leaching, burning and chemical infiltration may also change bone weights thus altering the relationship of bone to meat weight from that present in the live animal (Gilbert & Singer 1982, 31). Furthermore, a fundamental flaw with this method concerns the manner in which the bone weight is incorporated into the calculations. The ratio of bone to meat weight is calculated as if the specimens in a given assemblage derived from a single individual. Within the calculations, therefore, the bone weight of a given taxon effectively functions as a single, possibly ridiculously large, animal multiplied by the projected meat weight for an individual of that size. The Weight Method is also subject to many of the same problems that affect NISP calculations, such as differential preservation and recovery.

Both White's Method and the Weight Methods are hampered by the typically invalid assumption that only complete carcasses were present in the Deposited Assemblage (Klein & Cruz-Uribe 1984, 34). The application of both methods also fails to recognise the influence of cultural factors over the utilisation of animals. For instance, religious and political considerations may influence the consumption of different body parts or the exploitation of different species. The utilisation of animals for non-dietary purposes is likewise ignored. Consequently, neither this method nor White's Method were adopted to quantify the faunal remains from Sos Höyük and Büyüktepe Höyük.

3.6.5 Discussion

As a result of extensive ethnographic, ethnoarchaeological and archaeological investigation, it is now widely recognised that a myriad of cultural and natural factors exert an influence over faunal remains during their passage from the Life to Sample Assemblages. The inherent characteristics including relative and absolute species abundances of the faunal assemblage as it existed in the former phase will therefore be distorted to a significant and irretrievable extent by the time the latter phase is reached (Gautier 1984, 245; Gilbert & Singer 1982, 21; Klein & Cruz-Uribe 1984; Meadow 1980, 65). It is clear therefore that current quantification methodologies are inadequate to directly estimate features of the Deposited, Death or Life Assemblages.

Analysis is thus generally directed at assessing and quantifying features of that part of the Fossil Assemblage that is represented in the excavated area. This may be further extended to incorporate considerations of the influences of various potential biases such as cultural and taphonomic factors and recovery techniques (Gautier 1984, 245; Meadow 1980, 68). Analysis thus commences with treatment of the Fossil Assemblage as a discrete population that is subdivided according to contextual and temporal units and recovery procedures, in order to reveal essential features and subsequent biases (Meadow 1980, 7).[14] Recognition of, and correction for, these biases then permits attempts at estimation of the species ratios originally deposited.

Use of both NISP and MNI enables similarities and differences between assemblages to be detected and possible explanations developed to account for these (Ringrose 1993, 135). These attributes can then be used to determine aspects of the Deposited, Death and Life Assemblages using additional information derived from such sources as inter-site comparisons and the taphonomic and cultural histories of the sites in question. The assemblages from Sos Höyük and Büyüktepe Höyük were therefore quantified using both NISP and MNI.

As Klein and Cruz-Uribe point out, both MNI and NISP ignore the specific skeletal parts that make up assemblage. Thus, although two samples may share identical NISP or MNI values, their respective patterns of skeletal part representation may be substantially different (Klein & Cruz-Uribe 1984, 30). It is thus useful to complement inter- and intra-assemblage comparisons of species abundance with an examination of relative skeletal part representation.

Comparisons of NISP/MNI ratios between species have been utilised to determine the taphonomic characteristics of the sample assemblages. Comparisons using this ratio appear, however, to be of limited value as the variables that dictate the nature of this relationship cannot be simply defined. Klein and Cruz-Uribe suggested that if two species differ markedly in their NISP/MNI ratio this can be interpreted in terms of either differing degrees of fragmentation or skeletal part representation (Klein & Cruz-Uribe 1984, 25). Grayson however has shown that the NISP/MNI ratio will also vary as a function of sample size (Grayson 1981). The complex taphonomic and cultural histories of assemblages thus appear to preclude the definition of any simple relationship between MNI and NISP and confound attempts to explain fluctuations in NISP/MNI ratios.

3.6.6 MNI Quantification Method

Quantification of paired elements within the skeleton was calculated using the formula L+R-P, where L and R denote left and right specimens respectively, and P represents matched pairs, so that the MNI equals the number of unmatched left and right specimens minus the number of matched pairs. Pairs were matched by eye using criteria such as relative size, state of fusion, and the morphological features that permit identification of gender. For long bones, MNI counts were calculated separately for the proximal and distal extremities and only in cases where at least an epiphysis or portion of the epiphysis and shaft had been

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[14] This was limited in the current study, due to the present lack of detailed contextual information from either of the sites analysed.

preserved. Calculation of MNI values for the scapula and pelvis were based upon the glenoid cavity and acetabulum respectively. MNI counts for the ribs were based upon the number of vertebral extremities, while those for the vertebrae and sternebrae were derived from the number of body fragments divided by the number of each of these elements in the skeleton. Similarly, MNI counts for metapodial bones and phalanges were based upon the number of proximal and distal extremities divided by the expected number in a complete skeleton as they exist for the different families involved. Due to variation between breeds and varieties of a given taxon in the number of ribs, cervical, thoracic, lumbar, sacral, coccygeal vertebrae, and sternebrae, average figures for the major families were based upon those provided by Klein and Cruz-Uribe (Klein & Cruz-Uribe 1984, Table 6.1). Carpal and tarsal bones, including the calcaneus and talus, were treated in the same manner as the long bones although only one MNI value was calculated per element in contrast to the two calculated for long bones. Finally, MNI counts for the cranial remains were calculated separately for the occipital bones and for the mandibular and maxillary remains. Calculation was performed in the latter two cases only where two or more teeth were preserved *in situ* in the alveoli. This procedure is necessary because it is often impossible to assign single premolar and molar teeth to their correct position in the jaw due to morphological similarities. This is especially true in the ungulates, which comprise by far the most common taxa represented by the dental remains. Due to the problems associated with incorporating some identified fragments such as shaft specimens into MNI counts, most were rejected from the analysis. The MNI for a species within a given assemblage simply equalled the highest MNI obtained among those calculated for each element of that taxon.

The application of any quantification method requires the establishment of the minimum assemblage size below which analysis would not be viable (Chaplin 1971; Uerpmann 1973). The assemblages studied comprise all the specimens excavated from the Early Bronze and Iron Age contexts at the sites. Therefore all the excavated specimens rather than a sample of the excavated population are considered. The type of research questions posed for a given assemblage will influence the minimum number of specimens required for them to be satisfactorily addressed. Gamble has developed a generalised hierarchy for determining the sample size required to address particular questions (Gamble 1978, 342). As part of this he provides estimates of the minimum population, or assemblage, size required to answer these questions. The broader and more basic the question, the smaller the assemblage required to address it. The assemblages from Early Bronze Age Sos Höyük and Iron Age Sos Höyük and Büyüktepe Höyük were all of a size sufficient to permit analysis of the majority of the more basic questions questions outlined by Gamble including frequency of butchery and pathology and relative species abundance. The studied assemblages are however smaller than the estimates provided by Gamble for consideration of factors including age structure and stature. The fact that the available assemblages from Early Bronze Age Sos Höyük and Büyüktepe Höyük were studied in their entirety did not permit the taking of larger samples to increase the rigour of investigations into age and sex structure. The limited number of specimens available for analysis however is considered as a potential bias or drawback during the analysis and interpretation of results. The extremely low number of specimens recovered from Early Bronze Age contexts at Büyüktepe Höyük restricted the utility of this assemblage.

3.7 Log Ratio Diagrams

Comparison of measurement data from different archaeological assemblages is frequently hampered by the relative scarcity of measurable specimens. This paucity of specimens precludes a comparison of 'the absolute size of the various bone elements' that comprises the ideal mode of investigation (Grigson 1989, 82). As an alternative, the log ratio technique may be utilised. This method was developed by Meadow (1981) to graphically represent variability in body proportions. The log ratio method permits processes such as size diminution and increased overall size variability, as indicators of the process of domestication, to be explored metrically for a small sample by plotting the various dimensions derived from different bone elements on a single axis. A log ratio diagram is obtained through relating all measurements to the analogous dimensions of a 'standard animal', thus scaling the differing dimensions. This scaling is achieved through the conversion of the dimensions of both the standard animal and the archaeological remains into base 10 logarithms, followed by the subtraction of the former from the latter. The zero line in the diagram represents the dimensions of the selected elements from the standard animal, while values obtained from the archaeological specimens that are smaller or larger than the standard are plotted to the left and right of the zero-line, respectively. Due to the recognition that measurements of lengths and breadths of elements of the appendicular skeleton are analogous to different aspects of physical morphology, namely the height and weight of the animal (Meadow 1991, 90), these two groups of measurements are plotted separately in the current study. In the diagrams, breadths and length size indices are plotted in blue and red respectively with the median of each represented by a triangle. The log ratio technique is based upon the assumption that the dimensions of the different elements do not vary independently to a significant degree from one individual to the next. In reality, a significant degree of variability does occur and in an attempt to compensate for this, the elements from which the ratios were derived have been provided in the current study.

3.8 Mortality Profiles

Basic to analysis and discussion of age and sex ratios in the excavated population is the recognition that the assemblage under consideration is typically affected by temporal averaging. Bone specimens that may have in fact accumulated over decades, or even hundreds or years, are, by necessity, analysed as a single assemblage, primarily because of the frequently small numbers of specimens derived from individual spits or contexts. The resulting temporal averaging therefore precludes the identification of differing herding structures and practices using a fine temporal resolution. Additional factors that are largely beyond the control of the ancient herder, such as epidemics, famines, climatic fluctuations, and the level of predation by other species, will also alter the population dynamics of the herd through time while typically remaining undetected in a sample affected by temporal averaging.

Choice of terminology is also important in a discussion of mortality profiles. Inherent in terms such as 'slaughter patterns' and 'kill-off patterns' is that the death of the animal has resulted from intentional culling by humans. By providing covertly intrinsic implications regarding the interaction between human and non-human animals, terms such as these fail to acknowledge the inadequacies of the methodology to prove that mortality resulted entirely from these interactions. The term 'mortality profile' instead refers merely to the death of the animal without the burden of associated anthropogenic implications. Death may in fact result solely from, or through an interplay between, a variety of factors including congenital disorders, degenerative or age related changes, predation by species including humans, accidental death due to climatic factors, rutting fights, disease, or starvation (Baker & Brothwell 1980,11.). The term 'mortality profile', while admitting the potential that death resulted entirely from intentional culling, does not preclude the possibility of death by other means.

It can be relatively easy to assign excavated bone fragments to broad age categories such as infant, immature and adult. When details regarding the economic significance of a species is required, however, it is necessary to obtain a more specific picture of herd management practices. The principal method of investigation to yield this type of information is by the analysis of mortality profiles for a given species. This may be conducted through a variety of methods including analyses of dental eruption and attrition data and epiphyseal fusion.

3.8.1 Dental Eruption and Attrition

Mandibles are most frequently chosen as the means by which mortality profiles are calculated. Mandibles are less susceptible to destruction than are the majority of bone elements, and are typically one of the most abundant body parts excavated, even when sieving has not been carried out (Greenfield 1991, 171; Binford & Bertram 1977; Brain 1976.). Despite their tendency to be relatively well preserved, the effects of differential preservation upon specimens of different ages has not been fully established (Maltby 1982). The frequent recovery of loose teeth attests to the destruction of a percentage of the deposited mandibles and thus raises the strong possibility of bias within the sample recovered for analysis. Analysis is based most frequently upon cheek teeth rather than the incisors, due both to the greater recovery frequency of the former and the suggestion that attrition of the cheek teeth may display less variability within populations than that of the incisors (Deniz & Payne 1983, 155). A problem of specimen interdependence exists insofar as the frequently fragmentary state of the remains makes determination that each specimen derived from a different individual rather difficult. In order to minimise this effect, fragmentary specimens from Sos Höyük and Büyüktepe Höyük were carefully examined to maximise the likelihood that each derived from a different individual.

The eruption and wear of mandibular teeth is influenced to varying degrees by a number of factors, many of which are impossible to assess in an archaeological assemblage. Diet, breed and gender may all potentially interact to alter the timing of eruption of teeth and rate of wear.

The role of nutrition is poorly understood in terms of the effect it exerts upon dental development. Various studies nevertheless attest to the influence of nutritional levels over both the timing and sequence of eruption. Tschirvinsky observed that low levels of nutrition delayed the replacement of deciduous teeth in sheep although, significantly, such retarding effects were less pronounced in dental, as opposed to post-cranial, development (Moran & O'Connor 1994, 269 after Tschirvinsky 1909). The effects of nutritional fluctuations are most pronounced for infant and subadult animals, as the dentition undergoes its most extensive developments during this period (McRoberts, Hill & Dalgarno 1965). It is thus clear that nutritional levels may affect both the timing and nature of dental eruption.

Dietary intake affects the rate of dental attrition. Healy and Ludwig have demonstrated that soil ingestion as a consequence of poor and sparse grazing significantly accelerates the rate of dental attrition (Healy and Ludwig, 1965). Furthermore, males have been found to show greater rates of attrition than females, with the difference becoming more pronounced with increasing age (Deniz & Payne 1983, 156). This phenomenon may be attributable to the larger size and hence greater food consumption of males over females (Moran & O'Connor 1994, 269).

Gender may also influence eruption times and attrition rates. Eruption was observed to occur slightly earlier in males than females among Turkish Angora goats (Deniz & Payne 1983, 154). The influence of castration over dental development has not been fully addressed and is complicated by conflicting observations. While Noddle (1974, 200) found little difference between the tooth eruption times for castrated and intact males in a study of feral and domesticated goats, both Clutton-Brock *et al.* (1990) and Hatting (1983) observed significantly more advanced development among castrates over intact males among Soay and Gotland sheep respectively. The influence of castration and gender over dental eruption is therefore unclear.

The validity of modern analogues for comparison with dental development in domesticates from archaeological assemblages has been questioned due to the introduction during the last two centuries of breeding programs aimed at accelerating maturation among domestic stock (Bullock & Rackham 1982, 73). Various studies suggest, however, that differences in the developmental chronology between modern domesticates, their eighteenth century ancestors, and their wild relatives are largely insignificant. In their comparison between dental eruption times for modern domestic and Turkish wild pigs, Bull and Payne (1982) found that although variation was detectable among modern domestic breeds, the overall range of variation was reasonably small. Breidermann (1965), Matschke (1967), and Bull and Payne (1982) similarly found that the eruption dates for wild pig teeth fell within the range for those of domestic pigs, although greater discrepancies were observed for the later erupting teeth. By contrast, Habermehl (1975), although observing only minor differences between early- middle- and late-maturing breeds, found variation to be more pronounced between the earlier erupting teeth when compared to those erupting later. A further study by Moran and O'Connor (1994, 282), on both 'improved' and 'unimproved' breeds of sheep, revealed that accelerated maturation and larger body size appeared to exert no noticeable influence over dental eruption, with the result that modern analogues may be utilised for archaeological data until some justification emerges to do otherwise. The ages supplied by Silver (1969) for the dental eruption of the principal domesticates were therefore utilised for the present analysis, with the added benefit that the wide use of these ages affords some standardisation with data from other archaeological sites. However, the influence of breed over the timing of eruption clearly requires further investigation and must be recognised as a difficulty with the use of modern analogues for the dental eruption times of prehistoric domesticates.

Despite the recognition that factors such as nutrition and gender may affect dental development, their influence, and the way in which they may interact, are as yet poorly understood (Moran & O'Connor 1994, 271). An awareness of the influence of both extrinsic and intrinsic factors over dental development may nevertheless aid in the recognition of potential biases within, and limitations of, the data.

The mortality profile for a given species is typically obtained through an analysis of the mandibular specimens in terms of stages of dental eruption and attrition followed by the assignment of ages to the stages represented.

A variety of methods have been developed for recording and analysing both tooth eruption and attrition for the principal domestic species. These range from elaborate developmental stages to crown height measurements and dental cementum layers (e.g. Ewbank *et al.* 1964; Brown *et al.* 1960; Bull & Payne 1982; Levine 1982; Stallibrass 1982). Two of the most frequently used methods are those of Payne (1973) and Grant (1982). Both systems rely on coding the wear and eruption of cheek teeth in order to assess the overall development of a given mandible relative to other mandibles in the assemblage. Grant's system is based upon assigning a specific wear state to each molar in a mandible, the results of which are then pooled to produce an overall Mandibular Wear Stage (MWS) for that particular specimen. Once the Mandibular Wear Stage for each specimen in the collection has been determined, the Mandibular Wear Stages for the collection are ranked, resulting in a distribution that is expected to broadly approximate that of absolute age stages. The problem with Grant's method lies in the limited numbers of tooth wear stages to which the teeth and mandibles must be assigned, and the fact that a variety of different combinations of wear among the cheek teeth will result in the same MWS. It is also unclear how Grant's method, developed as it is from data deriving from British archaeological sites, may relate to Turkish specimens.

In contrast, Payne's system records the attrition state of each tooth using a highly flexible system in which the wear displayed by each molar is assigned a precise diagrammatic representation. Associated wear stages of teeth in more complete specimens are used to determine the relative state of wear of loose teeth within the sample. The specimens are then ranked to obtain a relative age ranking for the assemblage.

One of the primary problems of both Grant and Payne's methods for small and fragmentary archaeological samples of mandibular remains, such as those in the current study, lies in their extensive categorisation and ranking of specimens and subsequent reliance upon a considerable data set in order to yield worthwhile results. A further drawback to Payne's methodology in the current instance is that its application is restricted to ovicaprids.

Due to the often ambiguous and incomplete evidence pertaining to the occurrence of dental eruption and attrition, an approach that utilises broader categories with an emphasis on eruption versus attrition stages appears to offer the best alternative at present. Such a system has been developed and used by numerous German authors (e.g. Boessneck & von den Driesch 1975; Kussinger 1988; Stahl 1989). In this system, mandibles and loose molars are classified into one of nine stages of eruption and wear which broadly represent the dental maturation of the molar teeth ranging from the unerupted first molar to heavy wear on the third molar. Each specimen is either allocated to a single stage or rejected from the analysis. This system, while significantly reducing the size of the sample, has the benefit of ensuring that individuals are not represented more than once in the calculations through loose teeth or fragmentary mandibles. The more generalised attrition stages in this system also limits the influence of problems concerning wear rates (Moran & O'Connor 1994, 269). This system carries the final advantage of being applicable to each of the main domesticates, thus allowing for a standardised approach.

3.8.2 Epiphyseal Fusion

Analysis of epiphyseal fusion at present constitutes the only method whereby post-cranial elements can contribute to the mortality profile within a given excavated assemblage. Essentially, the number of fused or unfused specimens within a given age group broadly represent the percentage of animals within the excavated assemblage that have survived until the beginning of a range of ages or died before the end of the range. The percentages are obtained by calculating the number of fused relative to unfused epiphyses for each extremity of the bone elements (Hesse & Perkins 1974, 156). The percentages obtained are then placed in order of epiphyseal closure.

The analysis of epiphyseal fusion data is however fraught with difficulties. Problems arise concerning not only the fundamental application of the technique and the parameters influencing the nature of the data but also interpretation of the results.

Although general agreement exists among authors regarding the sequence of epiphyseal fusion throughout the appendicular skeleton, significant discrepancies are apparent concerning the timing of the closures (Amorosi 1989, 7). These disparities are partially attributable to the various methods of assessing epiphyseal fusion. For instance, radiologically determined times for epiphyseal closure yield much earlier dates than those studies based simply upon whether the epiphysis and shaft are readily separable. For the purposes of the analysis of epiphyseal fusion in this study, fusion is assumed to have taken place only when the epiphysis is no longer physically separable from the metaphysis.

Variation may also occur between the dates assigned by different authors for the fusion of epiphyses of the same species. High variation between fusion ages was observed among the dates supplied by various authors for sheep as surveyed by Moran and O'Connor (1994, 273). These variations became more pronounced in the later fusing elements. Dates for the epiphyseal fusion of the appendicular skeletons of cattle and ovicaprids were derived from an average of those supplied by Amorosi (1989).

An inherent limitation in the analysis of epiphyseal fusion data is that whereas the ages at which the epiphyses fuse range from birth until skeletal maturity at approximately three to five years, animal life expectancy may reach seven to ten years (Payne 1973, 283). The data are thus unable to document a significant proportion of an animal's adult life. Even during the period of maturation covered by epiphyseal fusion, further problems arise. This is due to the fact that the dates of fusion of the appendicular skeleton of domestic animals tend to cluster around specific ages (Watson 1978, 99). Complications are apparent even for those periods of skeletal maturation during which epiphyses fuse, as a particular epiphysis may fuse at any point over a reasonably extended time period. Epiphyseal fusion analysis will thus yield only broad and somewhat vague suggestions of the number of animals that reached a given age range, rather than specific percentages of mortality. This limitation inherent in the interpretation of fusion data has been highlighted by Watson (1978), although his comments have gone largely unheeded by subsequent researchers. In order to redress these drawbacks in the technique, the epiphyseal fusion data were used in the present analysis to indicate only the *range* of potential mortality which might be represented by the various stages of fusion of the appendicular skeleton, rather than attempting to pinpoint specific ages and relative abundances of animals within that group.

Analysis of epiphyseal fusion is furthermore complicated by the predominantly disarticulated nature of excavated assemblages. When faced with a disarticulated and fragmentary assemblage it is often impossible to ensure that each bone represents a different individual (Moran & O'Connor 1994, 275; Watson 1978, 100). Biases may thus arise where more than one element from an individual is represented in the calculations, thus overemphasising the relative representation of the age group from which that individual derives.

The age at which epiphyses fuse is known to be variously influenced by gender, level of nutrition and genetic constitution, although the relative importance of these factors and the manner in which they may interact to affect the timing of epiphyseal fusion is poorly understood (Moran & O'Connor 1994, 275).

Both the level of, and changes in, the plane of nutrition are known to influence the timing of epiphyseal closures, with poor nutrition resulting in delayed fusion (Moran & O'Connor 1994, 274). The timing of a nutritional change is of fundamental importance regarding which epiphyses will be affected. Those epiphyses that fuse around the time of the change will be more affected than those fusing either much earlier or later. In terms of field conditions, these changes in the nutritional plane might be expected to be made manifest at the time of weaning, whereby, depending upon the magnitude and abruptness of the change, the timing of fusion in the earlier fusing epiphyses might be more influenced than in the later ones.

Both gender and castration appear to exert an as yet indeterminate influence over the timing of epiphyseal closure. Various studies on the epiphyseal closure times for sheep and goats have yielded ambiguous results concerning the influence of castration. Delayed fusion was observed in some cases, but was not apparent in others (Noddle 1974; Hatting 1983; Moran & O'Connor 1994; Clutton-Brock *et al.* 1990). That gender may exert an influence on the timing of epiphyseal closure has been implied by various studies on sheep of different breeds in which clear differences were observed between the closure times for males, females and castrates, with fusion occurring consistently earlier in females (Moran & O'Connor 1994, 281; Hatting 1983; Garcia-Gonzalez 1981).

The state of domestication of the species involved may also have an influence upon the timing of epiphyseal fusion. Various studies have suggested that earlier breeds may have undergone later epiphyseal fusion than their modern descendants, as the dates for feral animals were observed to be later than those obtained for modern domesticates (Noddle 1974; Bullock & Rackham 1982, 79). Interpretation of the significance of this observation is however confounded by the influence that factors such as the domestication process, and environmental changes including the availability and nutritional value of feed, may have over the skeletal development of feral animals. A slower rate of skeletal maturation in early domestic breeds seems likely, given the breeding of modern domestics for accelerated maturation (Noddle 1974, 203). Variation may also exist between the absolute age of fusion of specific bones between different populations of the same breed (Meadow 1975).

Analysis of epiphyseal fusion data is further hampered by differential preservation (Payne 1973, 283; Maltby 1982). Unfused epiphyses and their complementary diaphyses are less dense than fused epiphyses. In cases where post-depositional mechanical and chemical destruction have occurred, fused elements have a greater chance of survival than unfused ones. Consequently, neonatal and infant animals tend to be under-represented in the excavated sample (Meadow 1975; Payne 1975). Retrieval of the smaller unfused epiphyses would also be less frequent than for fused elements in non-sieved excavations (Payne 1972; 1975). The preservation of epiphyses from different age classes and the subsequent fusion analyses are thus influenced by various factors that complicate interpretation of results.

Finally, the methodology utilised for calculating epiphyseal fusion differs between investigators. The elements incorporated into the analysis, the fusion times used, the groupings of different elements into age ranges, and the manner in which the calculations are performed, may all vary between reports in such a way as to make meaningful comparisons either difficult or impossible.

Overall the use of tooth eruption and wear provides a more rigorous and accurate method of estimating the mortality structure of a given population of animals. As epiphyseal elements are typically more abundant than mandibular remains, they may be utilised to suggest the main features of age distribution within a population. Given the shortcomings of the method, the results of the analysis of epiphyseal fusion data in the current study were restricted to the role of assessing the potential validity of the dental data. Any discrepancies between the results of the two data sets were identified and explained.

3.8.3 Sex Determination

Data on the sex ratio of a herd are important for the assessment of herding practices. Determination of the sex ratio should ideally be based upon measurements of elements exhibiting high sexual dimorphism and low age-related change. Forelimb elements in domesticates display the highest degree of sexual dimorphism in the post-cranial skeleton due to the greater weight loading of the fore- relative to the hindlimb. Forelimb bones, however, are also subject to a high level of age-related change including post-fusion widening of the diaphysis and epiphyses. The influence of age-related change over sexual dimorphism is thus difficult to separate in a sample of bones from a population with a predominantly unknown sex and age structure. Furthermore, although sexual dimorphism is apparent for cattle and goat skeletal elements, dimensions of male and female sheep specimens tend to overlap, thus obscuring relative representation of males to females (Luff 1984, 31; Albarella & Davis 1996, 13). Various morphological traits however permit sex identification for a number of skeletal elements. For cattle remains, determination of sex was based upon the acetabulum of the pelvis, the horn cores and plots of dimensions of the talus (Grigson 1982b; Armitage & Clutton-Brock 1976; Armitage,1982). Sex determination for the ovicaprid remains was based upon the criteria outlined by Boessneck for the pelvis (Boessneck 1969; Boessneck, Müller & Teichert 1964).

3.8.4 Discussion

The age and sex data from the various samples were analysed in terms of various models of herd mortality, most particularly those constructed by Payne (1973) for ovicaprids, and Higham and Message (1970) for cattle. These represent 'idealised' profiles that would result from the herders efforts towards optimal return for a single product. It is clear that in the majority of cases this provides an unrealistic and simplified analogue for the herding practices of subsistence farmers, as was readily acknowledged by Payne (1973, 282). Ethnographic accounts provide ample evidence of herders adapting herd structure to yield various products and outcomes. Vlach pastoralists from the Balkans raise sheep herds to yield milk, wool and lambs and thus practise a strategy to maximise returns on both primary and secondary products (Halstead 1996, 22). Herd mortality furthermore appears to reflect a dynamic response to a myriad of cultural, economic and environmental variables, rather than to reflect a static system persisting throughout generations of herders and stock. The Lakenkhel nomads of Afghanistan maintain their sheep herds as capital, with the exploitation of wool and milk products restricted to domestic use and infant males and sterile females sold to trader-pastoralists (Balikçi 1990, 318). By contrast, the neighbouring Kandahari nomads retain the males as wethers which are sold, once they are fattened, for three times the price of the Lakenkhels' stock. This difference in approach is dictated by various influences. These include geographical factors, such as the greater proximity of the Lakenkhels to lucrative markets. Cultural and social variables are also important such as the larger and richer pastures and sheep raising economy of the Kandahari nomads, in contrast to the mixed pastoral/agricultural interests of the Lakenkhels. Indeed the nature of sheep herding by the Lakenkhel nomads is influenced by 'ecological constraints, increasing demographic pressure, changing market conditions, varied agricultural involvements, leadership patterns and decisions, political alignments of various kinds, and structural forms such as lineages and household formations' (Balikçi 1990, 318). No model can provide an adequate accommodation of these variables, and indeed this is not the purpose of such exercises. Instead, as a simplified projection of the fundamental differences between herding strategies directed toward the outcome of specific products, models such as those of Payne provide a framework within which the age and gender data of a given assemblage may be interpreted. Differences between these models and the profile derived from excavation aid in the identification of various cultural and economic factors acting upon, or affecting the formation of, that profile.

3.9 Butchery

The process of disarticulation and butchery of an animal carcass may provide definitive insights into the nature of exploitation and principal products for which the animal was reared. Evidence of butchery processes, in the form of the incidence of modifications including cut and chop marks, was recorded and analysed. Butchery marks were recognised and are discussed using the characteristics for the various forms of man-made modifications as outlined by Fisher (1995) and Binford (1981). The lack of published analyses and descriptions of butchery marks from either ethnographic or archaeological contexts in Turkey precluded any extensive use of comparative material in this analysis.

3.10 Carnivore Gnawing

A further modification that may be of consequence with respect to the economic structure of the site, and that may act as a potential bias in the excavated assemblage, is carnivore gnawing. Evidence of gnawing on the bones was distinguished on the basis of both the nature and location of various characteristic modifications including puncturing, channelling, striations and furrowing, as defined and described by Fisher (1995) and Binford (1981).

3.11 Burning

Evidence of burning among the excavated remains was noted and recorded according to the criteria outlined in the bone coding system of Redding, Zeder and McArdle (1978) in addition to the extent of surface discolouration, cracking and warping of the specimen. These results where then interpreted in terms of actualistic studies of burning duration and intensity such as those outlined by Shipman, Foster and

Schoeninger (1984), and Spennemann and Colley (1990).

3.12 General Pathology

All specimens were examined for pathological conditions in order to assess animal health and disease. Detection of pathology in excavated specimens may provide insight into the interaction of the animal with its environment in terms of such factors as the conditions in which the animals were kept, feeding patterns, genetic factors within the population, and the nature of the exploitation. Herding strategies also exert an impact upon the levels and types of pathological conditions that emerge. For instance, nomadic practices could stress animals through extensive movement and a changing environment. The constant movement of animals, for example, prevents the parent from transmitting immunity to the new environment to their offspring during gestation (Baker & Brothwell 1980, 29).

Oral pathology is of considerable importance in assessing the general health of the animals, as the mouth provides direct contact between the body of the animal and the external environment, and thus permits easy access for toxins and parasites (Baker & Brothwell 1980, 136).[15] Diet affects the likelihood of contracting diseases, as both starvation and overfeeding increase susceptibility to infectious agents, while deficiencies and excesses of certain nutrients may initiate disease (Baker & Brothwell 1980, 29). The quality and degree of abrasiveness of the fodder further influences the oral health of an animal. A noticeable frequency of oral conditions may imply the more frequent attainment of advanced age in herds where animals were maintained for such purposes as wool or traction.

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[15] Oral pathologies were only recorded for the ovicaprid remains due to the lack of adequate literature concerning the identification and interpretation of conditions among the remains of other domestic taxa from archaeological contexts.

Chapter 4
EARLY BRONZE AGE SOS HÖYÜK

4.1 Introduction.

4.1.1 The Assemblage

A total of 5264 faunal specimens were recovered from Early Bronze Age contexts at Sos Höyük, comprising 2477 identified and 2395 unidentified pieces, with a further 392 identified specimens representing intrusive finds from later or modern contexts (Table 1a).[16] Excluding the intrusive specimens approximately half the specimens comprise identified remains in terms of NISP (Table 1bi-ii). Examination of the state of preservation of the specimens reveals a consistently high level of ancient breakage (AB) across the various size categories of unidentified remains (Table 5a i-ii). The incidence of ancient breakage is more variable across the remains of identified taxa however, being lowest for the wild mammal remains and highest among the horse and wild bird specimens. The higher level of ancient breakage among these latter two groups may reflect the relatively lower level of recent breakage (RB) during recovery. Overall, the level of damage caused during and following excavation was low, with 17.8% of the entire assemblage displaying recent (RB), or ancient and recent (AB/RB) breakage. Overall, recent breakage is significantly more common for the wild mammal remains than for the rest of the identified assemblage. The reason for this is unclear, although the small and often fragile nature of the majority of these bones may be a contributing factor. Very few specimens were recovered intact, although the percentages are reasonably consistent across the various identified taxa. The majority of these specimens comprise short bones such as carpal and tarsal bones, and phalanges.

4.1.2 Carnivore Gnawing

The incidence of carnivore gnawing was examined for the identified and unidentified remains in order to establish whether this factor had differentially influenced the representation of the various taxa within the assemblage. The incidence of gnawing is extremely low across the animal remains from Early Bronze Age contexts at Sos Höyük, with the frequency being slightly higher among identified specimens (Table 6a).

Nineteen of the total number of cattle specimens (1.9%)[17] display evidence of carnivore gnawing. This is restricted to reduction of the spongy bone of both long and short bones with characteristic pitting and furrowing. Evidence of gnawing is apparent on short bones including the calcaneus and talus, and on long bone epiphyses such as the distal humerus, radius and metapodial bones. A number of the specimens that display gnawing were found in association, either in the same deposit, or in contexts in the same area of the site. Four specimens came from a single pit in trench L17B while a further three specimens were recovered from slightly earlier pits in the same area. It is thus apparent that the bone remains were accessible to dogs either prior to their being discarded in the pits, or that the pits remained uncovered for some time once waste had been deposited. The low frequency of gnawed remains however implies that this accessibility was limited. Three additional specimens were found associated in a semi circular basin in trench M16AB. The remaining gnawed specimens do not display any significant patterning in their association with specific features or contexts.

Evidence of carnivore gnawing is apparent on 24 (1.8%) domestic ovicaprid specimens. The most common examples of gnawing, detected on two-thirds of the modified specimens, involve the furrowing, or the complete removal, of articular surfaces of long bones, and the scoring and channelling of long bone shafts. Furrowing and puncturing are apparent on the small bones, including the calcaneus and talus, and about the articular surface of a scapula. Pitting and crenelated edges are present on the wing and the ischiatic spine of some fragments of pelvis. These modifications all constitute typical by-products of carnivore activity as observed and defined by Binford in his actualistic studies of dog and wolf bone consumption behaviour (Binford 1981, 50). Those ovicaprid specimens that display gnawing were not concentrated in, or associated with, any particular region or feature of the excavated area.

Three further ovicaprid specimens, comprising distal tibial fragments with modification about the shaft, provide uncertain evidence of gnawing. Specimen 6.2129 exhibits an irregular elongated hole of approximately 11 by four millimetres in diameter penetrating the shaft dorso-ventrally. Specimen 6.1580 provides an example of a more rounded hole of some six millimetres in diameter that passes from the dorsal surface into the medullary cavity. These holes may be attributable to intentional modification by humans. Another specimen (6.2195) however, provides an indication as to a more likely cause of these modifications. This specimen illustrates the same irregular hole passing from the dorsal surface into the medullary cavity of the bone. The ventral and lateral surfaces of the distal shaft adjacent to the region of the hole had been extensively excavated and reduced by carnivore gnawing and show scoring marks and pitting. This may imply that carnivore gnawing resulted in all the modifications apparent on this, and by association, the other two specimens. Indeed, punctures from carnivore teeth have frequently been mistaken for intentional perforations by humans (Binford 1981, 44).

Given the presence of domestic dogs at the settlement (Table 1),[18] the low frequency of gnawing appears to have resulted from restricted access to waste material, as would occur with prompt burial. The consistently low frequency also implies that gnawing did not have a significant influence over the relative representation of different taxa or skeletal elements in the assemblage.

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[16] Intrusive specimens are omitted from all tables and calculations hereafter, for each of the assemblages studied.

[17] Unless otherwise specified, all percentages quoted in the text reflect the number of specimens relative to the total number for a given taxon within the assemblage.

[18] Also see page 39.

4.1.3 Burning

Burning may also differentially affect the representation of given taxa within an assemblage. Evidence of burning is extremely rare among the Early Bronze Age remains from Sos Höyük (Table 7a). Five cattle specimens (0.5%), and 20 ovicaprid fragments (1.5%), including five sheep (2.1%) and a single goat specimen (1.1%), display burning. Burning is apparent on a variety of skeletal elements and no particular association between a given element and its disposal or treatment with respect to fire is apparent. The burnt bone specimens do not appear to have been concentrated in a particular region of the excavated area or linked to specific architectural features.

Only two specimens representative of wild taxa display evidence of burning, including a red deer skull fragment and the first phalanx of a wild pig. The nuchal cranial specimen from the red deer (5.3486), which includes portions of the occipital, parietal, and left and right frontal and temporal bones and the most proximal portions of the antlers, displays the effects of burning throughout the exterior surfaces of the skull, although the lateral aspect of the left antler displays only a blackened surface. While the inner cores of the antlers are unaffected by fire, the most distal aspects of the preserved portions are burned. This implies that the remainder of the antlers had been separated, whether intentionally or through accidental breakage, from the skull some time prior to burning. This specimen was recovered adjacent to a wall, in a region of the site that provided abundant signs of burning. It therefore appears that the burning apparent on the deer skull did not result from treatment specific to this specimen but from factors following deposition. The first phalanx of a wild pig (6.1492) also displays evidence of burning on both the dorsal and ventral surfaces.

Fifteen unidentified specimens display evidence of burning, including eight (0.8%) and seven (0.7%) of the total number of large and medium-sized specimens respectively. The incidence of burning among the large and medium sized unidentified pieces is comparable to that for the identified cattle and ovicaprid remains, respectively, suggesting that these figures provide an accurate estimate of the relative frequency of burning. The burnt unidentified specimens were not recovered in any particular context or in association with a specific architectural features.

Although it has been asserted that the absence of charring on the bones may suggest that the meat was cooked only after it had been removed from the bones (Hole, Flannery & Neely 1969, 307), Kent's (1993, 348) ethnographic data from the Kalahari Bushmen has established the inadequacy of linking the degree of charring with any given cooking technique. In her study, fewer than one percent of bones that had been roasted displayed evidence of charring. Interestingly, this result is similar to that obtained for boiled bones (0.7%), where little or no charring would be expected. Roasting may not therefore significantly increase the frequency of charred bones. This is explained by the fact that roasted bones are typically not entirely defleshed and therefore do not come into direct contact with the fire. Charring is instead linked with post-consumption activities, whereby scraps of bone are tossed into the fire after the meal and subsequently burnt. Furthermore, it was observed that the heating of long bones by the Bushmen in the ashes of a fire, in order to facilitate marrow extraction, did not result in any evidence of charring on the bones. This indicates that bones may be exposed directly to ashes without incurring evidence of charring. The low frequency of charred bones at Sos Höyük therefore fails to suggest any method of food preparation.

4.1.4 The Unidentified Remains-Butchery and Tools

The frequency of butchery among the unidentified remains was examined to determine if fragmentation of specimens may have resulted in the under-representation of modified identified remains. Evidence of butchery is uncommon among the unidentified remains from Early Bronze Age Sos Höyük (Table 8a). One large specimen displays shallow cut marks, while further cut and chop marks are apparent on two medium-sized and one large-sized animal rib fragment. The frequency of butchery marks is comparable between the medium-sized and large-sized animal unidentified fragments, with both cases being slightly lower than is present among the identified remains. The overall comparability of the incidence of butchery among the unidentified and identified remains suggests that the frequencies observed for the cattle and ovicaprid remains are not significantly biased by the effects of fragmentation.

Twenty-one unidentified specimens provide evidence of human modification into utilitarian or decorative objects (Table 9a). These include 14 (1.3%) and six (0.5%) fragments from large- and medium-sized animals respectively, and a single specimen from a small-sized animal. The majority of these fragments had been modified into tools of standard type. Five large- and six medium-sized animal shaft fragments were fashioned into awls with polish about the point. Two further large-sized-animal shaft fragments had been worked into rectangular, chisel-like tools. A fragmentary portion of compact bone from a large-sized animal displays working to create an 'eye'. This incomplete specimen may have functioned as a needle or awl. Two further compact bone fragments from a large-sized animal had been modified into a crude arrowhead and barbed point respectively, while a fragment from a small-sized animal had been modified into a tanged arrowhead. Two shaft fragment from a large-sized animal reflect a particularly sophisticated level of workmanship. Both specimens are cylindrical portions of compact bone which taper gradually to a point at both ends (6.0075, 6.2002; Figure 32a-b). One of the specimens displays detailed working of the longer point into discreet facets, resulting in an octagonal cross section. The function of these items is uncertain, although they may have served as toggle pins (Sagona pers. comm.). Two fargments from a large-sized animal appear to represent off-cuts from other working, as they exhibit one or more worked surfaces.

4.2 Horse (*Equus caballus*), ass? (*E. asinus*), and hemione? (*E. hemionus*).

Ten equine specimens were recovered from Early Bronze Age contexts at Sos Höyük including eight caballine and two asinine/hemione specimens, representing an MNI of two and one respectively (Tables. 1, 10a, 15).

In addition to domestic horse and ass, a number of other equine species may have occurred in northeastern Anatolia during the Early Bronze Age. The wild horse, *Equus ferus*, although now restricted to isolated populations in Central Asia, formerly roamed throughout the northern regions of the Middle East during the Pleistocene, with specimens recorded from as far south as Petra in Jordan (Uerpmann 1987, 13). Wild horses were most suited to the open terrain of the Palaearctic, with occurrences in the Holocene coinciding with the areas of coldest climate in the Middle East. Although extinct in the Levant by the end of the Ice Age, there is some speculation that the wild horse existed in Anatolia during the Holocene period.[19] In Anatolia, wild horse remains have been identified on the basis of their large and robust size, and the fact that they predate the accepted introduction of the domestic horse into the Middle East in the Early Bronze Age. The species has been identified from Late Neolithic Tepecik and Tültintepe, Late Neolithic to Iron Age levels at Norşun- Tepe, Late Neolithic and Bronze Age contexts at Pulur Höyük, and Bronze Age levels at Demircihüyük (Boessneck & von den Driesch 1979a; Boessneck & von den Driesch 1976a; Boessneck & von den Driesch 1976, Table 1; Deniz 1975; Boessneck & von den Driesch 1978, Table 3). Suspected wild horse remains have also been recovered from Bronze Age Karataş-Semayük and Yarıkkaya (Hesse & Perkins 1974; Boessneck & Wiedemann 1977).

The hemione, *Equus hemionus*, which formerly ranged from the Mediterranean to Central Asia, is now extinct throughout much of the Middle East, with only small extant populations on the Iranian Plateau (Uerpmann 1987, 19). Hemione bones are common among Middle Eastern faunal remains from the Middle Palaeolithic to Late Neolithic periods, with remains being particularly concentrated in the region from the Levantine mountains to the Iranian highlands. In Anatolia, hemione remains have been identified from Early Neolithic levels at Çayönü Tepesı and Early Bronze Age Hassek Höyük (Meadow 1986a; Stahl 1989, 104). Questionable identifications have been made from other sites including Early Neolithic Çatal Höyük, Late Neolithic Amuq, Middle Bronze to Early Iron Age Lidar Höyük, and Early to Middle Bronze Age Demircihüyük and Karataş-Semayük (Perkins 1969; Stampfli 1983; Kussinger 1988, 101; Boessneck & von den Driesch 1978; Hesse & Perkins 1974). It has been postulated that the Taurus mountains were the northernmost periphery of its distribution, due to the absence of hemione bones in the abundant faunal remains recovered from the Altinova sites (Uerpmann 1986, 24). Given the dispute surrounding the northern limits of the hemione's range, however, it is clearly premature to conclude that hemiones were not present in northeastern Anatolia.

The range of the now extinct hydruntine, *E. hydruntinus*, extended eastwards through Europe to Asia, and south to the Levant (Groves 1986, 47). Although having osteological similarities to the zebra and being slightly smaller than the hemione, identification of the hydruntine is complicated by its overlap in many aspects of both size and morphology with *E. hemionus* (Uerpmann 1987, 19). Distinguishing post-cranial remains presents a particular problem, but various dental characteristics may permit successful separation of the two species (Uerpmann 1986, 260). Despite this, and due in part to the extreme difficulties associated with separating the remains of the smaller equids, identifications of hydruntines have remained rather tentative. Hydruntine remains have been identified in Anatolia at Early Holocene Can Hasan III, with a questionable identification from Demircihüyük (Payne 1991; Uerpmann 1987, 25). Based on current knowledge, however, the distribution of this species in Anatolia remains uncertain.

4.2.1 The Cranial Remains

Two equine mandibular teeth were identified from Early Bronze Age contexts at Sos Höyük. Although the lower cheek teeth of equids are less differentiated than upper cheek teeth for the purposes of species identification (Bökönyi 1986, 307), a variety of enamel fold morphologies are nevertheless characteristic of the different species.

The most complete specimen comprises the crown of a fragmentary second molar, (6.1491; Figure 20a).[20] The ectoflexid of this tooth reaches the end of the preflexid but remains distant from the postflexid. It is thus intermediate between the penetration by the ectoflexid apparent in hydruntines and horses, and the shallow ectoflexids typical of asses (Eisenmann 1986, 77; Bökönyi 1986, 307; Davis 1980, 283). The linguaflexid is reasonably deep, but rather than displaying the 'U'-shape characteristic of horses, reflects the pointed 'V'-shape typically seen in asinine, hemione or hydruntine specimens. The external walls of the protoconid and hypoconid are flatish as would be expected for asinine, hemione and caballine specimens, in contrast to the tendency for greater curvature apparent in hydruntines (Davis 1980, 294). The double knot is symmetrical with a rounded metaconid and metastylid, in contrast to the asymmetry apparent in caballines (Zeder 1986, 387), and the enamel fold pattern is somewhat simple. Taken together these characteristics identify the specimen as asinine/hemione. Due to the fragmentary state of the crown, the specimen could not be aged with any accuracy although the fact that the occlusal surface had been worn flat suggests an animal of at least six years of age (Levine 1982, 229).

A second molar, (6.0362; Table 15a; Figure 20b), displays caballine morphology. The ectoflexid penetrates the stem of the double knot, and, although the lingual portion of the occlusal surface of the tooth has been damaged, the linguaflexid appears to be deep and 'U' shaped. The fragmentary state of the occlusal surface precludes further assessment of fold patterns. The flat nature of the occlusal surface implies that the animal was six years of age or older.

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[19] Based on various forms of evidence, including overlap in size between the Anatolian 'wild' horse specimens and those from contemporary domestic horses from eastern Europe, and the absence of wild horse remains in earlier contexts, Bökönyi (1991) has discounted the existence of wild horses in Late Holocene Anatolia.

[20] Placement of the tooth in the dental sequence was based on the curvature of the crown, the obtuse angle between the occlusal surface and the crown wall, and the greater bucco-lingual width of the anterior over the posterior half of the crown (Davis 1980, 292).

A further specimen comprises the incisive part of the mandible with only the canine remaining *in situ*, (6.2259; Table 15a). The large size of this specimen suggests that it derived from a horse, and as the canines are typically absent or rudimentary in mares (Getty 1975, 465), the size and morphology of this canine tooth indicate a male animal. The worn state of the occlusal surface of the tooth suggests an animal of between five and eight years of age (Levine 1982, Appendix 1).

4.2.2 The Post-cranial Remains

Among the post-cranial remains, a number of equine species appear to be represented. Two specimens yield measurements that permit them to be identified as domestic horse. The depth of the caput femoris of a fused proximal femoral fragment (5.2291; Table 15i) is comparable in size to that from a modern Przewalski's horse, and only slightly smaller than a domestic horse specimen from Hellenistic/Roman levels at Lidar Höyük (Zeder 1986, Table 4; Kussinger 1988, Table 40). The greatest breadth of a complete distal sesamoid (6.1648; Table 15m) similarly falls into the size range expected for caballines.

A single post-cranial specimen provides evidence of a small equid. This radial carpal bone (6.0246; Table 15e) is most comparable in size to an asinine specimen from the Banesh level at Tal-e Malyan, southern Iran, and two modern hemione specimens, and is slightly larger than two hemione specimens from Aceramic levels at Çayönü Tepesı (Zeder 1986, Table 4; Meadow 1986, Table 3d). As the dimensions of hemione and asinine bones may overlap, the specimen is identified as asinine/hemione.

A number of specimens were recovered which are too fragmentary to yield meaningful measurements and lack the regions where diagnostic characteristics permit the identification of species. These specimens include a mandibular angle fragment (6.2826), a scapular fragment (6.2369), a proximal humeral fragment (6.0811), and a proximo-medial radial fragment (6.0528). Based on their large size, these specimens are tentatively identified as caballine.

None of the equine specimens from Early Bronze Age contexts at Sos Höyük display any evidence of butchery.

4.2.3 Summary

The remains from Early Bronze Age Sos Höyük provide evidence for the presence of at least two equine species, including the domestic horse and a smaller equid displaying asinine/hemione characteristics. Due to the difficulties associated with distinguishing fragmentary isolated remains of asses and hemiones it has been necessary to restrict identification to 'asinine/hemione'. No evidence to suggest the presence of the hydruntine or wild horse has been detected among the equid remains.

4.3 Domestic cattle (*Bos taurus*) and aurochs (*B. primigenius*).

One thousand and thirteen specimens assignable to the category of large-bovid were recovered from Early Bronze Age levels at Sos Höyük including 1006 specimens of domestic cattle and seven specimens of wild cattle, representing an MNI of 26 and two respectively (Tables 1, 11a, 16).

In addition to domestic cattle, the aurochs may have occurred in the region of northeastern Anatolia during the Early Bronze Age. Now extinct, this species, which was the wild ancestor of domestic cattle, was formerly distributed throughout most of the temperate and subtropical zones of Eurasia and inhabited a broad range of environments from Britain and the Mediterranean through to China (Uerpmann 1987, 71-2). Aurochs remains have been identified from various archaeological excavations in Anatolia dating from the Middle Palaeolithic through to the Byzantine period (Uerpmann 1987, 71-76). These include Bronze Age contexts at Demircihüyük and Hassek Höyük, Late Neolithic to Iron Age contexts at Norşun-Tepe, and Bronze to Medieval contexts at Korucutepe (Boessneck & von den Driesch 1978, Table 3; Stahl 1989,111; Boessneck & von den Driesch, 1976b; Boessneck & von den Driesch 1975, 130).

4.3.1 Differentiation of Wild from Domestic Specimens

A number of specimens were identified as aurochs on the basis of their large size and robustness. The dimensions of a forelimb first phalanx (6.1170; Table 16y) are considerably larger than those of contemporary domestic cattle, and are instead comparable in size, or larger than, wild specimens from Middle Bronze Age Korucutepe, and Early Bronze Age levels at Lidar Höyük and Hassek Höyük (Boessneck & von den Driesch 1975, Table 33d; Kussinger 1988, Table 58e; Stahl 1989, Table 29c). The dimensions of a distal humeral fragment (5.2226A-P; Table 16l), are comparable to those from a Middle Bronze II aurochs specimen from Korucutepe, and are considerably larger than those from a wild specimen dating to Middle Bronze Age levels at Lidar Höyük (Boessneck & von den Driesch 1975, Table 33; Kussinger 1988, Table 58c). A number of additional specimens, although too fragmentary to yield measurements, are sufficiently large and robustness to suggest that they also come from aurochs. These include a cervical vertebral fragment (6.2287; Table 16h), a left distal humeral specimen (6.1162), two proximal radial fragments (6.0468, 6.1161), and a proximal ulnar fragment (6.1165; Table 16n). None of these fragments display evidence of human modification, or pathological conditions.

Some fragments are too incomplete or damaged to allow even general determination of size. These were all tentatively identified as domestic cattle on the basis of the clear preponderance of this species within the assemblage. The domestic contribution to the diet of the inhabitants of Early Bronze Age Sos Höyük may thus be slightly exaggerated at the expense of the wild form.

The length of the mandibular third molar provides another useful measurement for distinguishing wild from smaller domestic cattle (Hole, Flannery & Neely 1969, 304). Determination of domestic status is facilitated by the fact that sexual dimorphism is not apparent in bovine teeth, in contrast to other skeletal elements, such as limb bones or horn cores (Grigson 1982, 7; Hole, Flannery & Neely 1963). Mandibular third molar lengths from Sos Höyük are all significantly smaller than the smallest dimension provided for *Bos primigenius* specimens from the Boreal period in Denmark (Table 43; Degerbøl & Fredskild 1970, 87). The Sos Höyük specimens also display a significantly lower range and mean than those of domestic cattle specimens from Neolithic Fikirtepe, Early Chalcolithic Çavi Tarlası, and Early Bronze Age Hassek Höyük and Lidar Höyük (Boessneck & von den Driesch 1979b, Table 4b; Schäffer & Boessneck 1988, Table 8; Stahl 1989, Table 8; Kussinger 1988, Table 9). The specimens from Sos Höyük are instead comparable, in terms of both range and mean, to samples from Middle Bronze to Iron Age levels from Lidar Höyük and Bronze Age contexts from Korucutepe (Boessneck & von den Driesch 1975, Table 9). In terms of the length of the mandibular molar, the Sos Höyük specimens therefore appear to be slightly smaller than domestic specimens from contemporaneous and earlier levels in Anatolia, and are more comparable in size to specimens from Middle Bronze to Iron Age levels.

4.3.2 Physical Characteristics of the Domestic Cattle

As relatively few examples of each bone element furnished measurements, metrical examination of the domestic cattle specimens was carried out using a log ratio diagram. The application of this technique also permits comparison with contemporaneous and later samples from other eastern Anatolian sites. Unfortunately very few measurements of aurochs from the Middle East are available for comparison. This is due to a lack of published material and because wild cattle remains have rarely been identified from sites in the Near East. Following Buitenhuis (1985, 66) and Grigson (1989), a female *Bos primigenius* skeleton dating to the Boreal period from Ullerslev in Sweden is employed as the standard for comparison. Measurements and a description of this skeleton are provided by Degerbøl and Fredskild (1970). Use of a European aurochs as a standard must be tempered with caution as European aurochs are known to have been significantly larger than the Middle and Near Eastern varieties (Grigson 1989, 90). It is unclear as to how much this would influence the outcome of the resulting log ratio diagram. For instance, specimens lying to the left of a standard derived from a European aurochs, while usually interpreted as domestic cattle, might still be representative of the smaller Near Eastern aurochs. The lack of published aurochs measurements from the Near East furthermore precludes determination of the absolute size range of aurochs for this region, and thus the range of measurements to be expected for the wild population. This complicates the interpretation of the log ratio diagram, as the relative influence of sexual dimorphism and domestication on the range of measurements observed in an assemblage cannot be readily assessed. It is known, however, that due to the strong sexual dimorphism displayed by both aurochs and domestic cattle, the size range of wild females and domestic males tend to overlap (Rowly-Conwy 1995, 116).

The histogram of size indices was based on the breadths of 76 specimens with the results falling predominantly to the left of the zero line, implying domestic animals that were somewhat smaller in size than the wild standard (Figure 9a; Table 42ai-ii). The wide range implies high variation in animal weight, with lighter animals being more abundant than heavier individuals The size indices of bone lengths were based on 64 specimens and provided a similar distribution to that apparent for the breadth measurements. Considerable variation was again apparent in height, with shorter animals being more common than taller individuals. The broad range apparent in the Sos Höyük graph may be due either to the inclusion of some wild individuals within the assemblage or a diversity of animal sizes among the cattle stock, suggestive perhaps of the presence of more than one breed. The size indices from Sos Höyük fall almost entirely to the left of the standard and the dimensions represented by the indices are comparable to those from domestic stock from Bronze Age contexts elsewhere in eastern Anatolia including Early Bronze Hassek Höyük, Middle to Late Bronze Age levels from Korucutepe and Bronze to Iron Age Lidar Höyük (Stahl 1989, Table 8; Boessneck & von den Driesch 1975, Table 11; Kussinger 1988, Table 12). This suggests that the broad range in the graph is due to domestic variability and the possible presence of more than one breed, rather than the presence of wild specimens. The distribution based on length size indices provides evidence of bimodality with groups to the left and right of the graph representing females and males respectively.

The plots of breadth and length size indices from Early Bronze Age Sos Höyük were compared to those from contemporaneous levels at Hassek Höyük and Lidar Höyük (Figure 9di-ii). The plots of size indices from Sos Höyük show a comparable median to those from Hassek Höyük although the latter displays a somewhat more restricted range for both breadth and length size indices. This indicates that the cattle from Sos Höyük and Hassek Höyük were of comparable height and weight although greater variation was apparent among the cattle at the former site. The median of the breadth size indices from Lidar Höyük suggest animals of lighter stature than were represented at Sos Höyük although the small size of the former sample necessitates that this conclusion remain tentative.

When compared with the assemblages from Middle and Late Bronze Age Lidar Höyük and Late Bronze Age Korucutepe the results from Sos Höyük again display a comparable although broader range in terms of both breadth and length size indices (Figure 9diii-v). The medians for the length and breadth size indices from Middle Bronze Age Lidar Höyük show a slight shift to the left relative to the Sos Höyük plot, perhaps indicating a small decrease in the average weight and height of the cattle from the Early Bronze to Middle Bronze period. The Late Bronze Age data from Korucutepe however implies a decrease in height relative to weight when compared to the data from Sos Höyük, while the graph from Lidar Höyük suggests a significant decrease in weight relative to the Sos Höyük graph. This may imply that greater variability in the stature of cattle had emerged by the Late Bronze Age period than was apparent in the Early Bronze Age, although the small size of many of the assemblages from the comparative sites makes this conclusion tentative.

The stature of the cattle from Early Bronze Age Sos Höyük was further investigated to obtain a better impression of the physical characteristics of the herd. Estimates of the withers heights of ancient cattle are typically calculated by multiplying the greatest length of a given long bone by a factor derived for that particular bone element, and are based on the assumption of analogous proportions in modern and ancient breeds. Breed however has been found to exert a significant effect on the relative proportions of each element in the appendicular skeleton (Wijngaarden-Bakker & Bergstrom 1988, 71). The validity of applying multipliers derived from modern breeds to determine withers heights in ancient stock is therefore questionable. A further disadvantage of this technique is the extreme rarity of intact long bones from archaeological contexts. Indeed no complete long bones were recovered from Early Bronze Age contexts at Sos Höyük. An impression of the approximate size of the cattle from Sos Höyük was thus determined using alternative means. The ranges and means of the measurements of various elements were calculated and compared with those from various Anatolian sites in order to provide a relative guide as to the size of the Sos Höyük cattle bones. The calculations were based on measurements derived from the tali, and from forelimb and hindlimb first and second phalanges (Table 44a-e). The results reveal that Early Bronze Age cattle bones from Sos Höyük are comparable in size to those from Early Bronze Age Hassek Höyük in terms of both mean and range, but tend to be slightly larger than contemporaneous specimens from Lidar Höyük. These results accord with those obtained from examination of length size indices as revealed in the log ratio diagrams.

4.3.3 Horn Cores

Three horn core fragments (6.0182, 6.1040, 6.2296; Table 16a; Figure 21) are complete enough to permit further investigation of the characteristics of the Early Bronze Age domestic cattle from Sos Höyük. These specimens were classified morphologically and assigned to a broad age class, according to criteria outlined by Armitage and Clutton-Brock (1976) and Armitage (1982). The lengths of specimens 6.0182 and 6.2296, which lack only the distal extremity of the horn cores, are estimated at approximately 235 and 260 millimetres, respectively. These specimens therefore represent a long-horned variety of cattle. Although specimen 6.1040 retained only the proximal portion of the core, the size and morphology of the fragment is suggestive of a long-horned animal. All three specimens exhibit curvature and torsion compatible with a twisted horn core morphology. On the basis of their robustness, flattened and oval cross-section, and downwards and inwards curvature, specimens 6.1040 and 6.2296 were identified as male. The former specimen displays rough bone, with porous bone concentrated about the base, and longitudinal furrows between the sheath and the core, indicative of a young adult. The latter specimen displays predominantly compact bone punctuated by few foramina and pores compatible with it being the horn core of a mature adult. By contrast, specimen 6.0182 has a greater basal circumference than the previous two specimens, a more circular cross-section and an appreciably thinner bone wall, all of which identifiy it as a castrate. This specimen, with its predominantly compact bone punctured by few foramina and pores, indicates that adult castrates were present at the site. In terms of basal dimensions, the male and castrate horn core specimens from Sos Höyük are significantly smaller than those from Middle Bronze II to Late Bronze I-II contexts from Korucutepe (Boessneck & von den Driesch 1975, Table 11a).

4.3.4 Mortality Profiles

Mortality profiles for the cattle from Early Bronze Age levels at Sos Höyük are based on mandibular remains and epiphyseal fusion data. The profile based on 25 mandibular specimens suggests relatively late mortality, with 84.0% coming from animals older than 30 months of age (Table 45a). Furthermore, 64.0% of specimens display either medium or heavy wear on the third molar, suggesting that most animals in the assemblage lived beyond 36 months of age. Infant and juvenile deaths are poorly represented with evidence for neonatal mortality lacking and the six to 18 month age group represented by only two specimens (8.0%). The dearth of specimens from young individuals may be due to the greater susceptibility of neonatal and infant bones to destructive forces, leading to their under-representation in the excavated sample. Alternatively, mortality among neonatal animals may not be represented at the site because of extramural deposition of the remains.

This mortality pattern for cattle from Early Bronze Age contexts at Sos Höyük was compared to those for cattle from contemporaneous and later levels at sites elsewhere in Anatolia (Table 45bi-ii).[21] The pattern for Sos Höyük is most comparable to those from Early Bronze Age Hassek Höyük and Late Bronze Age Lidar Höyük, although preadult mortality was slightly lower at Sos Höyük than is apparent at these sites. This may indicate that similar herding strategies were practised at these three sites during the periods represented by the profiles. A poor level of correlation is apparent between the pattern for Sos Höyük and those from Korucutepe and Demircihüyük, with the material from Bronze Age Lidar Höyük and Chalcolithic Hassek Höyük providing an intermediate degree of correspondence.

The mortality pattern derived from analysis of the state of epiphyseal fusion among the post-cranial remains is similar to that obtained from analysis of the mandibular remains. Epiphyseal fusion data derived from the analysis of 228 specimens. These data were grouped into four broad age categories reflecting the fusion times of the elements

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[21] Comparison is based on percentage abundance for the four age categories, as calculated from the number of mandibles quoted in the various reports. The dental data from Hassek Höyük and Lidar Höyük were recalculated according to the groupings of age categories used for the original analysis of Korucutepe (Boessneck & von den Driesch 1975, Table 45bi). Due to the fact that the data from Demircihüyük was grouped into a different set of age categories without values being supplied for each of the nine developmental stages, the data from Sos Höyük was also grouped according to the categories utilised for analysis at Demircihüyük in order to facilitate direct comparison (Boessneck & von den Driesch 1977, Table 45bii).

concerned (Table 46a).[22] The data reveal a strong trend toward maintaining animals into adulthood with at least 68.6% of animals having survived beyond 42 months of age. While it is clear that the majority of animals survived into maturity, a substantial degree of mortality is implied for the subadult age group. At least 89.4% of animals survived to 24 months compared with the 68.6% to 42 months. Thus both the epiphyseal fusion and dental data allow for the conclusion that mortality was largely restricted to young adult and mature adult animals. Neonatal or infant deaths are poorly represented, due perhaps to the greater susceptibility of bones of these age categories to destructive forces, and to the reduced chances of recovery of unfused specimens in a non-sieved excavation. Nevertheless, it appears that the majority of cattle from the Early Bronze Age at Sos Höyük survived into maturity.

Cattle may be herded for three principal, although not mutually exclusive, products, these being meat, dairy and traction (Higham & Message, 1970; Stein 1989, 221). Focusing management on any one of these economic goals results in a specific herd structure in terms of both the sex ratio and mortality profile.

A meat or primary production profile is characterised by low juvenile mortality, high subadult mortality among males, and adult mortality restricted primarily to female animals. The high subadult mortality of males coincides with the age at which the rate of weight gain has passed its optimum level. Although cattle may not reach their maximum weight until approximately seven years of age, 90% of their potential growth and weight gain has occurred by the age of 42 to 48 months (Higham & Message 1970, 328). Beyond this age, therefore, the additional food required by the animal to increase its bulk is not accompanied by a significant increase in size and thus meat yields. The culling of males prior to full adulthood thus provides the best return of meat for the amount of food invested in the animal. By contrast, most females will be retained into adulthood as breeding stock with only minimal numbers of males required for this purpose. The number of either males or females retained for breeding may be higher than is necessary to maintain herd size, in order to allow for such factors as stock losses through disease, predation or sterility. Due to the relatively poor meat yields obtained from immature carcasses, the culling of infants and juveniles is characteristically low in a purely or primarily meat production economy.

A herd management strategy which is focused on dairying will, by contrast, display high infant mortality, especially among males, with the majority of females surviving into adulthood for the purposes of breeding and milk production. The majority of males in the form of surplus stock will be culled within their first year, in order to reduce milk consumption, thus permitting greater exploitation of this resource by humans. The majority of females will be retained for breeding and milk production, with only a few males kept into adulthood to service the herd. Females would experience highest mortality after their reproductive and milk output had either decreased significantly or ceased completely. Overall, between 50 and 60 percent of animals would be expected to experience mortality within their first year.

A final possible influence over the demographics of herd production and mortality is the use of animals for traction. While Stein discusses this in terms of a third major mortality profile (Stein 1989, 221), this appears to overemphasise the impact that traction will exert on herd structure. Even if numerous animals within a herd are used for traction, this does not preclude their additional and simultaneous use as dairy animals or meat sources. In addition, the use of animals for traction is not necessarily restricted to castrates or indeed intact males, as the use of females, although they are less strong, carries the additional benefits of providing breeding stock and secondary products. Undoubtedly keeping animals for traction will exert some impact over herd demographics, although this influence will be highly variable, depending on the numbers and gender of the animals employed in traction activities.

The predominantly adult mortality documented for Early Bronze Age levels at Sos Höyük thus implies a herd strategy focussed on primary products. The dental data suggest that the vast majority of animals survived to beyond 30 months of age, with significant mortality, apparent from the epiphyseal fusion data, between 24 and 48 months of age. As the optimum age for the slaughter of surplus male stock occurs at between 36 and 48 months, a meat production strategy appears the most satisfactory model to account for the cattle mortality profile from Early Bronze Age Sos Höyük. Adult animals would therefore consist predominantly of females, with only a few males retained for breeding purposes. The adult females would function as breeding stock and perhaps would have furnished secondary products in the from of milk and traction.

4.3.5 Sex Ratio

Investigation of the ratio of males to females in the sample may provide further insights into the nature of exploitation and management of the cattle at Sos Höyük during the Early Bronze Age. On the basis of nine adult acetabulum specimens, two males and seven females are represented, indicating a predominance of female adults. While examination of the horn cores revealed two males and one castrate, the small number of specimens involved clearly restricts the value of this data. The results from the pelvis fragments accord well with the emphasis on primary products herd management suggested by the dental and fusion data, as the majority of males would have been culled prior to reaching adult age.

A plot of the distal breadth of the talus imparts further information regarding herd demographics. The graph (Figure 10a) reveals a bimodal distribution with a larger group, presumably females, toward the left of the graph and a smaller number of males toward the right. These tali may have derived from either subadults or adults, due to the fact

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[22] The first category, representing individuals of seven to ten months, is based on primary fusion of the pelvis. The second group is based on the fusion of the proximal radius, and first and second phalanges and the distal humerus, and spans 12 to 20 months. The third group ranging from 24 to 36 months is based on the distal metapodial bones and distal tibia. The final group is based on the proximal humerus, femur and tibia, and distal radius and femur, and ranges from 42 to 48 months.

that this bone reaches adult size reasonably early in skeletal development (Meadow pers. comm.). The results of the plot of the tali do not therefore indicate the presence of substantial subadult or adult male mortality. This is in contrast to the high subadult male mortality predicted for the primary products herd management strategy suggested by the epiphyseal fusion and dental data. This lack of subadult male mortality may imply that this age category was not present at the site, as may have occurred in a trading system of surplus male stock as either a meat or traction source to other settlements. The dental data indicate that some subadult mortality did occur at the site, although the small number of specimens involved precludes assessment of whether the higher subadult mortality indicated by the epiphyseal fusion data occurred within the vicinity of the site or at settlements elsewhere. The log ratio diagram of length size indices however indicates an approximately even representation of females and males. This includes both adult and subadult mortality as the elements on which the diagram is mainly based reach adult size early in life. It is therefore possible, given the relatively small number of specimens on which the talus data is based, that males were under-represented merely through chance. Further investigation of subadult cattle mortality at Early Bronze Age Sos Höyük is precluded however due to the restricted number of measurements deriving from other post-cranial remains from the site.

4.3.6 Butchery

Twenty-four cattle specimens (2.4%) display butchery marks. A number of horn core fragments display human modification although it appears to have resulted from a variety of activities. Seven fragments (5.3485, 6.0182, 6.0861, 6.1040, 6.1859, 6.2296, 6.2310) provide evidence of the intentional removal of the horn core from the frontal bone. Five specimens (5.3485, 6.0182, 6.1040, 6.1859, 6.2296) consist of proximal horn core fragments with deep chop marks running perpendicular to the long axis of the core and in the region of attachment to the frontal bone. Specimens 6.0861 and 6.2310 each consist of a frontal fragment showing chop marks in the region where the horn core had been separated from the skull. The horn is most commonly removed from the core by means of soaking, cutting and then pulling (Armitage & Clutton-Brock 1976, 329). Alternatively, the core and horn may be left to decompose, after which the horn can be easily separated from the core (Luff 1994, 182). Removal of the horn core, with the horn still attached, from the skull would facilitate either process, permitting easier manipulation.

The three mandibular fragments that provide evidence of butchery (5.2059, 6.0924, 6.1249) each display chop and cut marks centred about the base of the mandibular condyle. These marks occur on the lateral and aboro-lateral surface in specimens 6.0924 and 6.1249, respectively, and on the medial surface in specimen 5.2059. These types of marks are most commonly attributed to the removal of the mandible from the skull. Binford observed butchery of carcasses by Nunamiut Eskimos during which, following removal of the masseter muscles, the connective tissue at the base of the mandibular condyle was cut, after which the mandible was pried from the skull (Binford 1981, 109). Interestingly, this pattern of butchery was practised chiefly on larger animals or on those with advanced rigor mortis that had either died or were slaughtered away from the home camp. Both instances involved the removal of the mandible in order that the skull could be more easily transported back to the camp. The presence of mandibles among the excavated remains from Sos Höyük however, clearly precludes the discarding of the mandible at an off-site kill spot in order to facilitate transport of the skull back to the settlement. Instead, disarticulation of the mandible occurred at the settlement, possibly during preparation of the skull for cooking.

The right half of a cervical vertebra, which had been split in two along the saggital plane (5.2420) displays a cut mark on the caudal end of the body, running diagonally away from the articular surface. The modifications apparent on this specimen may be the result of the separation of cuts of meat in order to facilitate handling and food preparation.

A humeral fragment (6.0205) exhibits shallow cut marks on the cranio-lateral edge, and caudal surfaces, of the distal epiphysis. Transverse cut marks are in evidence on a proximal radial fragment (6.2456), on the lateral and medial edges of the dorsal surface adjacent to the articular surface. Diagonal cut marks are apparent on the medial surface of the ulnar fragment (6.1782) following the curve of the semilunar notch. These marks probably resulted from an attempt to disarticulate the radius and ulna from the humerus. Marks of this nature have been associated in modern ethnographic contexts with the disarticulation of a fresh carcass in which the joints were still flexible (Binford 1981, 124). This may imply that these specimens from Sos Höyük derived from animals that were butchered while still in a fresh state.

Cut marks are also apparent on two distal radial fragments (5.0125, 6.2372). Both specimens display transverse marks on the dorsal surface adjacent to the articular surface. These marks may have been associated with disarticulation of the distal limb or, more likely, skinning activities. Skinning marks are characterised by transverse cut marks associated with the articular regions of non-meat-bearing bones. This is due to the fact that applying the tool against a solid surface rather than a soft mass of muscle facilitates cutting and maximises the useful life of the blade (Clayton Wilson 1982, 303).

A distal femoral fragment (5.2196) displays three shallow transverse cut marks on the shaft, proximal to the supracondyloid fossa. In Binford and Kent's observations of butchery by Nunamiut Eskimos and Kalahari bushmen, respectively, cut marks on the distal extremity of the femur were most commonly associated with butchery for the purposes of meat distribution, preparation and consumption (Binford 1981, 116; Kent 1993, 337). These marks on the specimen from Sos Höyük may therefore have resulted from butchery involving removal of the vastus lateralis muscle, during food preparation and consumption .

A talus (6.1061) displays a transverse cut mark on the dorsal surface of the distal trochlea. This may have resulted either from skinning activities or an attempt to disarticulate the distal limb.

A number of metapodial bones display a variety of marks associated with different butchery activities. A metatarsal fragment including the proximal epiphysis (5.2229), displays a deep transverse chop mark on the lateral surface of the shaft. This mark is situated adjacent, and runs parallel to, the ancient break. It presumably resulted from an attempt to break the bone in two in order to extract the contained marrow. A similar series of chop marks are apparent mid-shaft on a metacarpal fragment (6.2384) and probably resulted in the breaking of the shaft at this point. This fragment also displays cut marks adjacent to the proximal articular surface due either to skinning or to disarticulation of the bone during initial butchery of the carcass. Shallow cut marks on the plantar face of a distal metatarsal fragment (6.1822) are adjacent to the articular surface and may have resulted from skinning activities or from an attempt to remove the phalanges.

A small number of phalanges display cut marks. Two first phalanges (5.1952, 5.1702) display shallow cut marks about the proximal and distal extremities, respectively. These marks would presumably have resulted from skinning activities. A third phalanx (5.2415) provides clear evidence of cut marks along the achsial margin of the sole, that may have resulted from an attempt to remove the claw.

4.3.7 Tools

Eighteen specimens (1.8%) had clearly been modified to create ornamental or utilitarian items. A rib fragment (5.3901) displays cut marks indicative of it being an off-cut or piece of debitage from working, while a scapular spine fragment (5.3462) had been fashioned into a scraper.

A number of examples were recovered in which the head of the humerus (5.3460, 5.3470) or femur (5.3465, 5.3466, 5.3468, 5.3481, 6.0244) had been modified to create a spindle whorl (Figure 22). In each case the head had been separated from the remainder of the proximal epiphysis to form a roughly hemispherical disc that had then been perforated through the centre. The humeral specimen (6.0513) represents an unfinished spindle whorl in which the disc had not been pierced.

Two specimens had been modified into awls. The unfused distal shaft of a tibia (6.1844) had been fashioned about the region of ancient breakage into a crude point. It displays evidence of both retouching and polish, with the metaphysis retained as a handle (Figure 23). The lack of scratches and high degree of polish on the working end suggests that the tool was used to pierce a soft material such as leather. A similar tibial specimen, although with a less robust point, was identified from Bronze Age levels at Dinkha Tepe in northwestern Iran (Gilbert & Steinfeld 1977, 341). A distal metapodial bone from Sos Höyük (6.0617) also displays modification of the shaft to produce a point, the polished state of which indicates use, while the epiphysis served as a handle.

A number of first phalanges (5.3479, 6.0957, 6.1669, 6.2367, 6.2622) had been modified in such a way that a hole of ten to 15 millimetres in diameter perforated the specimens dorso-ventrally through the medullary cavity (Figure 24). The lack of polish about the periphery of the perforations does not lend credence to the possibility that cords or rope were threaded through the holes. The function of these items remains unclear, although they may have served a utilitarian purpose.

A final first phalangeal specimen (6.1284) has a large hole passing from the dorsal surface into the medullary cavity. In addition, the dorsal surface of the bone had been reduced to a flat plane extending from the proximal to distal extremities. The purpose of these modifications is unclear, although an ornamental function is possible.

Evidence for a variety of activities appears to be represented in the cattle remains from Early Bronze Age contexts at Sos Höyük. The low frequency of the various marks largely precludes conclusions regarding either the sequence or precise methods of carcass processing. A low percentage of marks does not, however, necessarily correlate with infrequent butchery activities. A skilled skinner, for instance, will leave very little evidence of his activities on a carcass (Luff 1994, 189). Traces of marks may also be obscured by poor preservation. The specimens, nevertheless, illustrate activities associated with skinning, food preparation and the use of skeletal elements for the manufacture of tools or ornaments.

4.3.8 Pathology

Pathological conditions are extremely rare, with two phalanges (0.2%) representing the only instances. A complete first phalanx (5.2057; Figure 25a-b) represents an extreme case of osteoarthritis with deep, vertical grooving of the proximal articular surface, abundant exostoses about the entire bone, and extensive extra bone formation about the proximal articular surface. The cause of osteoarthritis is debated (Baker & Brothwell 1980, 115). Nineteenth and twentieth century draught horses were observed to display an extremely high frequency of osteoarthritis. Heavy traction work and constant use of an animal on hard, unyielding surfaces such as cobbled streets or metalled roads, were subsequently suggested as possible causes, with the latter considered to be the primary stimulus. In the case of the bovine phalanx from Sos Höyük, it is unlikely that this animal would have been driven continually over hard surfaces to the same extent as a modern draught horse. Traction or cartage can therefore suggested as the primary cause in this case. The absence of this condition among the other cattle phalanges from Sos Höyük may imply either that traction work comprised a specialised activity at the site for which only a limited percentage of stock was used, or that osteoarthritis was uncommon among the cattle employed in work of this kind.

A complete forelimb second phalanx (6.1868) displays exostoses around the proximal and distal articular surfaces. In the absence of additional diagnostic signs such as eburnation or grooving of the articular surface, it would be premature to conclude that this specimen displays evidence of osteoarthritis.

4.3.9 Summary

The utilisation of large bovids during the Early Bronze Age at Sos Höyük appears to have concentrated predominantly on medium-sized, long-horned domestic cattle. Exploitation focused on primary products with possible subsidiary uses including traction, for which castrates were perhaps employed, and the furnishing of secondary products from female breeding stock. Herding may have been supplemented by the hunting of wild cattle or the scavenging of their remains. Butchery marks on domestic cattle bones indicate that the entire carcass was utilised for a variety of purposes including dietary contributions in the form of meat and marrow as well as the manufacture of utilitarian or decorative objects.

4.4 Domestic sheep (*Ovis aries*), domestic goat (*Capra hircus*), wild sheep (*O. orientalis*) and wild goat (*C. aegagrus*).

One thousand three hundred and fifty-three ovicaprid bones were identified from Early Bronze Age contexts at Sos Höyük. Of these, 1347 were identified as domestic sheep or goat, representing an MNI of 85. Among the domestic ovicaprid remains, 244 specimens were identified as *Ovis* and 93 as *Capra*, representing an MNI of 36 and 14 respectively. Six specimens came from wild taxa, including three identified only as ovicaprid, two as sheep (MNI=2), and one as goat (Tables. 1, 12a, 17).

A number of medium-sized ungulates may have inhabited the region of northeastern Anatolia during the Early Bronze Age. The wild goat *Capra aegagrus*, which is now common throughout the region of the Taurus Mountains as well as the mountainous regions of Kurdestan, Azerbeidjan, Armenia and Iran, was widespread in the Near East from the Epipalaeolithic period onwards (Uerpmann 1987, 113). Wild goat remains have been identified from numerous Anatolian sites including Bronze Age Demircihüyük and Korucutepe, Chalcolithic and Early Bronze Age Hassek Höyük and Karataş-Semayük, and Bronze to Iron Age levels at Lidar Höyük and Norşun-Tepe (Boessneck & von den Driesch 1978; Boessneck & von den Driesch 1975, 131; Stahl 1989, 118; Hesse & Perkins, 1974; Kussinger 1988, 160; Boessneck & von den Driesch 1976b, Table 1). The remains of the wild goat are most commonly associated with sites in rocky environments (Uerpmann 1987, 114), and this species would have been well suited to the mountainous slopes surrounding the Erzurum and Bayburt plains.

The wild sheep, or Asiatic mouflon, *Ovis orientalis*, today exists in isolated regions in south-central Turkey and in the mountains extending from Azerbeidjan, through Armenia, to the southeastern end of the Zagros range (Uerpmann 1987, 126). The remains of wild sheep are abundant in archaeological contexts from sites throughout Anatolia. These include Bronze Age contexts at Demircihüyük Chalcolithic and Early Bronze Age Hassek Höyük , Karataş-Semayük and Pulur Höyük, Late Neolithic to Iron Age contexts at Norşun-Tepe and Bronze to Iron Age levels at Lidar Höyük (Boessneck & von den Driesch 1978; Stahl 1989 118; Hesse & Perkins 1974; Deniz 1975; Boessneck & von den Driesch 1976b, Table 1; Kussinger 1988, 159). Wild sheep are adaptable to a diversity of habitats ranging from rough and fairly mountainous terrain to sheltered plains. They nevertheless show a preference for the low vegetational cover characteristic of steppe or semidesert ecosystems.

A third species, the goitered gazelle, *Gazella subgutturosa*, is also native to regions of eastern Turkey. Post-cranial gazelle bones, although similar in size to the bones of sheep and goats, are more slender in character and differ morphologically, thus permitting differentiation in the majority of cases. By contrast, fragmentary cranial and appendicular remains are virtually indistinguishable from those of ovicaprids (Redding 1981, 245). The possibility therefore exists that gazelle specimens recovered in association with ovicaprid remains have gone unrecognised. Based on current evidence, the northernmost occurrence of the goitered gazelle comprises the lowlands and foothills to the north and east of the Tigris (Uerpmann 1987, 98). The remains of this species have been found at sites including Bronze Age to Hellenistic/Roman Lidar Höyük, and Chalcolithic to Early Bronze Age Hassek Höyük (Kussinger 1988, 164; Stahl 1989, 130). Our current understanding of it's geographical distribution therefore argues against, but does not preclude, the recovery of gazelle remains in northeastern Turkey. To judge from the more complete specimens, gazelle remains are absent among the skeletal remains identified. Thus remains identified as medium-sized ungulate are likely to represent only ovicaprids.

The differentiation of sheep and goat remains from Sos Höyük was aided by comparison with modern domestic sheep and goat reference skeletons in conjunction with the characteristics for separation outlined by Boessneck (1969) and Boessneck, Müller and Teichert (1964). The majority of specimens that preserve diagnostic characteristics were readily separated although some overlap of features was observed in a number of elements such as the first phalanges. All specimens that could not be assigned to either species with confidence were identified as ovicaprid (*Ovis/Capra*).

4.4.1 Differentiation of Wild from Domestic Specimens

On the basis of their large size and robustness, a number of the ovicaprid specimens were identified as wild. The measurements of trochlea breadth from two distal humeral fragments (6.1185, 6.2351; Table 17m) are significantly larger than those of domestic sheep from contemporaneous specimens from Sos Höyük, Middle Bronze II to Late Bronze I-II contexts at Korucutepe, and Early Bronze to Iron Age levels from Lidar Höyük (Boessneck & von den Driesch 1975, Table 18; Kussinger 1988, Table 18). These specimens are instead comparable to, or larger in size than specimens identified as wild sheep from Bronze Age levels at Lidar Höyük (Kussinger 1988, Table 61). Both specimens may thus be confidently identified as *Ovis orientalis*.

The breadth of the distal epiphysis of a goat metacarpal bone (6.2532; Table 17y) is considerably larger than those of contemporaneous domestic specimens from Sos Höyük, and from Bronze Age levels at Lidar Höyük, Chalcolithic to Early Bronze Age Hassek Höyük, and Early Bronze and Late Bronze I-II specimens from Korucutepe (Kussinger 1988, Table 19; Stahl 1989, Table 23; Boessneck & von den Driesch 1975, Table 21k). It is thus probable that this specimen represents a wild goat.

A number of fragmentary ovicaprid specimens also appear to represent wild animals. A radius (5.2193; Table 17n) and a distal tibial specimen (6.1534) are sufficiently robust to be identified with some confidence as coming from wild animals. A further distal tibia fragment, (6.0903; Table 17t), has a distal breadth comparable in size to those of wild sheep and wild goat specimens from undated and Late Bronze I-II contexts, respectively, at Korucutepe and to two wild goat specimens from Middle Bronze Lidar Höyük (Boessneck & von den Driesch 1975, Table 35; Kussinger 1988, Table 61).

Very few wild sheep or wild goat specimens therefore are apparent among the ovicaprid remains from Sos Höyük indicating a clear predominance of domestic ovicaprid remains in the assemblage.

4.4.2 Physical Characteristics of the Domestic Ovicaprids

The metrical characteristics of the sample of sheep and goat bones from Sos Höyük were investigated using a log ratio diagram. The standard measurements are derived from a wild sheep and a wild goat described by Uerpmann, and later used by Meadow, in order that results comparable to other investigations could be obtained (Uerpmann 1979, 175; Meadow 1983). Following Uerpmann's descriptions, the standard utilised for the investigation of the sheep specimens is a wild, adult, female sheep from West Iran.[23] Due to the strong sexual dimorphism apparent in the skeletons of goats, measurements for the standard came from an average of the values obtained from a male and a female wild goat skeleton from the Taurus region.[24]

The log ratio diagram for the ovine remains from Sos Höyük is based on 120 and 34 breadth and length measurements respectively. The histogram of size indices based on the breadth and length measurements reveals a reasonably small range which falls about the zero line, thus suggesting animals of comparable size to the wild standard (Figure 11a, Table 47ai-ii). This may be interpreted in one of two ways. Either the assemblage contains a large number of wild specimens, or the domestic sheep of the Early Bronze Age period in eastern Turkey were of comparable size to modern wild specimens. The results from Sos Höyük were compared with log ratio diagrams of ovine data from Chalcolithic to Iron Age contexts elsewhere in Anatolia (Figure 11d i-iv).[25] The diagram from Sos Höyük displays a similar range to that of domestic sheep specimens from Chalcolithic and Early Bronze Age Hassek Höyük and Middle II to Late Bronze I-II Korucutepe. The measurements of the specimens from Early Bronze Age Sos Höyük are also similar to those from domestic specimens from Early Chalcolithic Çavi Tarlası, and Bronze to Iron Age Lidar Höyük (Schäffer & Boessneck 1988 Table 10; Kussinger 1988, Table 18), suggesting that the Sos Höyük specimens are representative of domestic stock. The apparently large size of the domestic ovine stock from these periods has been attributed to the introduction of wool bearing sheep throughout the Near East in the Chalcolithic period (Meadow pers. comm.; Uerpmann 1994, 434). The diagram from Sos Höyük indicates that these larger wool bearing breeds were present at the site and throughout eastern Turkey during the Bronze Age period.

When the physical characteristics of the sheep from Sos Höyük are examined in further detail various parallels with other eastern Anatolian sites are apparent. The range of the breadth and length size indices from the Sos Höyük assemblage is more restricted than that from either Chalcolithic or Early Bronze Age Hassek Höyük with the median being also lower, indicating animals of shorter and lighter stature than were present at Hassek Höyük in contemporaneous and earlier periods. The range and median of the breadth size indices from Sos Höyük are however comparable to those of Middle and Late Bronze Age assemblages from Korucutepe suggesting sheep of similar body weight. By contrast, the sheep from Late Bronze Age contexts at Korucutepe appear to have been taller than those present at Sos Höyük during the Early Bronze Age. This may suggest the presence of various breeds through eastern Turkey in the Bronze Age. The lack of comparative Bronze Age data from other sites however precludes further examination of this possibility.

Twenty-eight breadth and 14 length measurements furnished size indices for inclusion in the log ratio diagram of goat remains from Sos Höyük. The resulting diagram indicates a fairly wide range distributed predominantly to the left of the zero line thus reflecting animals of smaller stature than the wild standard (Figure 12a; Table 48ai-ii). These results were compared with log ratio diagrams of domestic goat remains from Chalcolithic to Iron Age contexts elsewhere in Anatolia (Figure 12d i-v).[26] In terms of the breadth size indices, the Sos Höyük results are comparable in terms of both range and median to the assemblages from Chalcolithic and Early Bronze Age Hassek Höyük, Bronze Age contexts at Korucutepe and Middle Bronze Age Lidar Höyük Examination of length size indices, although available for only a couple of the comparative sites, presents a similar picture. The range and median at Sos Höyük are very similar to that for Early Bronze Age Hassek Höyük and Late Bronze Age Korucutepe. This implies that little variation in stature was apparent between the domestic goats of eastern Turkey during the Bronze Age period.

The stature of the domestic sheep and goats at Sos Höyük was further investigated through estimation of withers heights. Withers height calculations are based on the greatest length of various long bone elements multiplied by conversion factors developed by Teichert (1975). Analysis of a modern sample of female Shetland sheep skeletons has shown that most long bone lengths provide a reasonable estimate of withers height (Davis 1996, 611). Calculation

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[23] This specimen, (No. 57951), is currently in the collection of the Field Museum of Natural History in Chicago, U.S.A.

[24] The male (No. 653L2) and female (No. 653M) specimens are both housed in the British Museum of Natural History, England.

[25] The log ratio diagrams use Uerpmann's wild sheep standard and are based on measurements provided in the text of reports from Hassek Höyük (Stahl 1989, Table 22) and Korucutepe (Boessneck & von den Driesch 1975, Table 21).

[26] The log ratio diagrams use Uerpmann's wild goat standard and are based on measurements provided in the text of reports from Hassek Höyük (Stahl 1989 Table 22), Lidar Höyük (Kussinger 1988, Table 26) and Korucutepe (Boessneck & von den Driesch 1975, Table 21).

of the withers height for the *Ovis* specimens was based on a sample of nine long bones comprising seven metacarpal and two metatarsal bones (Table 49a). These calculations yielded a mean withers height of 65.2 centimetres, with a reasonably broad range, but relatively low standard deviation. The withers heights of the sheep from Sos Höyük show a comparable range and mean to domestic sheep specimens from Early and Middle Bronze Age Lidar Höyük and Late Bronze I-II levels at Korucutepe (Table 49d i-ix), indicative of comparable stature.[27] By contrast, the Sos Höyük sheep appear to have been slightly taller at the shoulder than specimens from Neolithic Fikirtepe and Middle Bronze II levels at Korucutepe, and smaller than specimens from Chalcolithic and Early Bronze Age Hassek Höyük. Medium-sized domestic sheep thus appear to be represented from Early Bronze Age levels at Sos Höyük. The variation apparent in the withers heights of the domestic sheep from eastern Anatolia appears to support the variation in sizes implied by the log ratio diagram, suggesting the presence and exploitation of a number of breeds in eastern Turkey during this period.

Unfortunately withers height calculations for the domestic goats from Early Bronze Age contexts at Sos Höyük are based on a single specimen (Table 50a). A complete metacarpal bone yields a withers height of 60.9 centimetres. This result is comparable to the withers heights, also based on single specimens, from Early Hittite/Early Bronze II-III levels at Ikiztepe, Early Chalcolithic Çavi Tarlası, Chalcolithic Hassek Höyük and Middle Bronze Korucutepe (Table 50ci-xi). The withers height derived from the Sos Höyük specimen is significantly lower than those calculated from single specimens dating to Early Bronze Age levels at Korucutepe and Late Bronze Age contexts at Lidar Höyük. As the calculation of withers heights from most of these sites was based on a single specimen, it would be premature to draw conclusions regarding the relative sizes of the domestic goats represented, although the specimen from Sos Höyük appears to represent a medium-sized animal. The comparability of the calculated withers heights from these sites suggests little change in the stature of domestic goats during the Bronze Age. This result agrees with the size comparability and lack of evidence for size diminution in the goat log ratio diagrams for eastern Anatolia.

4.4.3 Horn Cores

Further indications of the physical characteristics of the sheep and goats from Early Bronze Age levels at Sos Höyük can be obtained from an analysis of horn core morphology. Of the 28 horn core fragments recovered, 17 could be identified to species while 11 specimens, due to their highly fragmentary nature, could only be identified as ovicaprid.

Five *Ovis* horn cores (6.0027, 6.0282, 6.0514A-B, 6.2291; Table 17a) from four animals were identified among the ovicaprid remains. Each specimen displays features compatible with their identification as horn cores of domestic stock. These features include a prominent fronto-medial keel, rounded nuchal edge, a strongly convex lateral surface coupled with medial flattening, and no apparent torsion (Redding 1982 248). A single specimen (6.0514A-B) was identified as female on the basis of its slender morphology (Figure 26). This specimen is larger in terms of basal dimensions than female domestic horn cores identified from Middle Bronze to Iron Age Lidar Höyük, but comparable in size to the larger female specimens from Late Bronze I-II contexts at Korucutepe and to a female specimen of unknown date from Hassek Höyük (Kussinger 1988, Table 25; Boessneck & von den Driesch 1975, Table 21; Stahl 1989, Table 22). The specimen from Sos Höyük preserves both horn cores and the adjacent frontal bones and clearly shows the 'Y'-shaped parieto-frontal suture typical of sheep, in contrast to the 'T'-shaped suture observable in goats. The remaining three *Ovis* horn cores from Sos Höyük are particularly massive with extremely robust walls. Their morphology in addition to their cross-sectional profiles which exhibit a prominent frontal keel as opposed to the posterior keel apparent in wild sheep, are suggestive of their domesticated status (Hole, Flannery & Neely 1969, 278). In terms of both morphology and dimensions these male horn cores are comparable to a specimens from a so-called 'Kupferschaf (*Ovis aries studeri* Duerst)/Torfschaf (*Ovis aries palustris* Rütimeyer)' cross, which was recovered from Chalcolithic levels at Alişar Höyük (Patterson 1937, 301). The dimensions of the male *Ovis* horn core specimens from Sos Höyük are also comparable to those from domestic male sheep specimens dating from Neolithic contexts at Fikirtepe and to the larger specimens from Middle Bronze to Iron Age Lidar Höyük and Early Bronze Age Hassek Höyük. They are, however, significantly larger than a single male domestic specimen from Late Bronze I-II contexts from Korucutepe (Kussinger 1988, Table 25; Stahl 1989, Table 22; Boessneck & von den Driesch 1975, Table 21).

Thirteen *Capra* horn core specimens were recovered from Early Bronze Age levels at Sos Höyük. Seven specimens (5.3585, 5.3598, 6.0044, 6.0045, 6.0698, 6.1460, 6.1707) display a frontal keel, rounded nuchal edge, medial flattening and obvious helical twist. These are all features characteristic of the horn cores of domestic goats (Figure 27a-b; Hole, Flannery & Neely 1969, 272). Although nine of the *Capra* horn core specimens are highly fragmentary, their morphological similarities to the more complete specimens permit their identification as domestic. Two specimens (5.3598, 6.0045; Table 17a) were identified as male on the basis of their robustness, greatest and least basal diameter, and strongly twisted morphology (Tekkaya & Payne 1988, 235; Boessneck & von den Driesch 1975, 78). These specimens are smaller than those identified as domestic male goat specimens from Middle Bronze to Hellenistic/Roman contexts at Lidar Höyük and than a single horn core from Early Hittite to Early Bronze II-III levels from Ikiztepe (Kussinger 1988, Table 26; Tekkaya & Payne 1988, 235). The specimens from Sos Höyük are instead comparable to goat horn cores from Early Bronze Age Hassek Höyük, Early Bronze II and Late Bronze I-II levels at Korucutepe, and a single male specimen from Early Chalcolithic Çavi Tarlası (Stahl 1989, Table 23; Boessneck & von den Driesch 1975, Table 21; Schäffer & Boessneck

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[27] Where necessary withers heights were recalculated using Teichert's conversion factor. These recalculations were performed for the specimens from Korucutepe (Boessneck & von den Driesch 1975, Table 21), Çavi Tarlası (Schäffer & Boessneck 1988) and Ikiztepe (Tekkaya & Payne 1988). Withers heights from Fikirtepe (Boessneck & von den Driesch 1979b, Table 10), Lidar Höyük (Kussinger 1988, Table 17a), and Hassek Höyük (Stahl 1989, Table 20) were transcribed directly from the original reports.

1988, Table 10). With less twist and a more gracile appearance, two specimens (6.0698, 6.1460) from Sos Höyük were identified as female, although due to their fragmentary state they did not furnish measurements for comparison.

4.4.4 Mortality Profiles

The construction of mortality profiles was based on analysis of dental and epiphyseal fusion data. The analysis of ovicaprid mandibular specimens presents numerous difficulties in addition to those typically associated with the analysis of dental remains. Teeth may erupt at somewhat different ages for sheep and goats (e.g. Amorosi 1989). Deniz and Payne, however, found only minor differences between the eruption sequence and times for modern Turkish Angora goats and comparable data supplied by various authors for nineteenth and twentieth century domestic sheep (Deniz & Payne 1983, 161). Discrepancies between the data sets tend to involve the incisor teeth and are thus irrelevant to mortality profiles based on analysis of the cheek teeth. The application of sheep eruption times to ovicaprid mandibles thus appears to be a valid approach in cases where identification to genus is problematic. Variation between feeding patterns of the two genera, however, may result in different tooth wear rates (Nyerges 1977; Redding 1981). Within the sample analysed by Deniz and Payne, a tendency emerged for the early wear stages of the third molar to occur more rapidly in sheep than in goats.[28] The influence of discrepancies between the wear rates of sheep and goats in the construction of mortality profiles nevertheless can be minimised through the application of a technique of dental analysis that limits the importance of attrition.

It has been observed in the case of goats, at least, that the teeth of males erupt sooner and wear more quickly, than those of females (Deniz & Payne 1983, 161). As it is rarely possible to separate male from female ovicaprid mandibles, analysis of undifferentiated samples may provide misleading results regarding the ages at which mortality occurred.

While sheep and goats have traditionally been herded together, as they enhance the variety of returns from the herd, the two species have typically been bred for different products (MacKenzie 1970, 96). This may involve differing husbandry practices with consequent variation in the sex and age profiles for the sheep and goat components of the herd. These differences will be obscured in an assemblage in which sheep and goat remains cannot be separated. The detection of potentially different mortality profiles, and thus management strategies, for sheep and goats was attempted by identifying ovicaprid mandibles to genus. Payne's (1985b) methodology for distinguishing between the mandibles of sheep and goats was applied to the lower cheek teeth remains from Sos Höyük. Involving only deciduous third and fourth premolars, and first molars with minimal wear, these criteria are usable only on immature and subadult specimens. Another characteristic involving the morphology of the most distal cusp of the lower third molar was utilised in order to correct for this bias (Halstead pers. comm.).

Analysis of the dental data is based on a sample of 58 ovicaprid mandibular remains. Due to the greater frequency of specimens that could not be identified to genus than those that could be identified either to *Ovis* or *Capra*, the analysis was initially based on a cumulative sample of sheep, goat and ovicaprid mandibles (Table 51a). Analysis of these remains indicates that mortality was high among infants with 27.6% between six and 12 months of age, and somewhat lower between 12 and 24 months (22.4%) and between 24 and 48 months (17.2%). The level of mortality was also high among adults with 32.8% dying beyond 48 months. Evidence for neonatal and infant mortality is lacking.[29] This may be attributable either to the destruction of neonatal and infant bones through taphonomic and recovery biases, or to the failure of these age classes to be deposited at the site through such factors as extramural mortality. That neonatal animals are under-represented in the analysed dental data is indicated by the recovery of three fragmentary mandibular specimens of late fœtal or early neonatal age. As these specimens lack any portion of the cheek tooth row they could not be included in the molar wear and eruption stage data. In sum, the mortality profile based on the mandibular remains from ovicaprids therefore provides evidence of high infant and adult mortality, with lower levels apparent among juvenile and subadults. These results imply that the ovicaprids at Sos Höyük were raised and consumed at the site as this system is characterised by the representation of all age categories within the assemblage (Payne 1973).

The mortality profile for the Early Bronze Age ovicaprid mandibles remains from Sos Höyük is compared with those from contemporary and later contexts from other sites in Anatolia (Table 51d i-ii).[30] A high level of similarity can be seen between the profile from Sos Höyük and that from Middle Bronze Demircihüyük. A reasonable degree of similarity is apparent between the Sos Höyük profile and that from Late Bronze I-II Korucutepe, although infant mortality is proportionally lower in the latter case. By contrast, a relatively low degree of comoarability is found between the data from Sos Höyük and those from the remaining samples.

The dental data for the 28 sheep specimens from Sos Höyük were analysed separately in order to determine the relative contribution of sheep mortality to the ovicaprid data (Table 51a). The resulting picture of mortality is very similar to that obtained for the cumulative ovicaprid data. Infant and

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[28] (Deniz & Payne 1983, 161). Also see page 15 for a discussion of the influence of gender over dental development.

[29] Natural mortality rates for neonatals and infants among modern ovicaprids from the Middle East and north Africa that have been maintained under conditions of extensive husbandry equal approximately 32% and 45% for sheep and goats respectively (Redding 1981 112). Neonatal and infant natural mortality rates for more primitive pastoralists would be expected to equal or exceed those of modern herders.

[30] The dental data were grouped according to the same system as was applied to the cattle remains, with the mandibular specimens from Hassek Höyük and Lidar Höyük recalculated according to the groupings of age categories used for the original analysis of Korucutepe (Boessneck & von den Driesch 1975; See Table 51d i). The Sos Höyük specimens were also classified according to the groupings used in the original analysis of the Demircihüyük data (von den Driesch & Boessneck 1987; See Table 51d ii).

adult mortality is highest, at 25.7% and 31.4% respectively. Juvenile and subadult mortality are again lower, at 20.0% and 22.9% respectively. A reliable mortality profile could not be determined for goats as only six specimens identified from this genus are available for analysis.

The analysis of the Early Bronze Age ovicaprid mandibular remains from Sos Höyük thus implies a relatively low level of subadult and juvenile relative to infant and adult mortality. The validity of this result can be tested by comparison with the mortality profile derived from analysis of epiphyseal fusion data.

Analysis of epiphyseal fusion data from ovicaprid remains is complicated by numerous factors. Fusion of epiphyses may occur at different times for sheep and goats. Noddle's examination of a variety of sheep and goat skeletons suggests that skeletal maturation for goats, whether feral or domestic, is considerably later than for both domestic and feral sheep (Noddle 1974, 195). In cases where specimens cannot be identified as *Ovis* or *Capra*, and a combined sample must be used, this disparity in fusion times would decrease the usefulness of the results. It is possible, however, that the difference between modern domestic sheep and goat maturation rates is more extreme than it was in ancient times. Modern sheep are the result of vigorous selection for rapid growth and maturation whereas goats have been selectively bred primarily for milk production (Noddle 1974, 203).

Analysis of epiphyseal fusion is based on the fusion times of a number of skeletal elements grouped into four broad age categories (Table 52ai).[31] Three hundred and fifty-eight ovicaprid specimens were utilised for the analysis of epiphyseal fusion. Investigation of the combined ovicaprid sample provided a mortality profile that essentially agrees with that derived from the dental data. Infant and juvenile mortality are relatively high, with the data implying that at least 29.7% of animals had died by 24 months of age. This appears, nevertheless, to suggest somewhat lower mortality in these age categories than is apparent from the dental data. The greater susceptibility of infant and unfused bones to destructive forces and their decreased likelihood relative to fused specimens of being recovered in non-sieved excavation may account for this discrepancy. At least 76.3% of animals died prior to 42 months, generally agreeing with the 67.2% of animals dying prior to 48 months of age as suggested by the dental data.

The relative contribution of sheep and goats to the overall ovicaprid mortality profile, as derived from the analysis of the epiphyseal fusion data, can be assessed to some degree by the construction of separate profiles for elements that can be identified as either *Ovis* or *Capra*. Analysis of the sheep post-cranial elements was based on 129 specimens, while a sample of 37 post-cranial specimens provided information on goat epiphyseal fusion (Table 52ai). The mortality profile provided by the sheep epiphyseal data suggests that mortality was extremely low among infants and most pronounced among adults, with at least 2.9% dying prior to ten months and at least 44.4% surviving to over 36 months. A similar profile was apparent for the goat remains with no infant mortality and at least 50.0% dying after 36 months, although the extremely small sample size in the latter case limits any conclusions. When the ovicaprid, *Ovis* and *Capra* profiles are considered together, they reveal comparability in the level of mortality across the younger age classes, although mortality tends to be slightly lower for the ovicaprid profile. A significant discrepancy between the results for the combined ovicaprid and separate sheep and goat profiles is observed for the mature adult category, with survivorship being significantly higher in the latter two cases. These discrepancies can be accounted for by the fact that in all fusion categories, unfused elements may be under-represented relative to fused elements due to the greater difficulty associated with identifying the former to genus (Halstead pers. comm.). The discrepancy between the adult mortality for the ovicaprids as a whole and for the separate sheep and goat assemblages may also be an artifact of the small sample sizes involved in the latter cases, as only nine sheep and two goat specimens were available for the calculation of adult mortality.

The mortality profile provided by the *Ovis* epiphyseal data also differs from that derived from the dental data. While the epiphyseal fusion data indicate that at least 22.0% of animals died prior to 24 months, the dental data suggest mortality of 45.7% for the first 24 months of life. Similarly while the epiphyseal fusion data indicate that at least 55.6% died prior to 42 months of age, the dental data suggest that a somewhat higher figure of 68.6% had died by 48 months. The lesser identifiability to genus of unfused epiphyses may again account for these differences. The low numbers of specimens identified as *Capra* in the epiphyseal fusion and dental analyses precluded further investigation of the characteristics of this profile.

Overall, a mortality profile for the ovicaprids from Sos Höyük emerges in which approximately one third of animals died as infants, a further third as juveniles or subadults, and the remainder as mature adults. This result clearly does not accord with the predicted profiles for secondary products exploitation in the form of either milk or wool. In a herding strategy focused on milk production, the removal of young males and retention of adult females results in a profile in which infant mortality reaches between 50 and 60 percent and declines gradually thereafter. By contrast, a herding strategy designed to maximise wool production would be characterised by the retention of both males and females for wool, with over 50% of the herd surviving into adulthood. The profile for Early Bronze Age levels at Sos Höyük instead suggests a focus on primary products. In this regime, in which meat forms the focus of production, most surplus stock are killed prior to maturity. Young males tend to be culled when they reach optimum weight (Payne 1973, 281). Typically the highest return for the feed provided will result if animals are slaughtered in their second or third year. Most males are therefore slaughtered prior to skeletal maturity, with only a few retained for breeding purposes.

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[31] The first category representing animals aged less than ten months of age is based on analysis of the scapula, the pelvis, the proximal radius and distal humerus. The second age group representing juvenile animals is based on fusion of the proximal first and second phalanges, and the distal tibia and metapodial bones. The third group representing animals of between 30 to 36 months involves analysis of the proximal ulna and femur, and the calcaneus, while the fourth group representing animals of 36 to 40 months and over, is based on analysis of the distal radius and femur and the proximal tibia and humerus.

By contrast, the majority of females are retained until the cessation of their reproductive cycle, prior to which they may also provide milk and wool. An overall profile of approximately one third infant mortality, one third juvenile to subadult mortality, and one third mature adult mortality would thus be expected in an idealised primary products herding system (Greenfield 1991, 171). The profile from Sos Höyük accords well with this 'idealised' system, thus supporting the hypothesis that the ovicaprids were herded primarily for meat during the Early Bronze Age.

4.4.5 *Ovis:Capra* Ratio

Some assessment of the relative contribution of sheep and goats to the economy of Early Bronze Age Sos Höyük can be made through a closer examination of the data. Based on the total number of specimens that could be assigned to genus, the ratio of sheep to goats is 2.62:1. In order to assess whether this ratio remains constant throughout the different age categories, the ratio of sheep to goat amongst the fused elements for each fusion group was calculated (Table 55a ii). These data indicate that, within the limits of sample biases, the ratio of sheep to goats increased from the first to third fusion group. The relatively low ratio of 1.7:1 for the first group implies that only slightly more sheep than goats survived to eight months of age. The ratio of sheep to goats in the second and fourth groups is approximately 4:1. This may indicate that considerably more sheep than goats were also surviving to mature adulthood. The ratio of 8.50:1 sheep to goats for the third age group does not appear to accord with the results from the second and fourth age groups, although the relatively small sample sizes for fused sheep and goat bones in both the third and fourth age groups prompts caution in accepting the validity of these results. Indeed, the ratio of sheep to goat mandibles displaying medium to heavy wear on the third molar, and thus representing mature adults, equals 2.7:1, and is therefore extremely close to the overall ratio of sheep to goats. The ratio of sheep to goats derived from both the dental and epiphyseal fusion data for the subadult to mature adult categories nevertheless implies that sheep were between three and five times more abundant than goats. Both the overall ratio of sheep to goats, and those ratios representing different age groups based on the epiphyseal fusion data, are appreciably lower than the modern ratio of 10:1 for sheep to goats within the Erzurum province (A.S.P. 1983, 104). Personal observations of modern ovicaprid herds in the village of Yiğittaşı, which surrounds the ancient settlement of Sos Höyük, also indicate a substantial predominance of sheep relative to goats. This may indicate that the focus of ovicaprid herding has changed substantially in Erzurum province over time.

4.4.6 Sex Ratio

The herd management strategy employed during the Early Bronze period at Sos Höyük was further investigated through analysis of the relative mortality of males to females within the excavated sample. Data on the ratio of males to females within the sample of sheep and goat bones were obtained through the morphological analysis of various pelvic specimens. Six adult *Ovis* pelvis fragments permit gender identification. Five of these specimens were identified as female and one as male. Pelvic specimens identified as female are most likely to have come from animals that have given birth at least once and are thus two years of age or older (Halstead 1992, 38). The mortality data based on tooth eruption and epiphyseal fusion suggest that 30 to 50 percent of animals died prior to 24 months. Given that, at birth, the ratio of females to males will approximate 1:1, the sex ratio of the pelvic specimens may suggest that the majority of the younger deaths occurred among males. The small sample size however, makes this result somewhat tentative.

Ten adult *Capra* pelvic specimens were identified to gender, with a ratio of 9:1 females to males. As with sheep pelvic specimens, those identified as female are likely to have come from animals of at least two years of age. The lack of specific mortality information for goats, due to the small samples available for dental and epiphyseal fusion analysis, means that the significance of the sex ratio for goat herding remains unclear.

The apparent predominance of adult females in the pelvic remains lends further support to the suggestion that the ovicaprids present during the Early Bronze Age occupation of Sos Höyük were managed according to a primary products strategy. Meat thus appears to have constituted the focus of ovicaprid herding at Sos Höyük, although secondary products such as milk, wool, and hair may also have been exploited.

4.4.7 Fœtal and Neonatal Bones

Fifteen ovicaprid specimens (1.11%) came from either fœtal or neonatal animals. Fœtal bones were identified as ovicaprid on the basis of morphological traits outlined by Prummel for distinguishing the fœtal bones of horses, cattle, sheep, goats and pigs (Prummel 1987a; Prummel 1987b; Prummel 1988). Investigations of the fœtal development of sheep and goats show them to be essentially the same (Prummel 1987a, 27 after Rajtova 1972, 1973). For instance, the influence of sex on the ages of initial ossification during the development of the fœtal skeleton for both sheep and goats was found to be negligible. However, while the sequence of phases of ossification in the skeleton are the same for both species, the relative duration of the phases was found to vary slightly. Ovicaprid fœtal and neonatal bones are, however, virtually impossible to assign to species due to the poor development of the diagnostic morphological characteristics (Prummel 1988, 19). Due to the predominance of sheep relative to goats among the ovicaprid remains, and given the relatively minor differences between the fœtal development of sheep and goat skeletons, the fœtal specimens are considered to represent sheep specimens.

On the basis of their size, proportions and extreme porosity, five specimens were identified as fœtal. The age of fœtal specimens can be estimated from diaphyseal length through a variety of methods. These include Habermehl's (1975, 113-4) tables of concordance between fœtal age and mean diaphyseal length, Richardson, Herbert and Terlecki's (1976) linear regression equations, and McDonald, Wenham and Robinson's (1977) Gompertz equation. As the latter equation was devised using a sample comparable in withers height to sheep from Early Bronze Age levels at Sos Höyük, this method is likely to provide the best estimate of age for the fœtal development of long bones. Here, fœtal age is calculated using an adaption of the original Gompertz equation devised by McDonald *et al.* from which body weight is omitted as an independent variable.[32] A single tibial specimen (6.0461), with a diaphyseal length of 5.25 centimetres, suggests a gestation of 104 days.

Application of McDonald's Gompertz equation is based on an estimated gestation period of one hundred and forty-four days. Information concerning the probable length of gestation of early domestic sheep is lacking. Modern sheep display a gestation period of approximately 140 to 150 days (King & Thatcher 1993, 260). By contrast, *Ovis orientalis*, the wild ancestor of modern sheep, exhibits a longer and more variable period of gestation, ranging from 150 to 170 days (MacDonald & Barrett 1993, 221). As the duration of gestation is also known to be affected by breed, the sex of the fœtus, the number of lambs, the season of mating, and the nutritional status of the ewe (Amir, Genizi & Schindler 1980; Forbes 1967), it is difficult to estimate the approximate duration of gestation of the Early Bronze Age sheep at Sos Höyük relative to wild and modern domestic animals. Given that many modern sheep varieties have been bred for more rapid maturation (Amir, Genizi & Schindler 1980, 47), the gestation period of the early domestic sheep might be expected to more closely approximate that of their wild ancestors. It is thus important to consider that the results obtained using McDonald's Gompertz equation may slightly underestimate the age of the fœtus from Early Bronze Age levels at Sos Höyük.

A further four fragmentary specimens including two distal scapular fragments (6.1982, 6.2284), a metacarpal shaft (6.2147), and a metatarsal shaft fragment (5.1098) display a size and porosity that suggest that they also came from animals in the late stages of fœtal development.

Based on their size and porosity, four incomplete specimens, including an unfused distal humerus (6.0765) and three mandibular fragments (6.0269, 6.1453, 6.2522) were identified as either late fœtal or neonatal in age.

Six specimens (0.45%) comprised neonatal specimens. These included two distal scapular fragments (6.0588, 6.2284), an unfused distal humeral fragment (6.0276A-H), a complete radial diaphysis (6.1190), the unfused head of a femur (6.1314), and a metacarpal bone with an unfused distal epiphysis (6.1047A-B). The neonatal age of these specimens was indicated by the porous nature of the bone indicative of primary bone deposition, the slender proportions of the diaphysis relative to the extremities, and, in cases where the epiphyses were present, the lack of adult morphology.

Fœtal and neonatal mortality may result from a variety of causes including congenital defects of either the ewe or the fœtus, infections of the genital organs, or complications associated with parturition (Prummel 1988). Typically, fœtal and neonatal bones recovered during excavation can be expected to reflect failures of gestation and birth rather than intervention by man in the form of slaughter of pregnant ewes or neonatal lambs. It is, however, almost impossible to separate the influence of man over natural mortality given the nature of the remains. Mortality among young fœtuses might be expected to be under-represented in excavation. Embryos contain no bone, while bone from very young fœtuses may be resorbed in the uterus. The extremely small size and fragility of bones from young fœtuses would be prone to destruction and face an extreme unlikelihood of recovery in a non-sieved excavation. Identification of fœtal bones from early in pregnancy is also significantly more difficult than identification of fœtal bones from the terminal stages of gestation, due to their undeveloped morphology. The fœtal bones identified in the excavated sample suggest a concentration of fœtal mortality in the terminal phases of gestation. It is unclear, however, whether the lack of fœtal bones from the middle phases of gestation reflects a real absence of animals of this age at the site or is due, as seems more likely, to preservation and excavation biases.

4.4.8 Butchery

Evidence of human modification in the form of cut or chop marks was apparent on 23 specimens (1.71%) within the total ovicaprid sample.

Three sheep horn core specimens (6.0282, 6.0514A-B, 6.2291) exhibit chop or cut marks on the frontal bones. These marks probably derived from attempts to remove the horn core from the skull. This method of detachment of the horn cores is considerably easier than attempting to chop through the proximal portion of the horn core. Horn cannot readily be removed from the horn core in the fresh state. It is therefore likely that the horn core was detached from the skull to facilitate manageability during such horn removal processes as boiling or the natural decomposition of the intervening corium. Cut marks adjacent to the horn cores on the frontal bones of specimen 6.0514A-B provide probable evidence of skinning.

Not surprisingly, evidence of similar butchery is apparent among the caprine horn cores. Both specimens that retain a portion of the adjacent cranial bones (5.3598, 6.1460) display chop marks about the frontal bone associated with the probable removal of the horn core from the skull. A further two specimens (6.0045, 6.0698) display transverse cut marks towards the base of the horn core. These ultimately resulted in the separation of the horn core from the skull. A proximal horn core specimen (6.1707) and a horn core lacking the most proximal portion (6.0044) are distinguished in that they had been separated from the remainder of the horn core by means of oblique cuts in contrast to the transverse cuts typically observed. These specimens may have been modified during the manufacture of tools or ornamental pieces. The inhabitants of Early Bronze Age Sos Höyük were expending substantial effort to remove both sheep and goat horns and may also have utilised the resulting horn cores for the manufacture of utilitarian or decorative objects.

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[32] The equation used was as follows:

$$\ln (y/P) = Q/100R\ (1-e^{R(144-t)})$$

where t equals the days after conception, y is diaphyseal length in centimetres, P is an estimate of the diaphyseal length at birth, Q is an estimate of the specific growth rate and R is the rate of exponential decay of the specific growth rate (Prummel 1988, 18).

A single ovicaprid cranial specimen displays evidence of butchery which was not concentrated on or about the horn cores. A sheep mandibular fragment (6.1731) displays shallow horizontal cut marks on the lateral surface of the ramus, adjacent to the mandibular condyle. Marks in this region may be caused by attempts to remove the mandible, perhaps to facilitate food preparation.

A scapular fragment (5.3540) exhibits a small oblique cut mark on the lateral surface of its caudal edge. This mark may have originated from attempts to remove the meat from the scapula including the subscapularis and teres major muscles.

Evidence of butchery on the humerus is restricted to the distal epiphysis. Two ovicaprid (6.0408, 6.1852) and two sheep (6.1348, 6.2117A-B) distal humeral fragments have evidence of cut marks on the cranio-lateral and cranio-medial edges of the distal condyle. Kent's (1993) study of Kalahari Bushmen revealed that disarticulation of the radius/ulna from the humerus occurred in the primary stages of butchery, in order that the carcass, retaining the meat-bearing humerus, could be roasted in a relatively compact form. Alternatively, disarticulation of the radius may result from the need to obtain smaller cuts of meat that would fit into cooking pots. Binford's (1981, 124) study of the butchery practices of Nunamiut Eskimo revealed that marks on the cranial region of the humeral condyle most frequently resulted from disarticulation of the radius, and tended to be associated with butchery of fresh carcasses. This may imply that, in at least some cases, the disarticulation of ovicaprid carcasses during the Early Bronze Age at Sos Höyük was undertaken promptly after slaughter.

A radial fragment (6.2181) exhibits transverse cut marks on the distal portion of the shaft, adjacent to where the distal extremity had been removed. These marks probably originated from skinning activities. Comparable transverse marks have been detected 'encircling the shafts of lower limb bones' including the distal tibia, radius and metapodial bones in ethnographic observations of the skinning activities of Nunamiut Eskimos (Binford 1981, 107).

Four complete sheep tali (5.0409, 6.0705, 6.1326, 6.1939) all display transverse cut marks on the dorso-lateral and dorso-medial edges of the distal articular surface. Similar marks apparent on tali from Farukhabad were attributed to an attempt to disarticulate the metatarsal bone (Redding 1981, 250). Alternatively, marks in this region may indicate attempts to take advantage of the location of skin against a non-meat-bearing bone, which would facilitate skinning. As noted previously, transverse slicing marks on non-meat bearing elements are characteristic of skinning procedures (Clayton Wilson 1982, 303).

A number of metapodial bones also reflect evidence of probable skinning. A fragmentary ovicaprid proximal metacarpal bone (5.2688) displays transverse cut marks on the dorsal and plantar surfaces of the shaft, while a fragmentary sheep metatarsal bone (6.2130) exhibits transverse cut marks encircling the distal end of the shaft. Transverse cut marks were also observed on the dorsal surface towards the distal extremity of a complete sheep first phalanx (6.1661). These marks presumably also resulted from skinning activities.

Among the wild ovicaprid remains, two specimens display evidence of butchery. A sheep distal humeral fragment (6.1185) displays cut marks on the cranio-lateral and cranio-medial edges of the distal condyle, which probably resulted from attempts to disarticulate the radius and ulna. Cut marks on the medial and lateral edges of the proximal articulation of an ovicaprid radial fragment (5.2193) may have resulted from similar efforts at disarticulation.

4.4.9 Tools

Twelve (0.89%) specimens display intentional modifications that took advantage of their natural form in order to produce tools or implements. These specimens do not appear to be associated with any specific architectural features.

A number of tali provide evidence of use as rubbing tools. Seven ovicaprid specimens (6.0612, 6.0706, 6.1195, 6.1881, 6.1359, 6.1396, 6.1411) exhibit a reduction of their lateral and medial sides to flat polished surfaces. A similar example, in which only the lateral surface had been worn flat, has been described from Bronze Age contexts at Dinkha Tepe (Gilbert & Steinfeld 1977, 342). These tools may have been utilised for the treatment of such materials as leather or for the burnishing of pottery. The faint striations present on the polished lateral and medial surfaces of fragment 6.1195 may indicate that some rubbing tools were used against hard surfaces, such as dried clay, rather than against pliable media such as leather. This particular specimen has the additional distinction of displaying a clean oblique fracture that separated the proximal and distal portions. The absence of any wear or polish around the edges of this ancient break suggests that the tool was discarded following this damage.

A number of long bone specimens had been modified into awls or boring tools. These include a sheep distal metatarsal bone (6.1927), an unfused distal metapodial bone (6.0460) and the distal portion of a sheep radius (6.0054). Typically, a portion of the shaft was shaped to a tapered point, reflecting use by its highly polished surface, while the epiphysis or metaphysis was retained as a handle.

Two first phalanges display evidence of modification. A sheep specimen (5.2077) had a small hole drilled through the distal epiphysis from the medial to lateral sides. This specimen displays additional modification in the form of a vaguely quadrilateral perforation from the volar/plantar surface of the shaft into the medullary cavity. A further first phalangeal specimen (6.1661) displays a perforation of some two millimetres diameter passing diagonally from the saggital groove of the proximal articular surface to the volar/plantar surface. A shallow transverse groove is also apparent on the dorsal surface approximately one third of the way along the bone from the distal extremity. In addition, both the dorsal and volar/plantar surfaces of the distal extremity are polished. The function of these items is unclear, although they may have served a decorative purpose. It is furthermore unclear whether the differing locations of the holes is due to different functions.

4.4.10 Pathology

Fifty-four specimens (4.0%) from Early Bronze Age contexts at Sos Höyük exhibit some form of pathology. Pathological conditions are most frequent among the mandibular remains. Sheep mandibular remains display a higher incidence of pathology (60.9%) than goat specimens (50.0%).[33]

Inter-dental attrition, whereby the enamel on the tooth is abraded through proximity to an adjacent tooth, comprises the most common pathological condition observed. Recorded only in instances where the enamel on the mesial or distal surfaces has worn away completely (Levitan 1985, 43), the condition was identified on 33 ovicaprid mandibular specimens (12.3%). This includes 17 cases on sheep mandibles (37.0%), and two on goat specimens (11.1%).[34] The incidence is typically restricted to the third and fourth deciduous and permanent premolars, and the first molar. This condition is most frequently a symptom of overcrowding of the cheek teeth, and appears to have been more common among sheep than goats.

Anomalous crown heights are apparent on five ovicaprid mandibles (1.9%), including four sheep specimens (8.7%).[35] The incidence of anomalous crown heights consists primarily of 'weave mouth' centred about the deciduous and permanent premolars. Only one instance of 'step mouth', occurring on a deciduous third premolar, is apparent on an ovicaprid specimen (6.2073A-D). Anomalous crown height in the form of 'weave mouth' is apparent in only one maxillary specimen (6.0309). In this case, the deciduous second and third premolars display significantly heavier wear than is apparent on the other teeth in the cheek tooth row. Anomalous crown height results from different wear rates among the successive teeth in the cheek tooth row. This may occur as a consequence of a variety of factors including trauma, restriction of the chewing process, anomalous eruption sequences that result from conditions such as malnutrition, or the congenital absence or premature loss of the antagonist tooth resulting in lack of attrition of the surviving tooth (Levitan 1985, 43; Baker & Brothwell 1980, 147). As every case from Sos Höyük involved the deciduous and permanent premolars it appears that many of these instances may have originated during the evulsion and replacement of the premolar teeth.

Evidence for periodontal disease is extremely uncommon among the ovicaprid mandibles from Sos Höyük. One ovicaprid mandible (6.1911A-G; 0.4%) displays evidence of the early stages of periodontal disease. This specimen shows initial receding of the alveolar rim on the lingual side of the first molar. One instance of periodontal disease is also apparent on a maxillary specimen (5.3600; 0.5%). In this specimen, the lingual surface of the bony alveolus surrounding the deciduous fourth premolar shows considerable widening and the tooth had loosened. Periodontal disease is thought to result from an interplay of factors. These include gum irritation from calculus, abnormalities in wear or the eruption of teeth, or some forms of malnutrition (Baker & Brothwell 1980, 153). The disease causes inflammation of the gingival tissues and, later, the surrounding alveolar bone and periodontal membrane of each alveolus, resulting eventually in the loosening and shedding of the tooth. The condition may cause severe pain, with consequently reduced mastication and weight loss.

A ovicaprid specimen (6.1991A-G; 0.4%) displays a 'bovine' pillar on the first molar. The presence of pillars may be due to such factors as 'genetic and congenital defects, developmental conditions, [and].. disease' (Levitan 1985, 45).

Tooth malalignment was observed in only one specimen. A goat mandible (5.3595; 5.6%) exhibits distal displacement of the fourth premolar. This effect is often due to overcrowding although it may also be attributable to congenital defects, developmental disorders, disease or trauma.

Dental calculus was observed on nine specimens (3.4%), including seven sheep (15.2%), and a single goat mandible (6.1933; 5.6%).[36] Incidence is typically restricted to very small deposits of calculus on the lingual surface of the teeth. No cases of dental calculus were observed among the maxillary dental remains. The presence of dental calculus, or tartar, is important in any consideration of oral pathology as it is intimately connected with general oral health and dental function (Baker & Brothwell 1980, 151). Calculus is typified among ovicaprid remains as a black or red/brown deposit on the enamel surface and is easily recognised by its metallic sheen (Levitan 1985, 47; Hillson 1986, 302).

Seventeen specimens (6.3%) display extra nutrient foramina including eight sheep (17.4%) and four goat (22.2%) mandibles.[37] Typically one extra nutrient foramen of one to two millimetres in diameter is apparent, either oral to, or basal to, the second or third premolar on the buccal side. In three cases, two extra mental foramina are present. A sheep mandible (6.0344) displays an extra foramen oral to the second premolar and a second extra foramen adjacent to the large mental foramen always present on the buccal surface of the diastema. In one goat specimen (6.0140) one extra mental foramen is adjacent to the buccal surface of the second premolar, while a further foramen was apparent on the diastema. One ovicaprid specimen (6.2073A-D) exhibits an extra mental foramen basal to the deciduous third premolar. In contrast to the other two specimens, however, the second extra mental foramen, located toward the oral end of the

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[33] Percentages given in reference to dental pathology refer to the number of affected specimens as a percentage of the total number of mandibular specimens. Percentages for sheep and goat mandibular remains are similarly a measure of the frequency of the condition with respect to the total number of sheep or goat mandibular remains respectively.

[34] The ovicaprid specimens include 5.1618, 6.0047, 6.0079, 6.0252, 6.0726, 6.0753, 6.1014, 6.1620, 6.1732, 6.1850, 6.1911A-G, 6.2107, 6.2208, 6.2625. The sheep specimens include 5.3629, 6.0028, 6.0041A-B, 6.0126, 6.0256, 6.0334, 6.0335A-B, 6.0578A-D, 6.0882, 6.1302, 6.1459, 6.1731, 6.1870A-B, 6.2073A-D, 6.2105, 6.2188A-B, 6.2419A-B. The goat specimens include 5.3607, 6.0551.

[35] The ovicaprid and sheep specimens include 6.2073A-D, and 5.3571, 6.0335A-B, 6.1459, 6.1915 respectively.

[36] The ovicaprid specimens include 6.0334, 6.2073A-D. The sheep specimens include 6.0028, 6.0334, 6.0882, 6.1870A-B, 6.2105, 6.2178A-B, 6.2188.

[37] The ovicaprid specimens include 5.1533, 6.1242, 6.1589A-D, 6.1732, 6.2072A-B. The sheep specimens include 5.0098A-D, 5.0253, 5.0279, 6.0442, 6.1414, 6.1446, 6.1956, 6.1957, and the goat specimens include 5.3526, 6.0140, 6.0551, 6.1933.

diastema, measures some four millimetres in diameter. The presence of extra foramina is a discontinuous trait of variable occurrence even within a single population (Levitan 1985, 49).

Three ovicaprid specimens (1.1%) display perforation of the buccal surface of the mandible associated with the formation and eruption of the permanent teeth. A small perforation is apparent adjacent to the mental foramen in two sheep (5.2811A-D, 6.1198A-D; 4.4%) and one ovicaprid (6.2072A-B; 5.6%) mandible. These holes appear to have resulted from contact with the unerupted developing permanent incisors. This condition may be due to delayed evulsion of the deciduous tooth, premature development of the permanent tooth, or inadequate space for the permanent tooth to develop. In these cases, the developing permanent tooth comes into contact with, and consequently pierces, the buccal wall of the mandible.. Such conditions relating to tooth development and eruption may be congenital or attributable to environmental influences such as malnutrition (Levitan 1985, 49).

One sheep mandible (6.0334; 2.2%), is distinguished by an unusually well-developed bony prominence on the buccal surface of the mandibular angle.

Examination of the excavated ovicaprid mandibles and teeth from Sos Höyük illustrates that when a pathological condition does occur it tends to be associated with at least one other condition or abnormality. The mandibles displaying more than one condition are without exception from mature animals as indicated by the medium to advanced wear of the third molars. Given that pathological conditions are far less common among the younger mandibles from Sos Höyük, a correlation appears to exist between dental ailments and advancing age. Analysis of a sample of mandibles from modern adult ewes from a variety of breeds found that a poor correlation existed between the incidence of pathological conditions and the level of body condition whereby 'body condition did not appear to be adversely affected by high frequency of dental disease' (Richardson *et al*. 1979, 528).[38] The possibility therefore exists that the ovicaprids from Sos Höyük that display significant dental abnormalities may have maintained reasonable levels of health.

Interestingly, no examples of pathology were detected among the post-cranial remains of domestic sheep and goats.

4.4.11 Summary

Domestic ovicaprids were herded during the Early Bronze Age period at Sos Höyük according to a primary products strategy, with milk and wool comprising possible by-products. Herding appears to have been supplemented to a small extent by the exploitation of wild ovicaprids. The domestic sheep and goats were of medium stature, comparable in size to those from contemporaneous and later contexts at other eastern Anatolian sites. Although evidence of butchery patterns is largely lacking, various marks suggest that meat, hides and horn constituted important products of the economy. The low frequency of pathological conditions among the post-cranial remains may indicate that the animals were of reasonable health. Levels of dental pathology were high, although their impact over the health of the animals is unclear. The recovery of fœtal remains shows that pregnant ewes were present at the site.

4.5 Domestic pig (*Sus scrofa* domesticus) and wild pig (*S. scrofa*).

Thirteen pig specimens were recovered from Early Bronze Age contexts at Sos Höyük, including nine from domestic and four from wild pigs representing an MNI of two and one respectively (Tables 1, 13a, 18).

In addition to domestic pig, the wild pig is represented among the finds from Sos Höyük. The wild pig, which displays a high adaptability to environmental changes, is today one of the most widespread larger mammals of the Middle East, maintaining much of its former range (Uerpmann 1987, 41). The wild pig is common throughout modern Turkey, particularly in the heavily forested areas along the Black Sea coast. Reported from Pleistocene contexts onwards in both Europe and Asia (Tekkaya & Payne 1988, 238), wild pig remains are amply represented both geographically and temporally from archaeological sites throughout Anatolia. These sites include Neolithic Fikirtepe, Bronze Age contexts at Demircihüyük, Chalcolithic to Early Bronze Age Hassek Höyük, Late Chalcolithic to Iron Age contexts at Norşun-Tepe, Late Chalcolithic to Late Bronze Age Tepecik, Chalcolithic to Bronze Age Tültintepe, and Early Bronze to Iron Age contexts from Korucutepe and Lidar Höyük (Boessneck & von den Driesch 1979b, 42; Boessneck & von den Driesch 1978; Stahl 1989, 114; Boessneck & von den Driesch 1976b, 42; Boessneck & von den Driesch 1979a, Table 1; Boessneck & von den Driesch 1976a, Table 1; Boessneck & von den Driesch 1975, 136; Kussinger 1988, 168).

4.5.1 Differentiation of Wild from Domestic Specimens

On the basis of their large size and robustness, four specimens were identified as wild pig from Early Bronze Age contexts at Sos Höyük. The greatest length of the calcaneus (6.0351; Table 18i) is comparable to those of wild pig calcanei from Chalcolithic Hassek Höyük, and from Late Bronze Age Lidar Höyük (Stahl 1989, Table 30e; Kussinger 1988, Table 66). A first phalanx (6.1492; Table 18k) is comparable in size to wild specimens from Neolithic contexts at Fikirtepe, and Middle Bronze to Iron Age levels from Lidar Höyük (Boessneck & von den Driesch 1979, Table 16; Kussinger 1988, Table 66). Although comparable measurements are unavailable, two metatarsal bones (6.0291, 6.0292; Table 18j) display a robustness and size comparable to the other wild specimens from Sos Höyük, suggestive that they also derive from wild animals.

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[38] Breeds involved in the study included Border Leicester, Clun Forest, Down breeds (Dorset, Hampshire, South Downs), Kerry Hill, Mountain breeds (Cheviot, Exmoor, Rough Fell, Scottish Blackface), Romney Marsh, Suffolk, Welsh breeds (Welsh Half-breed, Welsh Speckle-face, Welsh Mountain) and Cross breeds including Welsh Cross and Suffolk Cross.

4.5.2 Physical Characteristics of the Domestic Pigs

Withers height calculations for pigs based on different skeletal elements, whether from a single individual or an average from a series of bones of different individuals, have been shown to yield highly divergent results (Weinstock 1993, 77). Due to this fact and the extremely small number of pig bones from Early Bronze Age Sos Höyük, this calculation was not performed.

4.5.3 Mortality Profiles

The small number of pig bones identified clearly precludes any form of meaningful analysis of the age structure of the population. That both adults and infants are represented is nevertheless indicated by the remains. A cranial specimen (5.2549) including fragments of the frontal, parietal and occipital bones, is from an adult animal. The very compact nature of the bone, and the fact that all sutures are barely visible, suggests an individual of greater than five to seven years.[39] By contrast, the unfused frontal-parietal suture and porosity of the bone displayed by a cranial specimen (5.2680) suggest an infant.

No evidence of butchery or pathological conditions was observed among the pig remains.

4.5.4 Summary

Overall the evidence suggests that pigs did not contribute significantly to the subsistence of the Early Bronze Age inhabitants at Sos Höyük. Exploitation of both wild and domestic populations appears to have taken place although the small size of the sample precludes further examination of their relative influence and function.

4.6 Domestic dog (*Canis familiaris*) and wolf (*C. lupus*).

Twenty-nine canid specimens were recovered from Early Bronze Age contexts from Sos Höyük (Tables. 1, 14a, 19). These comprise 28 domestic dog and one wolf specimen representing an MNI of three and one respectively.

Three species of canids could be represented among the excavated remains from Sos Höyük. These include the domestic dog (*Canis familiaris*), the wolf (*Canis lupus*), and the golden jackal (*Canis aureus*). Currently, the earliest secure identification of domestic dog remains in eastern Anatolia comes from Çayonü Tepesi and dates to approximately 7000 B.C. (Lawrence 1967). Domestic dog remains are abundantly represented from numerous contexts in the Near East. These include the Sabz to Bayat phases at Deh Luran in northern Iran, Chalcolithic to Early Bronze Hassek Höyük, Neolithic to Early Bronze Age levels from Hayaz Höyük, Bronze to Hellenistic/Roman levels at Lidar Höyük, and Bronze Age to Early Iron Age contexts from Korucutepe (Hole, Flannery & Neely 1969, 311; Stahl 1989, 98; Buitenhuis 1985, 67; Kussinger 1988, 117; Boessneck & von den Driesch 1975, 108).

The wolf is also likely to have been present in the region of Sos Höyük during the Early Bronze period. Although now extinct throughout much of Europe due largely to persecution, the wolf still ranges widely from Russia, Turkey and Iran through to east Asia (Harrison 1991, 115). The wolf is extremely adaptable, living in a wide diversity of habitats ranging from tundra and open woodland to dense forests and mountains (MacDonald & Barrett 1993, 92). The species does show a preference for open terrain with access to dense cover. Wolf remains have been identified from numerous sites throughout Anatolia. These include Neolithic Fikirtepe, Middle II and Late Bronze I-II levels at Korucutepe, Early Chalcolithic Çavi Tarlası, Late Chalcolithic to Late Bronze/Neo-Hittite Arslantepe and Late Chalcolithic to Early Bronze Age I levels from Norşun-Tepe (Boessneck & von den Driesch 1979c, 45; Boessneck & von den Driesch 1975, 139; Schäffer & Boessneck 1988, 46; Bökönyi 1993, 354; Boessneck & von den Driesch 1976b, Table 1).

The golden jackal is currently widespread from south-eastern Europe, through Turkey, to south-east Asia and north Africa (Harrison 1991, 113). Golden jackal remains are extremely poorly represented from archaeological contexts in Anatolia, with the only potential remains deriving from Early Hittite/Early Bronze I-II levels at Ikiztepe (Tekkaya & Payne 1988, 238). Golden jackals inhabit semi-arid habitats such as steppe and grasslands.

The ancestry of the domestic dog remains enigmatic in terms of geographic and taxonomic origins, the precise developmental time frame, and whether the domestication process occurred only once, or several times independently (Morey 1992; Clutton-Brock 1984; Dayan 1994; Olsen 1985). Current research suggests that the ancestral form of the dog was probably a local race of the Near Eastern wolf, as the earliest domestic dogs display similarities in terms of both size and cranial capacity to small wolves, including the Indian (*Canis lupus pallipes*) and Arabian (*Canis lupus arabs*) races (Olsen 1985, 76; Dayan 1994, 633). It remains unclear, however, if the wild progenitor involved single or multiple races (Olsen 1985, 76; Clutton-Brock 1984, 203). On the basis of current evidence it appears the dog was domesticated some time prior to the Natufian (Tchernov & Valla 1977, 66). Nevertheless, archaeological evidence indicates that by the fifth millennium B.C., a sufficient amount of time had elapsed for variation among different local populations of prehistoric domestic dogs to emerge (Clutton-Brock 1984, 207).

4.6.1 Differentiation of Wild from Domestic Specimens

Various morphological characteristics permit the separation of wolves and dogs from jackals. The golden jackal closely resembles, although is considerably smaller than, the wolf, with a more gracile build and shorter legs. On the basis of cranial morphology, no evidence of the golden jackal is provided by the dental remains from Sos Höyük. The cusps of the recovered mandibular molars display a greater

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[39] Ellenberger & Baum (1915) give dates of 5-7 years for the obliteration of the parietal-frontal, parietal-temporal and frontal-frontal sutures of domestic pigs. As no further studies of the ages of closure of these sutures has been published, these dates are used advisedly.

robustness than is present in jackals (Harrison 1991, 113-115). The two upper canines (5.2773A-B, 6.1634) both display a more dog-like weakly developed, mesio-lingual ridge, in contrast to the pronounced ridge displayed by the upper canine of the golden jackal. The canines furthermore exhibit weak disto-lingual ridges and lack a cingulum as in wolves. Two maxillary fourth premolars (6.0496, 6.1967) similarly reflect wolf or dog-like morphology rather than that of the jackal. Both specimens display reduced disto-lingual lobes with a barely perceptible cusp in contrast to the large well formed cusp on the disto-lingual surface of the upper carnassial of the jackal. In addition, these specimens display a low, inconspicuous cingulum, that differs markedly from the well developed cingulum on the upper fourth premolar of the golden jackal. Three mandibular first molars (5.3528, 6.0384, 6.1884) also more closely resemble dog or wolf morphology than that of the jackal. Each specimen displays less trenchant cusps than are observed for the jackal. The metaconid is also poorly developed, as it is in the dog and wolf, whereas this feature is more prominent in the jackal (Davis & Valla 1978, 609). The second molar of specimen 6.1884 also displays wolf and dog-like qualities, as it lacks the rudimentary fourth cusp and small anterior cingulum cusps sometimes evident in the second molars of golden jackals. The absence of any features compatible with the morphology of the jackal among the dental remains strongly indicates that the majority, if not all, of the canid remains came from either wolves or domestic dogs.

Various morphological changes have been seen to accompany the domestication of the dog from the wolf. One of the principal traits constitutes size reduction (Clutton-Brock 1984, 205; Zeuner 1963, 104). Separation of dog and wolf remains from sites in the Near East, however is, hampered in that the local species of wolf, *Canis lupus pallipes*, is of smaller stature than are members of more northern populations, thus resulting in only limited size differences between small west Asian wolves and early domestic dogs (Lawrence & Reed 1985, 485; Dayan 1994, 633). Dog remains from later Near Eastern sites however reflect animals that were appreciably smaller than recent wolves (Davis & Valla 1978, 61). Due to the difficulties associated with size, modifications in the shape and proportions of the skull and mandible, which occur during the process of domestication, are more helpful in distinguishing between dog and wolf remains (Lawrence & Reed 1985, 485). It is through the comparison of multiple proportional measurements taken from a series of skulls, mandibles and dentitions that a specific assignment can best be made (Olsen 1985, 91). Due to the small size and fragmentary nature of the sample of canid remains recovered from Sos Höyük, distinctions based on an assessment of multiple morphological traits and proportions could not be made. As a consequence, the morphological characteristics of the excavated specimens were examined in conjunction with tooth dimensions in order to ascertain the species represented.

Some dispute exists, however, as to how reliable teeth measurements are for the differentiation between dog and wolf remains. Benecke (1987, 33) claimed that tooth size and jaw size vary independently in *Canis*. Davis and Valla's (1978, Figure 4) use of the length of the mandibular molar to illustrate the north-south size cline of modern wolves from northern Europe to south Arabia, however, clearly illustrates that this is not always the case. In a more moderate statement, Lawrence and Reed (1983, 486) suggest that overlap in size between dogs and wolves in the Near East may cause problems, and furthermore, that while the jaws and cranial fragments of dog may be small, the teeth may be as large as those from wolves. In theory this should mean that specimens smaller than the range of observed tooth sizes for wolves for a given region are highly likely to come from domestic dogs. Indeed, the lengths of the lower carnassials from Sos Höyük are consistently smaller than the ranges provided for a variety of wolf populations from the Near East. The lengths of the three lower carnassial specimens (5.3528, 6.0384, 6.1884; Table 19c) are smaller than the range of measurements obtained for modern wolf samples from central and northern Europe, the Near East, and Turkey (Dayan 1994, Table 1; Lawrence & Reed 1983, Table 39; Davis & Valla 1978, Figure 4, Table 1; Meadow 1983, Table 10). Furthermore, the Sos Höyük specimens are relatively wide for their length when compared to these wolf carnassials. The carnassials from Sos Höyük are instead comparable in length and proportion to various domestic dog specimens from contemporaneous and later contexts in Anatolia. These include specimens from Early Bronze II to Late Bronze I-II contexts from Korucutepe, Early Bronze to Iron Age Lidar Höyük, two specimens from Early Bronze Age Hassek Höyük, and a single specimen from Middle Iron Age Norşun-Tepe, and are smaller than an Iron Age dog from Hajji Firuz Tepe (Boessneck & von den Driesch 1975, Table 28c; Kussinger 1988, Table 45; Stahl 1989, Table 25; Boessneck & von den Driesch 1976a, Table 6a; Boessneck & von den Driesch 1978b; Meadow 1983, Table 10).

The most complete mandible recovered (6.1884; Table 19b) retains the body from the alveolus of the fourth premolar to that of the third molar and includes a portion of the angle and coronoid process (Figure 35). The morphology of this specimen is more dog- than wolf-like, with bucco-lingual thickening of the body, a curved ventral margin, a more curved cheek tooth row, and a broad base to the oral border of the ramus (Lawrence & Reed 1983, 487). The specimen is furthermore comparable in size to a domestic dog mandible from Iron Age contexts from Hajji Firuz Tepe in northeastern Iran and to the larger specimens from Early Bronze to Iron Age Lidar Höyük (Meadow 1983, Table 10; Kussinger 1988, Table 45). The maximum breadth of the jaw, basal to the first molar, is slightly greater than was observed among a sample of Near Eastern wolf specimens (Lawrence & Reed 1983, Table 38), suggesting that the teeth were proportionally smaller relative to the breadth of the jaw than is apparent in the wolf. When the qualitative and quantitative characteristics are taken together they suggest that the specimen derived from a domestic dog rather than from a wolf.

While maxillary specimens are generally less useful for separating wolf and dog remains (Lawrence & Reed 1983, 487), a number of features apparent on the excavated specimens point to their representing dogs rather than wolves. Measurements of the breadth of the two upper carnassials recovered (6.0469, 6.1969; Table 19a) fall below the range for the small Indian wolf, modern Mediterranean wolves from Israel, and a single Turkish wolf specimen (Lawrence & Reed 1983, Table 38; Dayan 1994, Table 1; Meadow 1983, Table 10). The specimens from Sos Höyük are instead either comparable to, or smaller than, a number of measurements of upper carnassials from domestic dogs from the Near East. These include specimens from an Iron age dog from Hajji Firuz Tepe in Iran, Late Bronze I-II Korucutepe, Early Bronze Hassek Höyük and Middle Bronze and Iron Age Lidar Höyük (Meadow 1983, Table 10; Boessneck & von den Driesch 1975, Table 28; Stahl 1989, Table 25; Kussinger 1989, Table 45). Both of the preserved upper carnassials from Sos Höyük furthermore display a simplified cusp structure and more significant reduction of the mesio-lingual cusp than is observed in the wolf (Clutton-Brock 1984, 205). The maxillary fragment retaining the carnassial (6.0496) also displays a morphology more compatible with that of the domestic dog than of the wolf in the curvature of the tooth row (Lawrence & Reed 1983, 487).

Although based on a small sample, both the mandibular and maxillary remains from Sos Höyük display a pattern of tooth size reduction and have various morphological differences from the wild progenitor. It is unfortunate that, due to the fragmentary and limited nature of the sample, these characteristics cannot be examined in reference to mandibular and maxillary lengths in order to detect evidence of facial shortening, and thus provide more rigorous evidence for the domestication process (Dayan 1994, 633; Clutton-Brock 1984, 205).

The majority of post-cranial remains provide no evidence for the presence of large and robust wolf bones, and instead reflect the gracile proportions and smaller dimensions characteristic of domestic dog remains. Examination of the post-cranial canid remains, however, is hampered by the lack of adequate comparative data, both from contemporaneous sites and from modern wolf specimens (Olsen 1985, 73). Three atlas fragments (5.3636, 6.1743, 6.2164; Table 19d) nevertheless yield similar dimensions to various domestic dog specimens from Late Bronze I-II and mixed Early Bronze II/Medieval contexts from Korucutepe, Early Bronze to Iron Age Lidar Höyük, and a single specimen from Early Bronze Age Hassek Höyük (Boessneck & von den Driesch 1975, Table 28; Kussinger 1988, Table 45; Stahl 1989, Table 25). Three distal scapular fragments (5.3611, 6.0505, 6.1928; Table 19g) are each significantly smaller than a dog specimen from a mixed Early Bronze II/Medieval deposit from Korucutepe, but are of a size comparable size to specimens from Middle Bronze to Iron Age contexts at Lidar Höyük, and Roman/Byzantine levels at Didyma (Boessneck & von den Driesch 1975, Table 28; Kussinger 1988, Table 45; Boessneck & von den Driesch 1986, Table 18d). The distal radius (6.0157; Table 19i) is comparable in size to domestic dog specimens from Bronze Age Korucutepe and Middle Bronze and Hellenistic/Roman levels at Lidar Höyük (Boessneck & von den Driesch 1975, Table 28; Kussinger 1988, Table 45). The calcaneus (5.3509; Table 19l) is slightly smaller than a domestic specimen from Early Bronze II levels from Korucutepe, but comparable in size to specimens from Middle Bronze to Hellenistic/Roman Lidar Höyük and a single calcaneus from Chalcolithic Hassek Höyük (Boessneck & von den Driesch 1975, Table 28; Kussinger 1988, Table 45; Stahl 1989, Table 25). All these specimens thus represent medium sized dogs. The remaining specimens, although too fragmentary to yield meaningful measurements, are of a size comparable to the other domestic specimens, suggesting that they also represent medium sized domestic dogs.

A single specimen (6.0101; Table 19n) comprising a distal metapodial bone displays a size and robustness that suggests its identification as a wolf. The distal breadth of this specimen exceeds that displayed by the metapodial bones of domestic dogs such as those represented at mixed Early Bronze II/Late Seljuk deposits from Korucutepe, Middle Iron Age levels from Norşun-Tepe, Middle Bronze to Iron Age contexts at Lidar Höyük, and Roman levels at Didyma (Boessneck & von den Driesch 1975, Table 28r; Boessneck & von den Driesch 1978b, Table 6h; Kussinger 1988, Table 45; Boessneck & Schäffer 1986, Table 18k-l.).

4.6.2 Stature

Withers height estimations could not be calculated for the dogs of the Early Bronze Age as no adult long bones were preserved intact. On the basis of the metrical comparisons with remains from broadly contemporaneous sites in Anatolia, medium sized animals appear to be represented.

4.6.3 Summary

The conclusions regarding the species of *Canis* identified remain somewhat tentative given the fragmentary nature of the remains. Metrical and morphological characteristics reveal a sample of canid remains that is composed of predominantly medium-sized domestic dogs, with only one specimen suggesting the presence of the wolf. The function of domestic dogs at Sos Höyük is unclear. The absence of butchery marks does not preclude the possibility that these animals were consumed, while functions such as guarding, fighting and scavenging may also have been performed. The obvious reliance on domesticated ungulates during the Early Bronze Age may also have precipitated the adoption of dogs as protectors and herders of stock. Dogs may additionally have proven useful aids in hunting and game retrieval. In the absence of specific evidence it is impossible to say which of these functions was performed by the dogs at Sos Höyük.

Wild Taxa

4.7 Bison (*Bison bison*).

A total of five specimens excavated from Early Bronze Age contexts at Sos Höyük were tentatively identified as bison (Tables 1, 22). These specimens represent an MNI of one. The wisent or bison formerly inhabited the Caucasus Mountains and possibly also the mountainous regions of Azerbeidjan, Armenia and Kurdestan, and tended to be associated with deciduous forests juxtaposed with open glades (Uerpmann 1987, 76; MacDonald & Barrett 1993, 214). Bison bones have been detected at only a few archaeological sites in the Middle East. This is perhaps due largely to the fact that bison remains are extremely difficult to distinguish from those of cattle, particularly in the case of the often fragmentary remains recovered in archaeological contexts. The present lack of evidence from the Near East does not permit any definite conclusions regarding the ancient range of the bison (Uerpmann 1987, 78). That the species was present in the region of eastern Anatolia, however, is suggested by its identification at Early Neolithic Jarmo in northwestern Iraq, Middle Bronze to Hellenistic/Roman Lidar Höyük, Late Chalcolithic to Iron Age Norşun-Tepe, and Late Chalcolithic to Late Bronze Age Tepecik (Stampfli 1983; Kussinger 1988, 154; Boessneck & von den Driesch 1976b, Table 1; Boessneck & von den Driesch 1979).

Although bison bones display a tendency to greater size and robustness than those of domestic cattle, numerous morphological and size characteristics are shared by the skeletons of the two species. The large bovid bones from Sos Höyük were consequently subjected to careful analysis according to the diagnostic characteristics outlined by Balkwill and Cumbaa (1992) for distinguishing post-cranial elements of *Bison bison* and *Bos taurus*. A male *Bison bison* skeleton, R5918, from North America, contained in the collection of the Museum of Victoria, and a number of *Bos taurus* bones of unknown sex, breed and age were utilised for comparative purposes.[40] Although the criteria used are based on skeletons of the American bison, Old and New World bison are now recognised as members of the same species (Uerpmann 1987, 78). The European, Middle Eastern and North American subspecies may thus be expected to share many characteristics of skeletal morphology.[41]

Interestingly, all of the specimens identified as bison comprise intact first or second phalanges. Two single forelimb first phalanges (5.2958, 6.0024) were determined to be bison on the basis of the following characteristics. The distal two thirds of the lateral margin are more curved, and the pits on the dorsal surface of the proximal end are deeper than is typically observed in domestic cattle specimens (Balkwill & Cumbaa 1992, 164-67). A single forelimb second phalanx (6.1402) and two hindlimb second phalanges (6.0586, 6.0853) each display a deeper tendon imprint on the dorsal surface, a straighter dorsal margin when viewed laterally, and a more sharply angled step on the posterior margin of the proximal articular surface than is typically present in domestic cattle (Balkwill & Cumbaa 1992, 170-74). While the success rate for distinguishing first phalanges of known identity using these characteristics leaves room for doubt (Balkwill & Cumbaa 1992, 164-67), the higher success rate for the second phalanges (Balkwill & Cumbaa 1992, 170-74), inspires greater confidence in the accuracy of the identification. The rarity of bison finds from sites in Anatolia, in addition to the limited range of skeletal elements from Sos Höyük that reflect bison morphology, makes these identifications necessarily tentative. There is nevertheless a suggestion that bison were exploited to a minimal extent at Sos Höyük during the Early Bronze period. None of the bones identified as bison display any evidence of human modification or pathology.

4.8 Red deer (*Cervus elaphus*).

Nine specimens of red deer, representing an MNI of two, were recovered from Early Bronze Age contexts at Sos Höyük (Tables 1, 23). These included seven antler fragments (5.2405, 5.3469, 5.3500, 5.3486, 6.0809, 6.1127, 6.2593), and a second and third phalanx (6.1435, 6.1995). While remnant red deer populations in Turkey are today largely confined to forested mountains along the Black Sea coast due to over-hunting, red deer enjoyed a much wider distribution in prehistoric times (Tekkaya & Payne 1988, 229; Uerpmann 1978, 64). Red deer remains are common from a geographically diverse range of sites from the Early Neolithic onwards in Anatolia. Remains have been identified from sites including Neolithic Fikirtepe, Early Chalcolithic Çavi Tarlası, Chalcolithic to Bronze Age Norşun-Tepe, Tepecik and Tültintepe, Bronze Age levels at Demircihüyük, Chalcolithic to Early Bronze Age Hassek Höyük, Bronze Age Korucutepe, Early Bronze to Hellenistic/Roman Lidar Höyük, and Late Chalcolithic to Neo-Hittite Arslantepe (Boessneck & von den Driesch 1979b, 40; Schäffer & Boessneck 1988, 47; Boessneck & von den Driesch 1976b, 95; Boessneck & von den Driesch 1979a, 95; Boessneck & von den Driesch 1976a; Boessneck & von den Driesch 1978; Stahl 1989, 123; Boessneck & von den Driesch 1975, 122; Kussinger 1988, 138; Bökönyi 1993, 343.

4.8.1 The Cranial Remains

The majority of red deer specimens are antler fragments. Two specimens (5.2405, 5.3486) are uncast antlers as shown by the preservation of the burr and a portion of the frontal bone. The left antler of the latter fragment is preserved to the level of the brow tine indicating an animal either within or beyond Haltenorth and Trense's Stage B of antler development, that is, with at least two points (Haltenorth & Trense 1956). The robustness of the antlers confirms that a mature animal is represented.

Six antler specimens provide evidence of intentional modification for the manufacture of tools or ornamental items. Specimen 5.3500 is a flat comb with approximately sixteen teeth (Figure 31). Specimen 5.2405 comprises an incomplete beam preserving the burr and a portion of the pedicle. The pedicle exhibits a chop mark on the lateral side, whereby the antler had been removed from the skull. Although this provides evidence of direct contact with the animal, it is unclear whether this contact was in the form of hunting or merely the scavenging of a carcass. Although the beam had been broken proximal to the terminal tines, the presence of the most proximal portion of the bez tine indicates that the antler belonged to either stages E or F (an antler with ten to twelve points) of Haltenorth and Trense's model. Although the beam is worn about the region of the brow and bez tines, these tines appear to have been intentionally removed, perhaps for use in tool manufacture. A tine fragment (5.3469) displays a flattened portion on one side where a rectangular fragment of the peripheral surface

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[40] The skeleton of a Middle Eastern or European bison was unavailable for comparative purposes.

[41] Indeed, Hole, Flannery and Neely (1969) found a high level of concordance between the skeletal characteristics outlined for the then separate species of North American bison, *Bison bison*, and Near Eastern bison, *Bison bonasus*.

had been removed. The function of this modification is unclear. A further specimen (6.2593) comprises a section of the outer surface of the beam that had been modified on all sides save the peripheral surface to form a rectangular fragment. It appears to represent an unfinished object. Debitage from the working of antler is also represented by a single specimen (6.0809).

Two specimens (5.2405, 5.3486; Table 23a) with the burr preserved, represent antlers that were small in size. Specimen 5.2405 comprises an uncast antler with a burr circumference of only 169 millimetres, while the circumferences of the incomplete left and right burrs of specimen 5.3486 measure 171 and 162 millimetres respectively. These two specimens are appreciably smaller than antlers from Early Bronze II levels at Korucutepe and unspecified contexts from Arslantepe (Bökönyi 1993, 349).

4.8.2 The Post-cranial Remains

The excavated post-cranial remains are restricted to two specimens, a second phalanx (5.1435; Table 23c) and third phalanx (6.1995; Table 23d). The second phalanx is comparable in size to specimens from Early Bronze II to Late Bronze I-II contexts at Korucutepe and Bronze to Hellenistic/Roman levels from Lidar Höyük (Boessneck & von den Driesch 1975, Table 32; Kussinger 1988, Table 52). Although based on a single specimen, the similarity of the red deer measurement from Sos Höyük to those at Korucutepe and Lidar Höyük indicates that a large sized red deer is represented, comparable in size to red deer from sites in Central Anatolia, including Boğazköy (Vogel 1952, 130).

The restricted number of post-cranial elements indicate that red deer meat did not contribute significantly to the diet of the Early Bronze Age inhabitants of Sos Höyük. Indeed the paucity of post-cranial remains may suggest that meat did not constitute the prime motivation for the hunting of red deer. Instead, based on the frequency of antler fragments, the acquisition of antler for use as a raw material appears to have been of significance. That some form of hunting of red deer took place may be suggested by the presence of phalanges and the unshed antler specimen. Although the evidence of uncast antlers illustrates some sort of direct contact with the animal, this may have been in the form of scavenging of carcasses rather than hunting. Furthermore, the difficulty of determining whether the majority of antler fragments came from cast or uncast antlers makes any suggestion of large scale deer hunting premature. Regardless of the method of procurement, the effort expended on obtaining antler clearly establishes its status as a valued material for the manufacture of objects. MacGregor and Currey's analysis of the mechanical properties of bone and antler found the latter to be appreciably more resilient and malleable (MacGregor & Currey, 1985). The large length and circumference of many antlers and the morphology of the tines lend themselves to the production of larger and more complex tools than is possible with compact bone.

Red deer are highly adaptable (Bjärvall & Ullström 1986, 184). Modern red deer inhabit vegetational communities ranging from open deciduous forest and transition zones between forests and cultivated lands, to treeless moors, treeless subalpine environments and grassy plains. The species nevertheless exhibits a preference for woodland with the availability of adjacent grassland for feeding. This association may imply the proximity to Sos Höyük of wooded areas during the third millennium. Red deer tolerate only slight to moderate snow cover through which they graze ground cover and grasses. If the levels of snow falls experienced in the region of Sos Höyük during the Early Bronze Age were comparable to modern levels, that is, typically extremely heavy coverage, this would result in the unavailability of ground cover during winter. This in turn might imply the presence of larger shrubs and trees on which the animals could feed.[42]

4.9 Brown bear (*Ursus arctos*).

Six specimens of brown bear, representing an MNI of one, were recovered from Early Bronze Age contexts at Sos Höyük (Tables 1, 25). These include a mandibular fragment (5.1971), a mandibular canine (6.2259), a scapular fragment (6.2202), a metatarsal bone (6.2184), and two phalanges (6.1633, 6.1966). The distal scapular fragment preserves a portion of the neck and the most distal region of the spinous process and caudal border. The mandibular fragment (5.1971) includes the most oral portions of the left and right sides and retains both canines, the right fourth premolar and the right first molar (Figure 36). Wear on the right canine and first molar suggest an adult animal. Based on the appearance of the bone and the prominent areas for muscle and tendon attachment, the post-cranial remains also probably came from adult animals.

Although formerly distributed throughout the Old World, and abundant up until recent times, the brown bear is now a threatened species (IUCN 1990). Bears are similarly rare in Turkey (Smit & van Wijngaarden 1981, 225). The brown bear is, however, represented at numerous archaeological sites in Anatolia, although typically by only a few specimens. These include Late Neolithic Fikirtepe, Early Chalcolithic Çavi Tarlası, Early Bronze II to Early Iron Age Korucutepe, Early Bronze Age Demircihüyük, Late Chalcolithic to Neo-Hittite Arslantepe, Late Chalcolithic or Late Bronze Age Tepecik, Chalcolithic to Early Bronze Age Norşun-Tepe, Late Bronze to Hellenistic/Roman Lidar Höyük and Early Hittite to Early Bronze II-III Ikiztepe (Boessneck & von den Driesch 1979b, 46; Schäffer & Boessneck 1988, 49; Boessneck & von den Driesch 1975, 142; Boessneck & von den Driesch 1977; Bökönyi 1993, 353; Boessneck & von den Driesch 1979a, 114; Boessneck & von den Driesch 1976b, Table 1; Kussinger 1988, 173; Tekkaya & Payne 1988, 239). The metatarsal bone from

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[42] Red deer stags are known to practice seasonal migration whereby higher altitudes are inhabited only during summer (Clutton-Brock & Albon 1989, 90) with stags generally using higher ground than hinds (Clutton-Brock & Albon 1989, 93). Ranges may be as extensive as six square kilometres (Putman 1988, 77), with stags wandering up to more than sixteen kilometres from their birth area and the ranges of the hind groups (Clutton-Brock & Albon 1989, 48). Nevertheless, the relatively restricted size of home ranges implies that, regardless of migration, deer ranging in the vicinity of Sos Höyük would have inhabited a vegetational community similar to that around the site.

Sos Höyük is comparable in size to specimens from Late Bronze I-II levels at Korucutepe (Boessneck & von den Driesch 1975, 142), and thus comes from a from small- to medium-sized animal (Table 25b). The presence of cranial, metapodial and phalangeal bones may be due to the fact that these elements are often retained on a hide. The presence of the scapula however suggests that the meat may also have been consumed, although none of the bear bones exhibit evidence of butchery. The possibility that bears were hunted because they preyed on livestock or damaged crops also exists. Carruthers documented predation by brown bears on flocks of sheep and goats in Iraqi Kurdestan and damage to 'hummis' crops in Syria (Harrison 1991, 125 after Carruthers 1904/5, Personal Diary). The infrequency of bear remains nevertheless argues for the lack of importance of this animal for the subsistence activities at Bronze Age Sos Höyük.

Bears are most common in mixed woodland and forest, with coniferous forest, particularly spruce, being especially favoured along with steep terrain. Distribution may also extend to tundra, open mountain tops, clearings and cultivated lands, although these areas are typically visited only temporarily in search of food, as the proximity of some form of dense cover is preferred (Bjärvall & Ullström 1986, 132). The presence of the brown bear at Sos Höyük may reflect the proximity of forested areas to the site during the Early Bronze period.

4.10 Red fox (*Vulpes vulpes*).

Six red fox specimens, representing an MNI of three, were recovered from Early Bronze Age contexts at Sos Höyük (Tables 1, 26). They comprise two ulnar fragments (6.0478, 6.1107; Table 26a), a pelvis with an unfused pubic symphysis (6.1104A-B; Table 26b), two ribs (6.1105, 6.1106), and a first phalanx (6.1110). The small number of specimens makes any comments regarding the size of the foxes represented at Sos Höyük necessarily tentative. Measurements of the pelvis and ulnae indicate animals only slightly larger in size than specimens dating to the Middle Ages from Lidar Höyük (Kussinger 1988, Table 68), and therefore imply small to medium sized foxes.

At present the fox enjoys a wide distribution, ranging throughout Europe, Asia, North Africa and America (Harrison 1991, 117). The red fox comprises one of the most common wild carnivore species in sites throughout the Near East. Red fox remains have been identified from sites in Turkey including Late Chalcolithic to Late Bronze Age Arslantepe, Early to Middle Bronze Age Demircihüyük, Chalcolithic and Early Bronze Age Hassek Höyük, Late Neolithic Fikirtepe, Early Chalcolithic Çavi Tarlası, Neolithic Hayaz Höyük, Hittite levels from Alişar Höyük, Late Chalcolithic to Late Bronze Age Tepecik, Chalcolithic to Early Bronze Age Norşun-Tepe, and Early to Late Bronze Korucutepe (Bökönyi 1993, 343; Boessneck & von den Driesch 1978, 53; Stahl 1989, 134; Boessneck & von den Driesch 1979b, 45; Schäffer & Boessneck 1988, 49; Buitenhuis 1985; Patterson 1937, 295; Boessneck & von den Driesch 1979a, 114; Boessneck & von den Driesch 1976b, Table 1; Boessneck & von den Driesch 1975, 139). The ubiquity of fox remains can be attributed to both the behavioural and ecological characteristics of the species. Foxes are, to an extent, commensal, foraging in areas of human habitation for poultry and refuse. In addition, foxes are unspecialised opportunists, displaying an extreme adaptability to the great variety of habitats present throughout the Near East. Foxes, however, do show a slight preference for open fragmentary habitats such as scrub, woodland and farmland mosaics that offer a diversity of foods and cover (Bjärvall & Ullström 1986, 128).

No evidence of butchery is apparent on the fox specimens from the Early Bronze Age at Sos Höyük. The possibility that the identified specimens came from a single animal may also indicate either that foxes did not occur in any great frequency in the vicinity of the site or that this species did not occupy an important position in the subsistence or hunting activities of the Sos Höyük inhabitants.

4.11 Brown hare (*Lepus europaeus*). [43]

Ten specimens of brown hare, representing an MNI of two, were recovered from Early Bronze Age contexts at Sos Höyük (Tables 1, 31). Consisting entirely of post-cranial elements, the excavated specimens include a distal humerus (6.1885; Table 31a), a talus (5.3530), and eight metatarsal bones (6.1583, 5.3510, 6.0739, 6.1973, 6.0317, 6.0469, 6.0598, 6.2586; Table 31d). Measurements from the humerus and metatarsal bones from Sos Höyük are comparable to those from Late Bronze I-II Korucutepe, Early Bronze Age to Hellenistic/Roman levels at Lidar Höyük, and Chalcolithic to Early Bronze Age Hassek Höyük (Boessneck & von den Driesch 1975, Table 40; Kussinger 1988, Table 72; Stahl 1989, Table 45). This suggests that the animals were relatively small. None of the hare bones exhibit evidence of butchery.

Remains of hare are common in excavations throughout

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[43] Debate exists concerning the species of hare present in Turkey and indeed throughout Eurasia. While there appears to be general agreement that only a single species of hare exists in Turkey,taxonomic lists have variously classified this species as *L.capensis* with *L.europaeus* considered as a synonym (Petter 1961; Honacki, Kinman & Koeppl 1982, 599), *L.capensis* (Corbett & Hill 1991, 210), or *L.europaeus* (Smit & van Wijngaarden 1981, 225; Wilson & Render 1993, 817). The archaeological reports for sites in Turkey present an equally confusing picture with species designation for hare bones presumably mirroring the state of the debate at the time the report was written. In terms of the comparability of hare bone measurements from Turkey, whether the hares from Turkey are *L.europaeus*, *L. capensis*, the result of interbreeding between these two species, or indeed that these two species in fact represent regional differences of a single species, is to an extent immaterial, as it appears that all of the hare specimens from Turkey are representative of a single species. Based on the most recent taxonomic classification available at the time of writing (Smit & van Wijngaarden 1981, 225; Wilson & Render 1993, 817), the hare bones from both Sos Höyük and Büyüktepe Höyük have been assigned to the species *L. europaeus*.

Anatolia. Specimens of *L. europaeus* have been detected from Early Bronze II to Early Iron Age levels at Korucutepe, Neolithic to Medieval levels at Hayaz Höyük, Late Chalcolithic to Neo-Hittite contexts at Arslantepe, Late Chalcolithic to Late Bronze Age levels at Tepecik and Chalcolithic to Early Bronze Norşun-Tepe (Boessneck & von den Driesch 1975, 145; Buitenhuis 1985, 64; Bökönyi 1993, 354; Boessneck & von den Driesch 1979a, 114; Boessneck & von den Driesch 1978b, Table 1). *L. capensis* has been identified from Late Neolithic Fikirtepe, Chalcolithic and Early Bronze Age levels at Hassek Höyük, Early Bronze Age to Hellenistic/Roman Lidar Höyük and Early Chalcolithic Çavi Tarlası (Boessneck 1979b, 47; Stahl 1989, 137; Kussinger 1988, 179; Schäffer & Boessneck 1988, 49. Hare bones rank among the most abundantly represented wild species at Sos Höyük in terms of the number of specimens, despite their reduced chances of preservation and recovery when compared to the remains of species like deer and wild pig. This situation is mirrored at numerous sites including Hassek Höyük, Korucutepe and Arslantepe. This suggests both that the hare may have been a frequent supplement to the subsistence products provided by domestic stock and that this species was abundant in the region of eastern Anatolia.

Lepus europaeus exhibits adaptability to a great diversity of habitats, although the species displays a preference for temperate climates and open terrain. Brown hares occur in highest densities in flat country, including open grassland and cultivated lands, but tend to avoid association with high densities of livestock. The abundance of hares at Fikirtepe, in contrast to the relative scarcity of hare remains from sites in central Europe, led Boessneck and von den Driesch to assume that the habitat around the site particularly suited the species (Boessneck & von den Driesch 1979b, 47). The presence of the hare within the assemblage from Early Bronze levels at Sos Höyük may similarly suggest the proximity of open grassland or arable land to the site.

4.12 Bi-coloured white-toothed shrew (*Crocidura leucodon*).

A single fragmentary cranial specimen (6.2604) from the bi-coloured white-toothed shrew was recovered. This species is currently spread throughout Europe, Turkey and northern Arabia, and favours densely vegetated habitats (Harrison 1991, 14). The extensive use of rodent burrows by this species, in conjunction with the lack of discolouration on the recovered specimen, suggests that this find is intrusive.

4.13 Mountain mole rat (*Nannospalax nehringi*).

Ten cranial specimens of the mountain mole rat were recovered from Early Bronze Age contexts at Sos Höyük.[44] The mountain mole rat is distributed throughout Asia Minor and the southern Caucasus, and may occur at altitudes of up to 2600 metres (Nowak 1991, 710). This species inhabits sandy or loamy soils in a variety of habitats ranging from dry brush country and agricultural lands to woodlands. As this species lives underground, and the recovered specimens display an excellent state of preservation, the remains are interpreted as representing intrusive finds.

4.14 Turkish hamster (*Mesocricetus brandti*).

Thirteen Turkish hamster specimens were recovered, including 11 cranial, one mandibular and one femoral fragment.[45] This species is distributed throughout the Near East including Turkey, northern Transcaucasia, Iran and Iraq, Syria, and south into Israel (Musser & Carleton 1993, 539). It inhabits dry, rocky steppes, and slopes with low vegetation, although its burrowing habits and the quality of preservation of the recovered remains again indicate that these bones are intrusive.

Birds

4.15 White stork (*Ciconia ciconia*).

A single white stork bone was identified comprising a right distal tarsometatarsus (6.1608A-B; Table 1; Figure 44ii). White storks are distributed throughout southern and eastern Europe extending into western Asia and the northern regions of the Near East, with occupation restricted to summer residency (Cramp 1978, 328). Within Turkey, distribution is largely concentrated in the west, with only isolated populations occurring in the easternmost regions of the country. The white stork is relatively poorly represented at archaeological sites in Anatolia. Remains have been identified from Early Bronze Age levels at Demircihüyük and Late Chalcolithic to Early Iron Age levels at Norşun-Tepe (Boessneck & von den Driesch 1987; Boessneck & von den Driesch 1978b, 97).

White storks tend to inhabit regions where a continental or Mediterranean climate is associated with open wetlands, grasslands, steppes, flood lands and arable lands (Cramp 1978, 328). Storks display a preference for shallow, standing water such as pools and slow-moving streams, in preference to rivers and deep lakes. They avoid tall and dense stands of vegetation including forests and reed beds.

4.16 Whitefront goose (*Anser albifrons*).

A single specimen (6.1886), of whitefront goose was identified, being a right coracoid lacking the lateral angle of the distal extremity (Tables 1, 32; Table 32; Figure 45iii).

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[44] Specimen numbers include 5.1542A-T, 5.1672A-AZ, 6.1108, 6.1109, 6.3000, 6.3001, 6.3002, 6.3003, 6.3004, 6.3005.

[45] (6.3006, 6.3007, 6.3008, 6.3009, 6.3010, 6.3011, 6.3012, 6.3013, 6.3013, 6.3014, 6.3015, 6.2166, 6.2167, 5.0018).

Although comparative measurements are lacking, this specimen appears to have been somewhat larger than a fragmentary coracoid from Early Bronze Age Demircihüyük (Boessneck & von den Driesch 1987, 45).

Whitefront geese occur only seasonally in Turkey, inhabiting isolated pockets in the northeast, northwest and central region during winter (Cramp 1978, 405). Whitefront goose remains have been identified from sites throughout Anatolia. These include Late Chalcolithic and Bronze Age Tepecik, Chalcolithic to Early Bronze Age Norşun-Tepe, Early Bronze Age Demircihüyük, Late Bronze I-II Korucutepe, and Late Chalcolithic to Early Bronze Age Hassek Höyük (Boessneck & von den Driesch 1979a, 114; Boessneck & von den Driesch 1976b, Table 1; Boessneck & von den Driesch 1987, 44; Boessneck & von den Driesch 1975, 150; Stahl 1989, 147). While typically inhabiting tundra, whitefront geese will utilise a variety of habitats during both migration and winter occupation. These include lowland pastures, arable and fallow lands, rough grassland including wetlands, and steppe with halophytic or arid vegetation (Cramp 1978, 404).

4.17 Mallard (*Anas platyrhynchos*).

A single mallard bone (6.1457) was identified consisting of a left distal femur (Tables 1, 33c). The distal breadth of this specimen is slightly smaller than that of a femur from Early Bronze Age Demircihüyük (Boessneck & von den Driesch 1987 46).

The mallard is the most common and widespread of ducks throughout Europe, north Africa and the Middle East. The species is distributed throughout Turkey although it is restricted to summer occupation in the east of the country (Cramp 1978, 50). Mallards are represented widely at archaeological sites throughout Anatolia. These include Late Chalcolithic and Early Bronze Norşun-Tepe, Late Chalcolithic and Bronze Age Tepecik and Tültintepe, Middle Age contexts at Hayaz Höyük, Chalcolithic to Early Bronze Age Hassek Höyük, and Bronze Age contexts from Korucutepe and Lidar Höyük (Boessneck & von den Driesch 1978b, Table 1; Boessneck & von den Driesch 1979a, 114; Boessneck & von den Driesch 1976a, Table 1; Buitenhuis 1985, 64; Stahl 1989, 147; Boessneck & von den Driesch 1975, 150; Kussinger 1988, 187). The mallard is adaptable to a wide range of habitats from the Arctic to sub-tropical zone, the only limitation to its distribution being the requirement of still or slow-moving water (Cramp 1978, 507). The specimen from Sos Höyük shows no sign of butchery. The adaptability of the mallard imparts little information regarding the vegetational biota of the site during the Early Bronze period.

4.18 Marsh harrier (*Circus aeruginosus*).

The marsh harrier is represented by a single specimen, comprising a left distal ulna fragment (6.1974; Tables 1, 34; Figure 44i). The marsh harrier enjoys a wide distribution including both year long and seasonal occupation throughout north Africa, Europe and the Middle East. The species inhabits isolated pockets throughout Turkey on both a seasonal and permanent basis, with occurrence in the eastern regions largely restricted to a migratory stop during autumn and spring. Although a bird of temperate and Mediterranean climates, the marsh harrier will penetrate into boreal, steppe and subtropical regions (Cramp 1980, 106). Marsh harriers avoid wooded or forested environments, favouring instead sparsely treed habitats with shallow still or slow flowing rivers or lakes of fresh or brackish water with dense aquatic vegetation.

4.19 Golden eagle (*Aquila chrysaetos*).

A single golden eagle bone was identified (6.2165), comprising a left carpometacarpus, lacking the most distal portion of the minor metacarpal bone (Tables 1, 35b; Figure 46ii). The golden eagle is currently widely distributed throughout Turkey. The species is however poorly represented archaeologically with remains identified only from Early Bronze Age Demircihüyük and possibly also Late Neolithic Fikirtepe (Boessneck & von den Driesch 1987, 46; Boessneck & von den Driesch 1979b, 49). Golden eagles enjoy a wide distribution across Europe, Eurasia and north Africa, although their range has contracted in the last century due to persecution (Cramp 1980, 235). Golden eagles predominantly occupy steppe and boreal zones with temperate climates. The species tends to be associated with mountainous and upland treeless terrain, although it may extend into lowland forests in the eastern parts of its distribution (Heinzel, Fitter & Parslow 1995, 96). Golden eagles tend to avoid lakes, wetlands and forests, and instead prefer open undulating terrain with low vegetation, permitting good visibility and maximal use of air currents. The presence of the golden eagle at Sos Höyük during the Early Bronze Age may imply the proximity of open, sparsely vegetated terrain.

4.20 Chukar (*Alectoris chukar*).

A single specimen (5.2575) identified as chukar comprises a femur lacking only portions of the proximal and distal extremities (Tables 1, 37). The greatest length of the femur is slightly smaller than that of two specimens from Late Bronze I-II Korucutepe (Boessneck & von den Driesch 1975, 152).

Distribution of the chukar is restricted to the Middle East and similar latitudes eastward from Transcaucasia (Cramp 1980, 452). The species is widespread throughout Turkey, with the exception of a small portion of the Black Sea coast. Chukar remains are relatively common from archaeological sites in Anatolia. These include Middle Bronze II to Medieval Korucutepe, Early Bronze Demircihüyük, Chalcolithic and Bronze Age levels from Tepecik, Chalcolithic and Early Bronze Hassek Höyük, and Chalcolithic and Early Bronze Age Norşun-Tepe (Boessneck & von den Driesch 1975, 151; Boessneck & von den

Driesch 1987, Table 1; Boessneck & von den Driesch 1979a, 114; Stahl 1988, 148; Boessneck & von den Driesch 1976b, Table 1). The species can occupy a diversity of environments ranging from mountainous hillsides below the snow line to semi-desert but tend to avoid dense forests, preferring instead bare slopes, screes, and grasslands (Cramp 1980, 453; Heinzel, Fitter & Parslow 1995, 116). The chukar is traditionally hunted as a game bird and may have been similarly exploited during the Early Bronze Age at Sos Höyük.

4.21 Common crane (*Grus grus*).

Four specimens, representing an MNI of one, were identified as common crane (Tables 1, 39). These include a proximal humeral specimen (6.1606), a proximal ulnar fragment (6.1948; Table 39a; Figure 49i), the shaft of a tibiotarsus (6.0074; Table 39b) and a fibula lacking the distal extremity (6.0489; Figure 49iii). The proximal breadth of the ulna from Sos Höyük is comparable to that of specimens from Late Bronze I-II and mixed Early Bronze II/Late Bronze I-II deposits at Korucutepe (Boessneck & von den Driesch 1975, 153). The ulna from Sos Höyük may thus have come from a small sized crane.

The common crane tends to concentrate toward the northern regions of Europe and the Middle East. Southern and western regions have witnessed a decline since the Middle Ages, brought about by the draining of wetlands (Cramp 1980, 619). Occupation within Turkey is principally seasonal, with isolated instances throughout central Turkey, and an extensive region of summer occupation in the east. Common crane remains are frequently and relatively abundantly represented from excavations in Anatolia. Specimens have been identified from Early Bronze II to Middle Age Korucutepe, Early to Middle Bronze Age Demircihüyük, Neolithic and Early Bronze levels from Hayaz Höyük, Late Neolithic Fikirtepe, Chalcolithic to Early Bronze Hassek Höyük, Chalcolithic to Early Bronze Age Norşun-Tepe and Late Chalcolithic to Bronze Age Tültintepe (Boessneck & von den Driesch 1975, 153; Boessneck & von den Driesch 1987, 47; Buitenhuis 1985, 64; Boessneck & von den Driesch 1979b, 49; Stahl 1989, 148; Boessneck & von den Driesch 1976b, Table 1; Boessneck & von den Driesch 1976a). The common crane inhabits a great diversity of habitats ranging from treeless moorlands and pine forest clearings, to reedy wetlands, steppe and semi-dessert, although this species is always associated with water. Common crane meat appears to have been consumed at Korucutepe, and as the flesh of younger birds is particularly succulent (Boessneck & von den Driesch 1975, 153), it is possible that hunting of this species at Sos Höyük was governed by a similar motivation.

4.22 Great bustard (*Otis tarda*).

Four specimens of the great bustard, representing an MNI of two, were recovered from Early Bronze Age levels at Sos Höyük (Tables 1, 40). These included a coracoid (5.3587; Table 40a; Figure 45i), a distal tarsometatarsus (6.2020; Table 40b), a proximal tarsometatarsal fragment (6.1607), and a distal radial fragment (6.1635). The last two specimens came from a single excavation unit and may represent the same animal. The coracoid is comparable in size to a male specimen from Phase D, Hasanlu Period X at Hajji Firuz Tepe, Iran (Meadow 1983, Plate 6c). The distal tarsometatarsus from Sos Höyük is almost identical in size to a female specimen from Early Bronze II levels from Korucutepe, and is slightly larger than a number of female specimens from Phases A and C from Hasanlu Period X at Hajji Firuz Tepe (Boessneck & von den Driesch 1975, 154; Meadow 1983, Plate 6d).

The great bustard currently maintains a scattered distribution across Europe, Russia and the most northerly regions of the Near East. Within Turkey, modern distribution tends to winter occupation of the central and more southerly regions. The great bustard is frequently represented in archaeological assemblages from Anatolia. Remains have been identified from sites including Early to Middle Bronze Demircihüyük, Early Bronze II to Middle Bronze II Korucutepe, Chalcolithic to Early Bronze Age Norşun-Tepe and Late Chalcolithic to Bronze Age levels from Tepecik (Boessneck & von den Driesch 1987, 47; Boessneck & von den Driesch 1975, 154; Boessneck & von den Driesch 1976b, Table 1; Boessneck & von den Driesch 1979a, 114). Distribution is largely dependent on the degree of vegetational cover with lowlands, river valleys and undulating open country inhabited in preference to wetlands, forests, and grasslands with anything more than sparse tree cover (Cramp 1980, 659; Heinzel, Fitter & Parslow 1995, 130). Prolonged or heavy snow may prompt irregular migration, although the great bustard is known to nest at altitudes of up to 2000 meters in Russia. It is thus unclear if this species was present in the region of Sos Höyük only seasonally or throughout the year. It is possible that the great bustard was hunted as a game bird during the Early Bronze Age at Sos Höyük.

4.23 Little owl (*Athene noctua*).

A single specimen of little owl was identified, comprising a distal humerus fragment (5.3529; Tables 1, 41; Figure 47i). The little owl is currently widely distributed across Europe, North Africa and the Middle East, although both numbers and ranges have declined in Europe in recent times (Cramp 1989, 515). The species is present throughout Turkey with the exception of the Black Sea coast and a restricted region within the central south. Little owl remains have rarely been identified from excavations in Anatolia, with a single ulna coming from Early Bronze contexts at Demircihüyük (Boessneck & von den Driesch 1987, 48). The little owl has adapted to a wide variety of open habitats in temperate and Mediterranean climates, and inhabits dry unwooded mountains and hilly steppes in preference to dense vegetation and forests (Cramp 1989, 515).

Fish

4.24 Unidentified.

Six fish specimens were recovered from Early Bronze Age levels at Sos Höyük including one large vertebra (6.2307) and five smaller vertebrae (6.1951A, 6.1951B, 6.1951C, 6.1951D, 6.1951E) that appear to be from a single individual (Table 1). The lack of comparative skeletons precludes more specific identification. These specimens most plausibly represent freshwater species. The streams and rivers within the vicinity of the site would have afforded the opportunity to exploit aquatic resources.

4.25 Summary of the Faunal Assemblage from Early Bronze Age Sos Höyük.

The faunal assemblage from Early Bronze Age levels at Sos Höyük indicates an emphasis on the herding of cattle and ovicaprids, with primary products forming the focus of herd management strategies in each case. Secondary products were probably also exploited to some extent, including the use of castrated cattle for traction or cartage work. The incidence of cut and chop marks on the bones of these taxa suggest the use of a number of additional resources including horn, hides and marrow. The low frequency of butchery marks, however, means that the nature of butchery practices remains largely inferential. With the exception of the ovicaprid dental remains, the incidence of pathological conditions among the cattle and ovicaprid remains was low, suggesting that these taxa maintained good health. As dental health is not necessarily correlated to animal health, the impact of the high level of dental pathologies among the ovicaprid specimens remains unclear. Pig, horse and dog were also exploited, although at a significantly lower level than the ruminants.

A wide range of wild taxa were exploited at the site during the Early Bronze Age period, although the low frequency of identified remains from all taxa suggests that they occupied a limited role in the subsistence activities at the settlement of Sos Höyük. Exploitation of wild taxa appears to have focused upon the red deer and brown hare, with the former being used mainly for their antler as a material for tool manufacture and the latter for meat and probably also fur. The wild ancestors of the main domestics, including the aurochs, wild pig, wild sheep and goat, and wolf, were all either hunted or trapped, probably for both meat and hides. Further wild taxa including the red fox, brown bear, brown hare and various bird species may have furnished similar products.

Chapter 5
EARLY BRONZE AGE BÜYÜKTEPE HÖYÜK

5.1 Introduction

5.1.1 The Assemblage

Eighty-one specimens were recovered from Early Bronze Age contexts at Büyüktepe Höyük (Table 2). Thirty-four (42.0%) of these were identified to species level with the remaining 47 (58.0%) specimens classified as unidentified (Table 1bi-ii). The small number of recovered specimens precludes detailed consideration of the preservation of the sample, although when compared with the assemblage from Early Bronze Age Sos Höyük, the sample from Büyüktepe Höyük shows a higher proportion of unidentified specimens. When the degree of breakage is assessed, it is clear that the majority of recovered fragments display ancient breakage (Table 5b i-ii). The overall frequency of recent damage or ancient and recent damage reaches 13.6%, which, although slightly higher than in the case of the Sos Höyük assemblage, is still low.

The small number of remains recovered from Early Bronze Age contexts at Büyüktepe Höyük preclude consideration of the relative representation of different taxa.

5.1.2 Carnivore Gnawing

Only three cases of carnivore gnawing were detected on the animal remains from Early Bronze Age contexts (Table 6b). A single *Bos* specimen (5.1255; 8.3%) displays evidence of carnivore gnawing in the form of pitting and furrowing. This calcaneus shows a reduction of the spongy bone of both the proximal extremity and distal articulation. A tibial fragment (4.0971; 6.7%) is the only ovicaprid specimen to exhibit signs of carnivore gnawing, with furrowing and scoring apparent on the distal shaft. A single unidentified specimen consisting of a rib fragment from a large-sized animal (5.0%) displays evidence of gnawing.

5.1.3 The Unidentified Remains

Neither the unidentified or identified remains from Early Bronze Age levels at Büyüktepe Höyük display evidence of burning or of tool manufacture. Evidence of butchery is also lacking from the unidentified remains. This may simply be an artifact of the small number of specimens in the assemblage.

5.2 Horse (*Equus caballus*), hemione (*E. hemionus*) and ass? (*E.asinus*).

Four equid specimens were recovered from Early Bronze Age contexts at Büyüktepe Höyük, including two domestic horse specimens, representing an MNI of one, and single hemione and hemione/asinine specimens (Tables 2, 15).

5.2.1 The Post-cranial Remains

Two specimens display caballine morphology. The humeral specimen (4.0782; Table 15c) includes portions of the distal shaft and extremity. The articular surface of the trochlea slopes distally toward the lateral side and does not exhibit the almost straight surface characteristic of hemiones (Uerpmann 1986, 257). The dimensions of this specimen are comparable to those of domestic horses from Late Bronze and Hellenistic/Roman levels at Lidar Höyük, a male specimen from a Middle Iron Age burial at Norşun-Tepe, and the humerus from the Thebes horse (Kussinger 1988, Table 40; Boessneck & von den Driesch 1978b, Table 5.; Boessneck 1970, Table 2). A chop mark is apparent running cranio-caudally from the latero-ventral edge of the capitulum toward the lateral epicondyle of this specimen. This mark presumably resulted from an attempt to sever the lateral collateral ligament in order to facilitate disarticulation of the radius and ulna from the humerus. A complete right first phalanx (4.0785; Table 15n) has an index of robustness [46] that falls toward the lower end of the range for horses. This specimen is comparable in size to the first phalanges of a male horse from Middle Iron Age Norşun-Tepe and the Thebes horse (Boessneck & von den Driesch 1978b, Table 5; Boessneck 1970, Table 2), although the specimen from Büyüktepe Höyük is somewhat longer and more narrow proximally than the latter.

A single hemione specimen (4.0784; Table 15h) was identified. This is a pelvic specimen that preserves the acetabular region including the body of the ilium, the lateral portion of the cranial branch of the pubis, and the body of the ischium to the caudal end of the obturator foramen. Although the depression for the medial tendon of the rectus femoris muscle is reasonably shallow, that for the lateral tendon is quite deep. It is common among hemiones for the lateral rectus femoris depression to be well developed, whereas this is virtually never the case for asses (Uerpmann 1986, 258). The dimensions of the acetabulum are very similar to those of a modern hemione from the Smithsonian Collection, while the length of the acetabulum on the rim is paralleled by hemiones from the first half of the fifth millennium at Shams ed-Din (Zeder 1986, 383; Uerpmann 1986, 253). Although very little of the os pubis is preserved, the robustness of the cranial branch suggests a male animal.

A proximal radial fragment (4.0783) preserving only the medial half of the epiphysis is too fragmentary to permit conclusive identification. Due to the preservation of only a small portion of the proximal shaft it is impossible to distinguish whether the medial margin is rounded or flaring, reflecting hemione/caballine or asinine morphology, respectively (Meadow 1986, 275). Based upon the general size and morphology of the fragment, in addition to its adult character, it appears to be too small to be from a horse and is thus identified as asinine/hemione.

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[46] SD x 100 / GL (Compagnoni 1975,111).

5.2.2 Summary

The equid remains from Büyüktepe Höyük suggest the presence of at least two species, the domestic horse and the hemione. The presence of butchery marks on the horse humerus suggests that horses may have been consumed during the Early Bronze Age period.

5.3 Domestic cattle (*Bos taurus*).

Twelve domestic cattle specimens, representing an MNI of two, were recovered from Early Bronze Age contexts at Büyüktepe Höyük (Tables 2, 11b, 16).

5.3.1 Differentiation of Wild from Domestic Specimens

Examination of the morphology and size of the specimens provides no evidence of particularly large or robust morphologies, and subsequently all specimens were tentatively identified as domestic cattle.

5.3.2 Physical Characteristics of the Domestic Cattle

A single incomplete horn core (4.0167; Table 16a) was recovered which lacks both the tip and the base. The core has an estimated length along the outer curvature of approximately 260 millimetres. Based on the criteria outlined by Armitage and Clutton-Brock (Armitage & Clutton-Brock, 1976), this specimen displays a domestic long-horned morphology with distinct outer curvature but without noticeable torsion. The large basal circumference, circular cross section and thin bone walls suggest that a castrate is represented. The surface of the horn core has a texture and surface appearance compatible with Age class 4, thus suggesting an individual of adult age. The long-horned morphology of this horn core is comparable to that displayed by contemporaneous specimens from Sos Höyük, although the specimen from Büyüktepe Höyük displays significantly larger basal dimensions. The specimen is comparable in size to domestic male and castrate specimens from Middle Bronze to Late Bronze Age I-II levels at Korucutepe (Boessneck & von den Driesch 1975, Table 11).

5.3.3 Mortality Profiles

Virtually all the Early Bronze Age specimens from Büyüktepe Höyük appear to have came from adult animals. The single exception is the unfused distal shaft of a metatarsal bone (4.0836). The small number of specimens in the sample precludes any investigation of the herding strategy practised at the site.

5.3.4 Butchery

The horn core is the only specimen from Early Bronze Age contexts at Büyüktepe Höyük to display evidence of butchery. Deep chop marks are apparent encircling the base of the core, adjacent to the region where the core was removed from the skull. These marks would have resulted from the removal of the horn core from the skull possibly to facilitate later separation of the horn. Similar butchery marks are apparent on specimens from Early Bronze Age levels from Sos Höyük.

No evidence of pathology was observed amongst the cattle bones from Early Bronze Age contexts at Büyüktepe Höyük.

5.3.5 Summary

The paucity of cattle specimens from Early Bronze Age contexts at Büyüktepe Höyük restricts conclusions regarding the exploitation of large bovids at the site during this period. The horn core specimen suggests that domestic cattle of a long horned variety, similar to that being utilised in Early Bronze Age contexts at Sos Höyük, were being herded.

5.4 Domestic sheep (*Ovis aries*) and domestic goat (*Capra hircus*).

A total of 15 domestic ovicaprid specimens, representing an MNI of three, were recovered from Early Bronze Age contexts at Büyüktepe Höyük (Tables 2, 12b, 17). These include two sheep specimens, representing an MNI of one.

The majority of specimens are too fragmentary to permit species identification using the characteristics outlined by Boessneck, and Boessneck, Müller and Teichert (Boessneck 1969; Boessneck, Müller & Teichert 1964). Two of the four mandibular specimens, however, were identified as sheep using the characteristics described by Payne and Halstead (Payne 1985b; Halstead pers.comm). The remaining specimens were identified only as ovicaprid. None of the specimens display a size and morphology compatible with their identification as wild stock. All of the specimens came from adult animals.

The Early Bronze Age ovicaprid specimens display neither pathological conditions nor any evidence of butchering.

The extremely small sample size afforded no opportunity to investigate any characteristics regarding the nature of pastoralism or physical attributes of the Early Bronze Age ovicaprids at Büyüktepe Höyük.

5.5 Domestic pig (*Sus scrofa* domesticus).

Two pig specimens, comprising a deciduous fourth premolar (4.0113) and a mandibular angle fragment (4.0781) were recovered from Early Bronze contexts at Büyüktepe Höyük (Table 2). The small length and breadth of the fourth premolar suggest that it came from a domestic animal, although lack of comparative measurements do not permit confirmation of this identification. The fragmentary state of the angle specimen precludes a definite identification as to wild or domestic, although its small size would tend to suggest the latter. These specimens bear no evidence of butchery.

5.6 Domestic dog (*Canis familiaris*).

A single domestic dog specimen was recovered from Early Bronze Age contexts at Büyüktepe Höyük (Table 2). This fragmentary mandibular canine (4.0094) is smaller in length than domestic dog specimens from Early Bronze Age Hassek Höyük and Late Bronze I-II Korucutepe (Stahl 1989, Table 25; Boessneck & von den Driesch 1975, Table 28). The morphology of the canine precludes identification as golden jackal, as the specimen displays weak mesio-lingual and dental margins, and lacks a cingulum (Harrison 1991, 113-115).

5.7 Summary of the Faunal Assemblage from Early Bronze Age Büyüktepe Höyük.

Due to its small size, the bone assemblage from Early Bronze Age Büyüktepe Höyük permits only limited conclusions to be drawn regarding the subsistence systems of the site during this period. Domestic cattle and ovicaprids appear to have been herded, although further information regarding herd management strategies is lacking. Indication of the presence of castrates amongst the cattle remains suggests that some form of traction work or cartage was taking place during the Early Bronze Age period. Horse, pig and domestic dog are also represented at the site during this period. The identification of a hemione bone suggests that some form of hunting or trapping of wild equids took place.

Chapter 6
IRON AGE SOS HÖYÜK

6.1 Introduction

6.1.1 The Assemblage

A total of 4982 faunal remains were recovered from Iron Age contexts at Sos Höyük including 2217 identified to at least family level, 2761 unidentified specimens and four intrusive identified specimens (Table 3). Excluding the intrusive specimens, almost half of the assemblage in terms of NISP represented identified remains (44.5%), and thus the degree of preservation was reasonable (Table 1bi-ii). When compared with the samples from Early Bronze Age Sos Höyük and Büyüktepe Höyük, that from Iron Age Sos Höyük was intermediate in the relative representation of identified to unidentified remains. Overall, however, this ratio is comparable across the three samples, suggesting similar levels of preservation.

Among the unidentified fraction there is a low percentage of modern breakage. This is in contrast to the situation with the identified remains that display a remarkably high percentage of modern breaks and complete specimens (Table 5c i-ii). Among the identified remains, the degree of ancient breakage was higher for the large, than for the medium and small sized taxa.[47] The bones of medium and small taxa would be more prone to damage during post-excavation handling and transport than those of larger animals because of their relatively less robust morphology. Also, the majority of intact specimens comprise small bones including phalanges, carpal and tarsal bones, with those of the small and medium sized taxa being more resilient to post-depositional forces of destruction than the same elements of larger taxa. With 22.2% of the total assemblage displaying recent or ancient and recent breakage the assemblage from Iron Age Sos Höyük was more affected by post-excavation damage than those from Early Bronze Sos Höyük and Büyüktepe Höyük. This may reflect variation in recovery or chance damage caused during transportation of the remains.

6.1.2 Carnivore Gnawing

The incidence of carnivore gnawing is extremely low on the Iron Age remains from Sos Höyük (Table 6c). Six cattle specimens (1.3%) display evidence of carnivore gnawing. Pitting, furrowing, and reduction of the spongy bone are apparent on short bones including a calcaneus, a mandibular condyle fragment and two acetabulum fragments, and on various long bone specimens including proximal humeral and distal metacarpal fragments. Sixteen ovicaprid specimens (1.0%) display evidence of carnivore gnawing. This is almost exclusively restricted to long bone specimens in which the shafts show scoring and channelling, often associated with pitting and furrowing of the articular surface. The exceptions comprise three scapular specimens, two of which consist of caudal margin fragments (7.0910, 7.1051) displaying pitting, and a distal fragment (7.0650) with furrowing and puncturing about the articular surface.

Three ovicaprid tibial specimens (7.0677, 7.1006, 7.1230) provide uncertain evidence of gnawing. In each case the shaft is pierced adjacent to the distal extremity in a dorso-plantar direction. In two cases the hole passes from the plantar surface of the shaft into the medullary cavity only, whereas in the other specimen the hole pierces both the dorsal and plantar surfaces of the bone. In each case, the holes are extremely irregular in outline, and in one specimen (7.0677) the perforation is associated with pitting and transverse scoring of the shaft characteristic of carnivore gnawing. It is thus unclear whether these specimens were modified by humans for the purpose of creating a tool or functional item, or whether the modifications resulted from activity by non-human agents. Similar specimens from Early Bronze levels are equally ambiguous although the associated characteristics of carnivore gnawing in both assemblages suggests that the damage did not result from human activity.

Twenty-six of the unidentified remains, including 13 large (1.0%) and 12 medium-sized animal (0.8%) specimens, and a single fragment of indeterminate size (5.9%), exhibit carnivore gnawing. The comparability between the incidence of gnawing on the medium- and large-sized animals among the identified and unidentified remains suggests both that the observed frequency among the cattle and ovicaprid remains provides an accurate measure of gnawing, and that this factor would not have resulted in significant biases in the representation of different taxa or skeletal elements within the assemblage.

Among the remains displaying evidence of gnawing, 20 unidentified, three cattle and six ovicaprid specimens came from trench J14. As the majority of fox and dog remains were also concentrated in this trench, a relationship appears to exist between the location of gnawed bones and the carnivore skeletal remains. The low incidence of modifications to bones by carnivores nevertheless implies that dogs did not enjoy frequent access to the skeletal remains at the site.

6.1.3 Burning

Although the incidence of burning among the Iron Age remains from Sos Höyük is low (Table 7b), it is the highest frequency observed among the four assemblages analysed.

Two equid phalanges (15.4%), and 26 cattle specimens (5.5%) display evidence of burning. These remains derive principally from various bone samples in trenches L16 and M15d. Five of the cattle specimens originate from a single sample in L16 and were recovered in association with burnt building debris including beams and charcoal. The burnt condition of the bones therefore appears to have been

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[47] The current unavailability of contextual data precludes investigation of the effect that differential deposition and preservation may have had on the remains of large, medium and small sized taxa. Variation in the methods of carcass processing for different sized taxa may have also contributed to the relative representation of complete bones.

unintentional.

Twenty-six (1.6%) ovicaprid specimens from Iron Age contexts at Sos Höyük display evidence of burning. These specimens were not concentrated in particular deposits or associated with any specific features. That the burning occurred prior to the deposition of the bone in its recovered context is suggested by the fact that burnt bones were typically recovered in association with unburnt specimens. Burning is apparent on a range of skeletal elements and thus no specific link between the type of element and the nature of its treatment or disposal with respect to fire can be established.

Two equid, ten cattle, and three ovicaprid specimens display white discolouration and were associated with extensive evidence of burning activities, including charcoal and distorted fragments of pottery, in the area of pottery or lime kilns. Typically the longer a bone is exposed to heat or the higher the temperature, the whiter it will become (Spennemann & Colley 1990, 57). These specimens were therefore exposed to high intensity burning, although it is unclear whether this occurred in the form of high temperatures, prolonged exposure to heat, or perhaps a combination of the two. Based on analogy with experiments conducted by Shipman, Foster and Schoeninger, involving the controlled burning of a variety of ovicaprid bones, the colour of the specimens from Sos Höyük imply temperatures of at least 745 degrees Celsius (Shipman, Foster & Schoeninger 1984, Table 2). The morphology and density of the bone however may also affect its colour following burning. It is thus extremely difficult to ascertain the precise nature of the conditions that these specimens were subjected to.

Seventy-three unidentified specimens showed evidence of burning including 43 of the large-sized animal specimens (3.4%), 29 of the medium-sized animal specimens (2.0%) and one fragment (5.9%) of indeterminate size. The incidence of burning among the specimens of large- and medium-sized animals is comparable to that for the cattle and ovicaprid remains, respectively, suggesting that these figures provide an accurate estimate of the relative frequency of burning. Thirty-five of the unidentified remains come from M15d and were thus associated with the pottery or limestones kilns located in this region of the site. Following the trend among the identified remains, burnt specimens from large animals are more common than those from medium-sized species from this area. Twenty-six of the unidentified specimens from this trench also display white discolouration.

6.1.4 The Unidentified Remains- Butchery and Tools

Evidence of butchery is rare among the unidentified remains. One rib fragment of a large-sized animal (0.1%; Table 8c) displaying shallow cut marks.

Twelve unidentified specimens provide evidence for human modification into utilitarian or decorative objects (Table 9b). These include seven (0.6%) and five (0.3%) fragments of the total number of large- and medium-sized animals, respectively. All of these specimens are shaft fragments mmodified into awls or points, and are polished about their worked surfaces.

6.2 Horse (*Equus caballus*), ass (*E.asinus*), hemione? (*E.hemionus*), and hydruntine? (*E.hydruntinus*).

Twelve equid specimens were identified from the Iron Age deposits at Sos Höyük (Tables 3, 10b, 15). These included five caballine and one asinine specimen, each representing an MNI of one, and one asinine/hemione fragment. Two further specimens could only be identified as hemione/ hydruntine/ caballine due to their fragmentary and damaged state of preservation. Three specimens were assigned only to genus.

6.2.1 The Cranial Remains

The cranial remains recovered consist of two permanent mandibular cheek teeth. These included a fragmentary third premolar (7.0422) and a fragmentary third premolar or first molar (7.1078).[48]

In the third premolar (7.0442; Table 15a; Figure 20c) the ectoflexid does not penetrate the double knot and the postflexid is consequently long. The ectoflexid is thus deeper than is generally observed in asses but shallower than is apparent in caballines and hydruntines and as such most closely resembles a hemione morphology (Zeder 1986, 387; Bökönyi 1986, 307). The linguaflexid is shallow and smooth, features also characteristic of hemiones (Eisenmann 1986, 76). Although the lingual portion of the occlusal surface of this specimen is damaged, the double knot formed by the metaconid and metastylid appears to be fairly symmetrical. This is a feature of hemione, hydruntine and asinine mandibular teeth and stands in contrast to the asymmetry generally apparent in horses (Zeder 1986, 387). The features of this specimen thus suggest a hemione/asinine morphology, tending toward hemione. That the age of this specimen exceeds six years is implied by the fact that the occlusal surface is worn flat (Levine 1982, 231). Using height-wear curves for aging horse teeth based on New Forest pony and fossil specimens, a more precise age of approximately thirteen to fourteen years is obtained (Levine 1982, Figure 1).

Another tooth was identified as a fourth premolar or first molar (7.1078; Table 15a; Figure 20d). In this specimen, the ectoflexid reaches the end of the preflexid but remains distinct from the postflexid and thus tends toward the deep lateral valley apparent among caballine specimens. The linguaflexid is deep and U-shaped, thus also resembling caballine morphology (Eisenmann 1986, 76). The double knot is asymmetrical with a rounded metaconid, in contrast to the symmetry and more flattened metastylid typical of hemiones, hydruntines and asses. This specimen may be identified fairly confidently as caballine. Due to the

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[48] The third premolar was identified using the straightness of the crown body, the right angle formed by the occlusal surface and crown wall and the larger buccolingual width of the distal relative to the mesial half of the crown (Davis 1980, 292). The difficulty associated with separating fourth premolars from first molars necessitated a combined category for these teeth.

fragmentary state of this tooth, the age of the animal could not be determined with accuracy, although the flat nature of the occlusal surface of the tooth implies an animal over six years of age (Levine 1982, 229).

6.2.2 The Post-cranial Remains

Among the post-cranial remains, a single specimen was readily identified to the domestic horse. A distal metacarpal fragment, (7.1106A-B; Table 15l), displays caballine morphology and dimensions. This can be seen in the significantly greater breadth of the articular surface relative to the greatest supra-articular breadth (Eisenmann & Beckouche 1986, 123). The domestic status of this specimen is suggested by the fact that this feature is more developed in domestic than wild forms. That this animal was domestic is further implied by the measurements of least to greatest depth of the medial condyle. The specimen displays the greater tapering of the medial condyle typical of domestic relative to wild horses. The distal breadth of this specimen lies within the range for caballine specimens dating to Phase IIa at Dereivka in south central Russia (Anthony 1991, Table 4). The specimen is also comparable in size to caballine metacarpal bones from Iron Age to Hellenistic/Roman Lidar Höyük and is only slightly smaller than two Late Chalcolithic horse specimens from Arslantepe and Değirmentepe respectively (Kussinger 1988, Table 40; Bökönyi 1991, Table 2).

Another distal metacarpal was identified as asinine. This specimen (7.0740; Table 15l) is considerably smaller than would be expected for a horse. The greatest breadth of the articular surface and greatest surpra-articular breadth are approximately equal in both asses and hemiones with the former slightly reduced relative to the latter in hydruntines (Eisenmann & Beckouche 1986, Figures 8,12). The medial condyle is better developed in both the ass and hydruntine than is apparent in hemiones. With its approximately equal distal articular and supra-articular breadth and a tapering medial condyle, the Iron Age specimen displays an asinine morphology. A further difference is apparent between the metapodial bones of asses and hemiones in terms of the distal shaft. While in asses the distal articulation lies in line with the shaft, in hemiones this articulation is offset ventrally with a curvature apparent in the distal shaft (Meadow 1986, 276). The manner of fragmentation of the Iron Age specimen, however, precludes use of this character. In terms of dimensions this specimen accords well with asinine specimens. The distal breadth falls into the mid-range of dimensions from asinine metacarpal bones from the Near East including those from Middle Bronze II to Late Seljuk levels at Korucutepe, Early Bronze to Early Middle Age specimens from Selenkahiya, Sweyhat, El Qitar and Hadadi in northern Syria, Middle Bronze to Hellenistic/Roman Lidar Höyük, and two specimens from Layer IVA at Dinkha Tepe in Iran (Boessneck & von den Driesch 1975 Table 6k; Buitenhuis 1991, Appendix; Kussinger 1988 Table 42; Gilbert 1991 Appendix 3). There is however considerable overlap apparent between the distal breadth of hemione, hydruntine and asinine metacarpal bones (Eisenmann & Beckouche 1986, Tabs. 6-9). Nevertheless, the combination of morphology and dimensions for the Iron Age specimen suggest that an ass, rather than a hemione or hydruntine, is represented.

Two phalanges, including a complete forelimb second phalanx (7.1337; Table 15o) and an incomplete forelimb third phalanx (7.1338A-B; Table 15p) had been burnt, resulting in cracking and warping of the specimens. Based on overall size, these specimens appear to have came from a single individual. The distortion of the specimens, however, did not permit direct confirmation of this impression. In terms of dimensions, both specimens are larger than the range observed for asinine specimens, but somewhat smaller than would be expected for caballines. Instead, the dimensions of the second phalanx lie towards the upper part of the range displayed by hemione forelimb middle phalanges dating to the Zarzian period at Palegawra Cave in northeastern Iraq and by specimens dating to the later part of the Halafian period at Shams ed-Din in northern Syria. The dimensions of the Sos Höyük specimen are also comparable both to modern hemione second phalanges, and to specimens dating to the Banesh to Middle Elamite contexts at Tal-e Malyan in southern Iran (Turnbull 1986, 362; Uerpmann 1986, Table 3; Zeder 1986, Figure 22). Hydruntine second phalanges from early Holocene Can Hasan III in central Turkey are only slightly smaller than the Sos Höyük specimen (Payne 1991, Appendix 2).

Similarly, the dimensions of the third phalanx from Sos Höyük are comparable to those of modern hemione phalanges, to two specimens from the Halafian period at Shams ed-Din, and to the larger forelimb specimens dating to the Zarzian period at Palegawra Cave (Zeder 1986, Figure 21; Uerpmann 1986, Table 3; Turnbull 1986, 362). Comparative hydruntine measurements are unfortunately lacking, but the overlap between the range of dimensions for hemione and hydruntine specimens establishes the likelihood that the dimensions of the Sos Höyük specimen would also coincide with those from hydruntines. The high temperatures that these specimens were exposed to, as evidenced by their white discolouration, are known to cause shrinkage. Although a function of the extent of incineration, the degree of shrinkage cannot be readily predicted when the maximum temperature that the bones have been heated to is unknown (Shipman, Foster & Schoeninger 1984, 322). As their white colour suggests that these bones were heated to at least 750 degrees Celsius, this may imply, based on analogy with the experimental data of Shipman, Foster and Schoeninger, that shrinkage of between five and 15 percent occurred. If the degree of shrinkage was closer to five percent, the unburnt specimens would be more comparable in size to the phalanges of hemiones and hydruntines, whereas if shrinkage was maximal, it is possible that a domestic horse is represented. Thus while the two specimens from Iron Age Sos Höyük are larger than asinine specimens, they may be from a hemione, hydruntine or horse.

A number of the equid specimens recovered from Iron Age contexts at Sos Höyük are too fragmentary to permit the taking of meaningful measurements. These included a fragmentary upper incisor (7.0936), a fused proximal epiphysis of a humerus preserving a portion of the lesser and intermediate tubercles (7.0878), a distal femoral fragment including the medial epicondyle and condyle (7.0353), a fourth metacarpal bone (7.1193), a fourth metatarsal bone (7.0076), and the lateral half of a hindlimb first phalanx (7.0314). Based on the size and robustness of the humeral and femoral fragments and the first phalanx, these specimens can be tentatively identified as caballine, with the remaining fragments assigned only to the genus *Equus*.

No evidence of butchery was found on the equid specimens. On the basis of the fused state of the epiphyses and morphology of the bone surface, all specimens appear to have come from adult animals.

6.2.3 Summary

In spite of the fragmentary and isolated nature of the equid specimens recovered from Iron Age contexts at Sos Höyük, the remains provide evidence for at least two equid species. Both the domestic horse and ass appear to have been utilised, although the paucity of remains suggests that these species were not abundantly represented at the site. They may have filled the function of transport and pack animals. The possible presence of hydruntines and hemiones suggests some hunting or trapping of wild equids. All these species may have contributed to the diet of the inhabitants of Sos Höyük although, in the absence of direct butchery evidence, this cannot be established with certainty.

6.3 Domestic cattle (*Bos taurus*).

Four hundred and seventy-four domestic cattle specimens, representing an MNI of 14, were recovered from Iron Age contexts at Sos Höyük (Tables 3, 11c, 16).

6.3.1 Differentiation of Wild from Domestic Specimens

Examination of the morphology and robustness of the large bovid specimens from Iron Age Sos Höyük provides no suggestion of the presence of wild cattle remains, and thus all specimens were tentatively classified as domestic.

The length of the mandibular third molar provides a further criterion that permits the separation of wild and domestic cattle. Based on six specimens (Table 43), both the range and mean of the sample from Iron Age contexts at Sos Höyük are appreciably lower than those recorded for wild cattle from both the Boreal period in Denmark and from Ali Kosh and Mohammad Jaffar contexts at Ali Kosh in Iran. The specimens from Sos Höyük furthermore display a lower range and mean than those for domestic cattle from Early Bronze Age Hassek, Bronze Age Korucutepe, Bronze Age to Iron Age Lidar Höyük, and Early Chalcolithic Çavi Tarlası. The mandibular molars from Iron Age levels at Sos Höyük thus clearly represent domestic stock.

6.3.2 Physical Characteristics of the Domestic Cattle

Due to the small number of specimens yielding meaningful measurements, the morphological characteristics of the cattle remains from Sos Höyük were examined using a log ratio diagram. The standard measurements are those used for the Early Bronze Age remains from Sos Höyük.[49] Breadths and length measurements from Sos Höyük yielded 41 and 23 size indices respectively (Figure 9b; Table 42bi-ii). Both plots lay far to the left of the zero line, thus representing animals of considerably smaller stature than the wild standard.

When compared with the graph of length and breadth size indices from Early Bronze Age Sos Höyük, that from the Iron Age reflects an obvious shift to the left relative to the standard. The range for both the length and breadth size indices is also more restricted in the Iron Age relative to the Early Bronze Age assemblage, suggesting less variation in the stature of the domestic cattle represented during the Iron Age period. Comparison of the medians suggests that a more significant decrease occurred in weight versus height from the Early Bronze Age period. The results therefore imply that the domestic cattle at Sos Höyük were of lighter stature and slightly shorter in the Iron Age period than those in the Early Bronze Age. The cattle at Iron Age Sos Höyük were also of lighter stature but similar height to those from Early Bronze Age Hassek Höyük, and of lighter stature than those from Middle Bronze Age Lidar. When the median for the breadth indices from Iron Age Sos Höyük is compared to that for the assemblages from Late Bronze Age Korucutepe and Lidar Höyük, it indicates a significantly lower and comparable median, respectively. In terms of length indices the median of the Sos Höyük assemblage is comparable to that from Late Bronze Age Korucutepe. This may suggest that variation in stature and therefore perhaps breed was apparent between sites in the Late Bronze and Iron Age periods. Comparison with size indices of breadth between the Sos Höyük assemblage and that from Iron Age levels at Lidar Höyük reveals a slightly lower median at the former site, suggesting further variation in cattle size in the Iron Age period. The lack of length dimensions from Iron Age Lidar Höyük unfortunately precludes comparison of height parameters between the cattle from Lidar and Sos Höyük.

An impression of the stature of the domestic cattle from Iron Age contexts at Sos Höyük can further be obtained through examination of various post-cranial elements, including the tali and the first and second phalanges (Table 44a-e). Measurements of the tali from Iron Age contexts yields a mean comparable to those from Middle Bronze Age Lidar Höyük, and Middle and Late Bronze levels at Korucutepe, indicating that the Iron Age cattle from Sos Höyük were medium sized animals. The cattle from Iron Age contexts appear to have been smaller in stature than those from the preceding Early Bronze Age levels at Sos Höyük and from Bronze Age at Boğazköy but larger than those from Early and Late Bronze Age Lidar Höyük and Early Bronze Age Hassek Höyük. That the cattle from Sos Höyük were medium sized animals is confirmed by measurements of the first and second phalanges. The means of the greatest length of these two elements from Iron Age levels is significantly lower than that from Early Bronze contexts from Sos Höyük and is instead comparable to, or only slightly lower than, the means from Bronze Age levels from Lidar Höyük and Korucutepe. Based on the measurements of the greatest length of the forelimb second phalanges and hindlimb first and second phalanges, the sample from Iron Age Sos Höyük exhibits a lower range and mean than those from earlier levels from Korucutepe, Lidar Höyük, Hassek Höyük, and Early Bronze Age Sos Höyük. The results from Iron Age Sos Höyük support the impression of variation in the withers heights of cattle throughout the Bronze Age to the

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[49] See page 24 for use of this standard for the *Bos* sample from Early Bronze Age Sos Höyük.

Iron Age period, suggestive of the presence of various breeds.

6.3.3 Horn Cores

A further impression of the physical characteristics of the cattle from Iron Age contexts at Sos Höyük can be obtained from examination of the morphology of the horn cores. Each of the five horn core specimens recovered (7.0674, 7.0974, 7.1098, 7.1290A-D, 7.1537A-J) was analysed and classified according to the characteristics outlined by Armitage and Clutton-Brock (Armitage & Clutton-Brock 1976). In almost all cases the hard and compact nature of the bone indicated that the horn cores came from adult animals. The single exception (7.1537A-J) displays porous bone and appears to represent a subadult. Due to the fragmentary state of the specimens, the length of the horn cores could not be determined with precision. Based on the size and curvature of the most complete specimen (7.0674) a 'medium-horned' breed appears to be represented. As the horn length of the Iron Age cattle from Sos Höyük is based on a single specimen, it is unclear whether these animals represent a different variety from the long-horned cattle of Early Bronze Age Sos Höyük. Two specimens (7.0674, 7.0974) permitted assessment of the curvature and torsion of the horn cores. In both cases the cores display curvature and torsion compatible with a twisted-horn morphology and are thus comparable to horn cores from Early Bronze Age Sos Höyük.

Two horn core specimens (7.0974, 7.0674; Table 16a) were identified to gender on the basis of various morphological and metrical characteristics. Specimen 7.0974 appears to represent a castrate on the basis of its circular cross section, thin walls, length and large basal circumference. The horn core also extends from the skull in an upright, caudo-lateral direction, as is typical of castrates. This specimen is considerably smaller in terms of basal dimensions than a castrate horn core from Early Bronze levels at Sos Höyük. The dimensions of the Iron Age specimen, however, are similar to those of two horn cores of indeterminate gender from Middle and Late Bronze Age contexts at Lidar Höyük (Kussinger 1988, Table 12). Based on the more gracile appearance of the core, and circular cross section, specimen 7.0674 was identified as female. This specimen is comparable in terms of least and greatest basal breadth to a female horn core from Early Bronze contexts at the same site. The horn core from Iron Age Sos Höyük also has basal dimensions similar to those of female specimens from Middle to Late Bronze levels at Lidar Höyük. The fragmentary state of the remaining specimens from Iron Age Sos Höyük do not permit their identification to gender.

6.3.4 Mortality Profiles

The mortality profiles for the Iron Age cattle from Sos Höyük are based on analysis of the mandibular tooth eruption and wear and epiphyseal fusion data. Although analysis of the dental remains is based on an extremely small sample of only nine specimens, it provides a clear suggestion of the predominance of adult mortality (Table 45a). Eight specimens (88.9%) are from individuals that survived until after the full eruption of the adult dentition and were thus at least 30 months of age. Six of the specimens (66.7%), show medium wear on the third molar and thus represent mature adults. No senescent animals are represented as none of the specimens display advanced wear on the third molar. The absence of evidence for neonatal mortality among the mandibular remains may an artifact of differential preservation or of chance when dealing with a relatively small sample size. The recovery of three fœtal post-cranial specimens shows that animals of that age were exploited. The possibility also exists that some neonatal animals, at least, were disposed of or died in an extramural context. Overall, a profile characterised by low neonatal to subadult mortality and high adult mortality is reflected by the dental data.

When compared with age distributions calculated on the basis of dental data from other sites including Demircihüyük, Korucutepe, Lidar Höyük and Hassek Höyük (Tables 45b i-ii), the age distribution from Iron Age contexts from Sos Höyük is most comparable to that from Early Bronze levels at the same site. For both the Early Bronze and Iron Age assemblages from Sos Höyük low juvenile and negligible subadult mortality are coupled with pronounced adult mortality. Although preadult mortality patterns for Early Bronze Age Hassek Höyük and Early and Late Bronze Age Lidar Höyük are different from that at Iron Age Sos Höyük, adult mortality is pronounced in each of these profiles, perhaps reflecting a comparable economy.

Analysis of epiphyseal fusion is based on 111 specimens divided into four broad age groups as determined by the fusion times of the elements concerned (Table 46b).[50] These data provide a clear indication of predominantly adult mortality. At least 60.9% of specimens came from animals that survived beyond 42 months of age. Mortality within the juvenile and subadult categories appears to have been consistently low with at least 94.2% and 85.2% of the sample surviving beyond 12 and 24 months, respectively.[51] The analysis of epiphyseal fusion is thus in broad agreement with that derived from the mandibular remains, indicating that mortality predominated in the mature adult age group.

The age distribution from Sos Höyük appears to reflect an emphasis on primary products. Thus while the dental and epiphyseal fusion data imply little herd mortality prior to 30 months, the epiphyseal fusion data suggest a significant increase in mortality by 42 months of age. This would accord with a primary products herd management strategy.

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[50] The first age group is based on the pelvis, the second group on the proximal radius, proximal first and second phalanges and the distal humerus, and the third group on the distal metapodial bones and distal tibia. The fourth group was calculated using the proximal humerus, ulna, femur and tibia, and distal radius and femur.

[51] The data provide the contradictory result that the survivorship for greater than twelve months is higher than survivorship for greater than seven months. As survivorship for greater than twelve months is based on more specimens from a greater number of elements than that for greater than seven months, the former is taken as providing a more accurate result.

6.3.5 Sex Ratio

Examination of the gender of seven adult pelvic specimens reveals three male and four female animals, indicating a slight predominance of adult animals of the latter gender. With only two horn core specimens identified to gender, representing a castrate and female animal respectively, these contribute little insight into the sex ratio for the cattle remains. The result from the pelvic fragments provides some support for the suggestion that the herding strategy focussed on a primary products economy. Further examination of the sex ratio of the cattle from Sos Höyük is precluded due to inadequate sample size.

6.3.6 Fœtal and Neonatal Bones

Three fœtal bones of *Bos* were recovered from Iron Age contexts at Sos Höyük, comprising two incomplete ulna specimens (7.0482, 7.2028) and an incomplete diaphysis of a tibia (7.1074). These specimens were identified as bovine on the basis of the criteria outlined by Prummel for distinguishing between the fœtal bones of the main domesticates (Prummel 1987a; Prummel 1987b; Prummel 1988). Estimation of the fœtal age of cattle specimens is most accurately obtained through calculations based on the greatest length of the diaphysis of the long bones. The number of days following conception is strongly correlated to the length but only poorly linked to the breadth of the diaphysis. Various methods have been developed based on the sigmoidal relationship between diaphysis length and fœtal age (Prummel 1988 after Bünger-Marek 1972; Regli 1963). The methods of Bünger-Marek and Regli were found to yield comparable results for fœtuses younger than approximately 230 days. Prummel's testing of the equations on modern cattle fœtuses of known ages found that both methods provide consistent estimates of age based on different bone elements in fœtuses under 200 days, and thus accurate age estimates could be calculated independent of which skeletal element is used (Prummel 1988, 15). The methods differ markedly however in their age estimations for fœtuses older than 230 days. The sigmoidal curves calculated by Regli yield significantly earlier ages for a given diaphysis length than those provided by Bünger-Marek's equations. The degree of deviation between the results obtained from the two methods furthermore increases with advancing fœtal age. The breeds on which the studies were based may, however, have exerted an influence on the nature of the results. Regli's study utilised Simmertal and Fribourg breeds with average withers heights of 1.38 and 1.42 metres respectively for cows, and 1.44 and 1.52 metres respectively for bulls, while Bünger-Marek's study was based on Black and White Lowland cattle with average withers heights of 1.31 metres for cows and 1.42 metres for bulls. Although the withers heights of the cattle from Iron Age contexts at Sos Höyük could not be established, the comparability in size of the Sos Höyük specimens to those from Middle Bronze II and Late Bronze I-II Korucutepe suggests animals of similar stature. The Korucutepe cattle, with mean withers height estimations of 1.15 metres for females and 1.25 metres for males, are thus more comparable to the German Black and White Lowland breed than the larger Simmertal and Fribourg breeds used in Regli's study. The method devised by Bünger-Marek was thus utilised in the current analysis.[52] The equation yields an estimate of fœtal age of 154.51 and 142.28 days, respectively, for the two ulnar specimens. Due to the fragmentary nature of the tibial diaphysis, a precise determination of age could not be calculated. Based on an estimate of its size, an approximate age of between 170 and 180 days was obtained from Regli's tables of concordance (Prummel 1989, Table 2).

As with the ovicaprids,[53] age estimations based on the fœtal bones of prehistoric cattle using modern analogues assumes that the gestation period of prehistoric cattle was of the same duration as in modern breeds. A suggestion of the likely gestation period of the earliest domesticates might be obtained by examination of the gestation period of modern examples of their wild forbears. As the wild ancestors of domestic cattle are now extinct, however, it is impossible to ascertain how great a discrepancy may have existed between the gestation period of early and modern domestic cattle.[54] It is nevertheless probable that, as with the other main domesticates, the gestation period of cattle has decreased during the process of domestication. Calculations based on modern analogues may therefore produce underestimates of the ages of prehistoric cattle fœtuses.

It is nevertheless clear that, despite the difficulties associated with projecting fœtal age at death from archaeological cattle specimens, the ulnae and tibia examined suggest the presence of fœtuses that can be broadly assigned to the second trimester of pregnancy.

6.3.7 Butchery

Twelve specimens (2.5%) provide evidence of butchery activities. Four horn core specimens (7.0974, 7.1098,

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[52] The method involves a regression equation according to the formula: $y=a+bx+cx^2+dx^3$ where y equals the fœtal age in days, x is the diaphysis length in centimetres and a, b,c and d are constants specific to a given bone element. As prehistoric breeds were typically smaller in stature than modern domestic cattle, it is likely that for a given fœtal age the length of the diaphyses were correspondingly smaller than that observed in modern animals. Boessneck and von den Driesch (Prummel 1988 18) consequently devised a procedure whereby the fœtal diaphysis lengths, as determined by Bünger-Marek or Regli's methods, could be adjusted to correct for the smaller prehistoric breeds. This was achieved by correcting the fœtal age, as determined by diaphysis length, using the relative difference in withers heights between the prehistoric breed, and the modern breed on which the particular age estimation method was based. As the diaphysis length of fœtal bones does not however exhibit a simple and predictable relationship to the subsequent adult length, the appropriate scale required to correct for prehistoric fœtal bones cannot be readily determined.

[53] See page 35.

[54] The gestation period of modern domestic cattle ranges from approximately 278 to 290 days and is dependent on various factors including breed, sex of the calf, the age and parity of the cow and the number of calves being carried (Foley *et al.* 1973 328). It is likely that, with the obvious exception of breed, these effects may have similarly influenced gestation in both wild cattle and the earliest domestic forms.

7.1290A-C, 7.1537A-L) display evidence of modification about the basal region. Both specimens 7.1290A-C and 7.1537A-L exhibit shallow transverse cut marks encircling the most proximal portion of the horn core. These marks may have resulted from skinning activities. Specimens 7.1098 and 7.0974 show deeper marks directed at an oblique angle towards the base of the horn core. These marks appear to have originated from attempts to remove the horn cores from the skull probably in order to facilitate horn removal through boiling or natural decomposition. Similar marks were noted for the cattle horn cores from Early Bronze Age Sos Höyük.

A single mandibular specimen (7.1593A-B) consisting of the condyle and coronoid process and a portion of the ramus, displays a deep transverse chop mark on the aboral surface of the condyle. This mark may have occurred during attempts to disarticulate the mandible from the skull. The removal of the mandible from the skull may have resulted during preparation of the skull for cooking. Similar marks were apparent on the mandibular condyles of cattle specimens from Early Bronze contexts at Sos Höyük.

Three rib fragments (7.1046, 7.1099, 7.1321A-C) display transverse chop marks that resulted in each case in breakage of the body. This may have occurred during butchery activities to either remove cuts of meat, whether for distribution or cooking, or to obtain raw material for the manufacture of decorative or utilitarian objects.

Two scapular specimens (7.1065, 7.1076) both comprising fragments of the caudal margin, display transverse chop marks on their lateral sides. The purpose of these marks is unclear although they may be associated with the removal of the subscapularis and teres major muscles.

A distal tibia specimen (7.0010) displays a deep oblique chop mark of approximately two centimetres in length on the planto-medial portion of the shaft, adjacent to the epiphysis. As this mark occurs just distal to, and parallel with, an oblique break in the shaft, it appears probable that it resulted from an attempt to break the bone, perhaps in order to extract the marrow.

A transverse chop mark is apparent adjacent to the line of ancient breakage on the distal shaft of a metatarsal fragment (7.1297). It appears likely that this mark originated during an attempt to break the shaft in order to extract the marrow. Similar evidence of marrow extraction was noted for the cattle metapodial bones from Early Bronze Age contexts at Sos Höyük.

The low frequency of marks apparent on the domestic cattle bones from Iron Age contexts at Sos Höyük precludes any reconstruction of butchery practices. The specimens examined nevertheless suggest that cattle were utilised for a number of resources including horns, meat and marrow.

6.3.8 Tools

Nine *Bos* specimens (1.9%) had been intentionally modified into utilitarian objects. The coronoid process of a mandible (7.3001) functioned as an awl, whereby the basal portion of the oral border had been worked into a point, with the process itself retained as a handle. A distal metacarpal fragment (7.0360), comprising one half of the distal end and a portion of the distal shaft, had been split dorso-volarly along the longitudinal sulcus. The most proximal region of the shaft, that had been broken obliquely in the dorso-volar plane, displays evidence of both unifacial retouching and polishing. This specimen furthermore displays regions of polish on both the dorsal and palmar surfaces of the shaft that may have resulted from the manner in which the tool was held, with the distal epiphysis functioning as a handle. The specimen appears to have been used as a probe or awl. A humeral fragment (7.0490) provides evidence of similar modification about its distal extremity to yield an awl or scraper. The distal epiphysis and shaft had been split cranio-caudally in the region of the synovial fossa. The epiphysis displays evidence of polish where it had been used as a handle, while the worked end of the shaft had been fashioned into a blunt chisel-like tool. Evidence of polish on the working surface suggests that the tool was used against a pliable surface such as leather. Three further distal humeral specimens (7.0006, 7.0288, 7.0385) had been similarly broken about the distal epiphysis, although the breaks are situated obliquely in the medio-lateral plane in two cases. These three specimens lack any portion of the shaft. Given their similarity to specimen 7.0490, it is likely that these fragments also represent awls or scraping tools, which had been discarded following breakage either during the process of manufacture or after use. Similar specimens, in which the shaft of a long bone had been modified into an awl or probe, were recovered from Early Bronze Age Sos Höyük.

An ulna specimen (7.1530) has a transverse cut mark on the medial surface of the olecranon that resulted in the separation of the proximal extremity from the rest of the bone. The function of this modification is unclear although it may have resulted during the manufacture of a tool or decorative item.

A single femoral head fragment (7.1105) displays evidence of intentional modification. A portion of the head had been removed from the remainder of the bone and subsequently modified into a hemispherical object. Modification of femoral head fragments from Early Bronze Age contexts at Sos Höyük appears to have resulted exclusively from the manufacture of spindle whorls. It is thus likely that the specimen from Iron Age contexts at Sos Höyük represents an unfinished whorl, as it lacks the central hole characteristic of the finished pieces. It is unclear, however, why no completed spindle whorls were recovered, although this may simply be an artifact of the small size of the faunal collection.

6.3.9 Pathology

Four cattle specimens (0.8%) display evidence of pathological conditions. A rib body fragment (7.0557) has a healed fracture.[55] Two forelimb first phalanges (7.0203, 7.1481) and a single hindlimb first phalanx (7.0617) display extensions of the distal articular surface through exostoses. In each case, the extent of the extra bone growth is limited. It is unclear what factors may have caused this condition.

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[55] For a comparable specimen see Baker & Brothwell 1980, Figure 6a.

6.3.10 Summary

A medium-sized variety of domestic cattle appears to have been exploited at Sos Höyük during the Iron Age period. Although of similar stature to animals from Early Bronze Age deposits from Sos Höyük, the Iron Age specimens reflect a medium horned morphology rather than the long horned morphology represented in the Bronze Age. The cattle from the Iron Age deposits appear to have been herded primarily for meat, although secondary products including tractions were also exploited and their skeletal remains were utilised for a variety of tools and perhaps decorative items. The low incidence of butchery marks from Iron Age contexts do not permit any definite reconstruction of butchery patterns. The frequency of burnt specimens and pathological conditions is also low. The presence of fœtal remains supports the idea that cows were present in the vicinity of the site during pregnancy.

6.4 Domestic sheep (*Ovis aries*), and domestic goat (*Capra hircus*).

A total of 1682 domestic ovicaprid specimens, representing an MNI of forty, were identified among the excavated remains from Iron Age contexts at Sos Höyük (Tables 3, 12c, 17). Of these, 341 specimens were identified as sheep and 41 as goat, representing an MNI of 25 and eight, respectively.

Sheep and goat specimens were differentiated, where possible, from the ovicaprid remains.[56] All specimens that could not be assigned to either genus with confidence, were identified merely as ovicaprid.

6.4.1 Differentiation of Wild from Domestic Specimens

On the basis of size, metrical attributes and through morphological comparison with those specimens identified as domestic, none of the specimens from Iron Age levels at Sos Höyük provided evidence for the presence of wild sheep or goats

6.4.2 Physical Characteristics of the Domestic Ovicaprids

The sheep and goat remains from Sos Höyük were investigated using a log ratio diagram. The standard measurements for the *Ovis* diagram were derived from a wild adult female sheep from West Iran.[57] The diagrams of breadth and length size indices of the assemblage from Iron Age Sos Höyük were based on 107 and 12 measurements respectively (Figure 11b; Table 47bi-ii). The results based on length and breadth measurements display a reasonably broad range falling about the standard. When compared with the Early Bronze Age assemblage from the same site, the results indicate a reduction in the average weight of domestic sheep from the Early Bronze Age period, while height appears to have remained fairly stable. By contrast, comparison with other assemblages indicates that the Iron Age sheep at Sos Höyük were both lighter and shorter than those from Early Bronze Age Hassek Höyük and Late Bronze Age Korucutepe, and lighter than those from Middle Bronze Age contexts at Korucutepe. This suggests that while some differences existed between the sheep of Early Bronze and Iron Age Sos Höyük, these were less pronounced than between the sheep at Sos Höyük and those at Bronze Age sites elsewhere in eastern Anatolia. The lack of Iron Age data from these other sites precludes further investigation of this factor, although it appears that a different breed to those represented at the other sites may be represented at Sos Höyük.

The log ratio diagram for the goat specimens from Iron Age levels at Sos Höyük is based on 11 breadth measurements only, due to the lack of length measurements in the assemblage (Figure 12b; Table 48bi-ii). The standard values were obtained from an average of measurements from a skeleton each of a wild male and female goat from the Taurus region.[58] The results reveal a reasonably restricted range falling largely to the left of the zero line, indicating domestic animals of smaller stature than the wild standard. When compared with various eastern Anatolian sites from earlier contexts, the Sos Höyük results appear to correlate well with trends elsewhere (Figure 12d i-v). Both the range and median of the Sos Höyük sample are similar or identical to those from the comparative sites including Early Bronze Age contexts at Sos Höyük, suggestive of similar sized animals.

An examination of the withers heights of sheep and goats from Iron Age contexts at Sos Höyük provides further insight into the morphological characteristics of ovicaprids utilised at the site during this period. Eight sheep specimens were intact enough to permit investigation of stature using this technique (Table 49b). These include four humeri (7.0137A-C; 7.1653; 7.1654; 7.1655), three radii (7.0953; 7.1624; 7.1670) and a single metacarpal bone (7.2243). Based on the greatest length of these long bones multiplied by Teichert's conversion factors (Teichert 1975), the sheep sample yields a mean withers height of 58.4 centimetres, a reasonably limited range, and a low standard deviation. The sheep from Iron Age contexts were thus appreciably shorter at the shoulder than those from Early Bronze Age levels at Sos Höyük in terms of both mean and range (Table 49a). Instead, the sample from Iron Age Sos Höyük yields a mean only slightly lower than that for the specimens from Middle Bronze II Korucutepe, suggesting small sized sheep (Tables 49d i-ix). The Iron Age sample from Sos Höyük reflects an obvious and significant reduction in size from earlier levels. The sample displays a lower range and lesser mean than those of specimens from Chalcolithic to Early Bronze Age Hassek Höyük, Late Bronze Age contexts at Korucutepe and Bronze and Iron Age Lidar Höyük. On the basis of withers heights, the results provide some evidence for size diminution from the Bronze Age and earlier periods, although the variation in the relationships of the Iron Age Sos Höyük data to the withers heights from the Bronze Age sites considered may suggest

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[56] See page 29 for outline of methods used.

[57] For a brief description of the standard animal see page 30. For a more detailed description refer to Uerpmann (1979, 175).

[58] For a brief description of the standard animal see page 30. For a more detailed description refer to Uerpmann (1979, 175).

that the presence of different breeds in the various regions of eastern Turkey may complicate the picture. The contrast between the withers heights from Iron Age levels at Sos Höyük and Lidar Höyük may suggest that breed differences do in fact account for at least some of the variation apparent in the sizes of the domestic sheep at contemporaneous levels.

The small number and fragmentary nature of the goat specimens identified from Iron Age levels at Sos Höyük do not permit any investigation into the stature of the animals represented.

6.4.3 Horn Cores

Eleven sheep horn core specimens were identified among the ovicaprid remains. In four cases (7.1413, 7.1514, 7.1720A-B, 7.1721A-I) the pronounced fronto-medial keel, rounded nuchal edge, obvious medial flattening, and convexity of the lateral surface provide clear evidence of domestic stock. Of these the most complete specimen (7.1514) represents a juvenile as suggested by the porosity of the horn core. Due to the immature nature of this specimen, its gender is uncertain. Two further specimens (7.1721A-I, 7.1720A-B; Table 17a) preserve both the left and right frontal bones and horn cores, lacking only the distal portions of the latter. Given the robustness of these specimens they appear to represent male animals. The pronounced curvature, slight twist, and fronto-medial keel continuing to the base exhibited by these specimens parallel the morphology of two specimens described by Patterson from Chalcolithic and Hittite levels at Alişar Höyük (Patterson 1937, 301). The two specimens from Iron Age Sos Höyük, however, differ from those at Alişar Höyük insofar as the former are of intermediate size between the Chalcolithic and Hittite specimens. The specimens are of similar morphology but smaller in size than those of male sheep from Early Bronze levels from Sos Höyük. They are, however, of similar size to male domestic specimens from Late Bronze Age Korucutepe, and Early Chalcolithic Çavi Tarlası and are comparable in terms of least and greatest basal breadth to specimens from Middle to Late Bronze Age Lidar Höyük (Boessneck & von den Driesch 1975, Table 21; Schäffer & Boessneck 1988, Table 10; Kussinger 1988, Table 25). Specimen 7.1413, although too fragmentary to yield meaningful measurements, is also identified as male on the basis of its robustness and similarity to the two previously discussed specimens.

Two further sheep specimens (7.0498, 7.1717) consisting of portions of the frontal bone retaining a fragmentary and complete horn core respectively, were identified as juvenile due to the porosity and relatively small size of the specimens and the rudimentary nature of the preserved horn cores. The gender of these specimens could not be determined due to the immature status of the animals.

Five sheep specimens (7.0085, 7.0124, 7.0361, 7.0966A-B, 7.1201) preserved the most proximal portion of the horn core attached to a fragment of skull including the frontal and in some cases, parietal bones. These specimens were identified as sheep on the basis of the angle at that the horn core emerges from the skull and, where preserved, the 'Y'-shaped fronto-parietal suture, as opposed to the 'T'-shaped suture apparent in goats. In each case, the size and morphology of the specimens, and the cross-section of the basal portion of the horn core, reveal its domestic status. On the basis of measurements and their gracile morphology, two specimens (7.0085, 7.0361; Table 17a) were identified as female. These specimens are comparable in size to domestic female horn cores from Late Bronze Age I-II levels at Korucutepe and Early Chalcolithic levels at Çavi Tarlası but larger than specimens from Middle Bronze to Iron Age Lidar Höyük (Boessneck & von den Driesch 1975, Table 21; Schäffer & Boessneck 1988, Table 10; Kussinger 1988, Table 26). By contrast, specimen 7.0124 displays a robustness compatible with its identification as male.

Two specimens provide evidence of hornless ovicaprids. Specimen 7.1718A-B preserves portions of the left and right frontal bones and lacks evidence of horn core development. The smooth curvature of the dorsal surface of the frontal bones and the nature of both the interfrontal and fronto-lacrimal sutures suggest that a sheep is represented. Although not of advanced age, given the unfused state of the interfrontal suture, the compact nature of the bone indicates that the animal was beyond juvenile age. The lack of horn core development is therefore characteristic of the adult form and not due simply to the immaturity of the animal. Specimen 7.1719, comprising a fragmentary right frontal bone, similarly lacks horn core development. However, the juvenile state of this specimen, as is apparent from the small proportions of the preserved orbital region and porous nature of the bone, precludes identification as a hornless adult sheep. The evidence from Sos Höyük, nevertheless, points to the association of hornless and horned domestic females during the Iron Age period. Both horned and hornless ewes were similarly recovered from Bronze Age contexts at Korucutepe (Boessneck & von den Driesch 1975,69).

Two goat horn cores were recovered from Iron Age contexts at Sos Höyük. The most complete specimen (7.0497) comprising a proximal portion of a right horn core displaying medial flattening and a sharp anterior keel, was identified as domestic. Based on its gracile appearance and lack of twist, the specimen was identified as female. Although this specimen is fragmentary, in its morphology and estimated size it closely resembles a female goat horn core from Hasanlu period X at Hajji Firuz Tepe, Iran (Meadow 1983, Table 16, Plate 2A,a). The specimen also appears to be of a size comparable to female domestic goat horn cores from Early Bronze II to Late Bronze I-II levels from Korucutepe and Early Chalcolithic Çavi Tarlası (Boessneck & von den Driesch 1975, Table 21; Schäffer & Boessneck 1988, Table 10). The second fragmentary specimen (7.1265) is also identified as goat based on its morphological similarity to the previous horn core.

6.4.4 Mortality Profiles

The nature of herding strategies for the domestic sheep and goats from Iron Age contexts at Sos Höyük was investigated through the examination of trends in mortality among the identified remains using both dental and epiphyseal fusion data. Analysis of the dental data involves 46 ovicaprid specimens (Table 51b). The results indicate that the highest level of mortality occurred among adults, with 41.3% of animals dying at 48 months or later. The level of mortality remains fairly constant from the infant to juvenile categories, reaching 23.9% and 21.7% respectively. The lowest rate of mortality is apparent in the subadult category with only 13.04% of animals dying between 24 and 48 months. Overall, there appears to have been a tendency to keep animals into adulthood, with minimal subadult mortality. The representation of mortality for all the age categories suggests that ovicaprids were raised and consumed at the site in contrast to being traded as a meat supply to other settlements.

When compared with the mortality profiles from other sites, that from Iron Age Sos Höyük bears the closest resemblance to the profile from the Early Bronze Age levels at the same site. The data from Iron Age and Early Bronze contexts at Sos Höyük are similar for the infant and juvenile categories, although subadult and adult mortality are lower and higher, respectively (Tables 51a). The Iron Age profile is also reasonably comparable to that from Late Bronze I-II levels at Korucutepe (Tables 51d i-ii). Again, mortality in the infant and juvenile categories is similar for the two profiles. The subadult mortality at Sos Höyük is, however, considerably lower than that observed at Korucutepe, with adult mortality being correspondingly higher. A poor level of correlation is found between the data from Iron Sos Höyük and those from Early and Middle Bronze Age contexts at Demircihüyük, Early Bronze levels at both Korucutepe and Hassek Höyük, and Bronze and Iron Age levels at Lidar Höyük. Although the Iron Age mortality profile based on the dental data from Sos Höyük shows some parallels with those from other sites in terms of the infant and juvenile categories, the Sos Höyük material differs in important respects from these other sites, in terms of both subadult and adult mortality.

Examination of the relative contribution of sheep to the overall ovicaprid profile was conducted through the analysis of the mortality profile of the sheep mandibles from Iron Age levels at Sos Höyük (Table 51b). Based on a sample of 18 sheep mandibles, the resulting mortality profile differs quite substantially from that derived from the combined ovicaprid sample. Most particularly, infant mortality is significantly higher and adult mortality appreciably lower for the sheep profile, when compared to that for the ovicaprid sample. The mortality profile for the sheep sample may reflect the actual herd structure for this species, that is subsequently obscured by the presence of goat specimens in the ovicaprid sample. A more likely explanation for the disparity between the sheep and ovicaprid profiles, however, lies in the methods for identifying sheep and goat mandibles within ovicaprid samples. As these methods rely largely on the morphology of deciduous premolars and first molars displaying little or no wear, it is likely that the specimens within these categories, representing younger age groups, will be over-represented relative to adult specimens in samples of sheep and goat mandibles. It is therefore probable that the higher infant and lower adult mortality apparent in the sheep sample, relative to the ovicaprid sample, is due to these parameters rather than reflecting real differences between the sheep and ovicaprid mortality profiles. With only three mandible specimens identified as goat, the relative contribution of goats to the ovicaprid mortality profile could not be assessed.

Comparison between the dental data and those derived from analysis of epiphyseal fusion reveals that the two data sets broadly correlate, although some discrepancies are evident. Analysis of epiphyseal fusion is based on 576 ovicaprid post-cranial specimens divided into four broad age categories (Table 52b i).[59] In terms of infant and juvenile mortality, the epiphyseal fusion data appear to be in broad agreement with those from dental analysis with at least 28.9% of animals dying prior to ten months, and at least 46.0% dying at under 24 months. At least 30.7% of animals survived to 36 months of age. By contrast, analysis of the dental data revealed that 40.4% of animals lived beyond 48 months of age. Although the figure for adult mortality derived from the dental data was obtained from a smaller sample than that from the epiphyseal fusion data, the former is taken to reflect a more accurate measure of mortality due to the greater reliability of the technique. The relatively small discrepancy between the figures for adult mortality obtained from epiphyseal fusion and dental analysis provides confidence in the overall accuracy of the results.

The post-cranial sheep specimens were analysed in terms of the state of epiphyseal fusion in order to detect trends in mortality when compared with the ovicaprid sample (Table 52bi). Two hundred and twenty-nine sheep specimens were available for analysis. With at least 10.9% of animals dying prior to ten months of age, mortality appears to have been lower for this age category than was observed from the sheep dental remains or from the ovicaprid epiphyseal fusion data. The most plausible explanation for this discrepancy lies in the difficulty of assigning unfused neonatal and infant long bones to species. It is thus likely that unfused sheep bones would be under-represented in the sample. Based on the epiphyseal fusion data, mortality for the sheep sample appears to have been highest among mature adult animals, with at least 65.5% surviving to over 36 months of age. By contrast juvenile and subadult mortality appears to have been particularly low. This profile differs substantially from that derived from the dental data. The relatively small sizes of the samples involved and the difficulties and biases associated with identifying both dental and post-cranial ovicaprid elements to genus are likely to account for these differences. The small number of goat mandibles available for analysis again precludes any conclusions regarding a separate mortality profile for this genus.

Both ovicaprid dental and epiphyseal fusion data suggest that mortality was highest among mature adults and lowest among subadults, with intermediate levels observed for the infant and juvenile categories. Such a profile clearly does not accord with an emphasis on secondary products in the form of either milk or wool.[60] Instead, the mortality profile for the Iron Age material from Sos Höyük complies most readily to a focus on primary products. While the data generally accord with the idealised profile of approximately one third infant mortality, another third juvenile to subadult, and one third mature adult mortality, infant and adult mortality are slightly lower and higher, respectively, than would be expected in a meat production profile. The

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[59] The elements that the groups were based on were the same as those utilised previously in the analysis of epiphyseal fusion of the Early Bronze Age ovicaprid specimens from Sos Höyük (See page 33).

[60] See page 33 for a description of these secondary product profiles.

discrepancies between the Iron Age and the idealised profiles may imply that the ovicaprids were being herded as part of a mixed strategy in which secondary products were also utilised. This may be further indicated by the fact that mortality is lowest in the subadult category, which economically would be the best age at which to cull males if primary products were the only objective.

6.4.5 *Ovis:Capra* Ratio

The ratio of sheep to goats was investigated in order to assess the relative importance of each species to the economy of the site during the Iron Age. A ratio of 8.32:1 sheep to goats was obtained based on the number of specimens identified to each genus. The consistency of this ratio was examined using the ratio of the total number of fused elements of sheep to goats for the various age categories covered by the epiphyseal fusion data (Table 52b ii). Examination of the data provides somewhat conflicting results. Given the limitation of sample size, the ratio of sheep to goats for Fusion Groups One and Two, is somewhat lower than the overall ratio. At 14:1 and 19:1, for Fusion Groups Three and Four, the ratio of sheep to goats based on the number of fused elements illustrates a significant deviation from the overall ratio. This may indicate that more sheep than goats were retained into maturity. However, the small number of goat specimens involved in these calculations clearly dictates caution regarding any conclusions. Indeed, the ratio of sheep to goats based on dental data provides different results. When the numbers of sheep to goat mandibular third molars displaying medium to heavy wear are compared, the resulting ratio of 4:1 is much lower than that suggested by the epiphyseal fusion data. This suggests that the ratio of sheep to goats may have remained fairly consistent at between four and eight to one throughout the age groups. The Iron Age ratio of sheep to goats is thus intermediate between the ratio of 2.7:1 calculated for Sos Höyük during the Early Bronze Age and the modern ratio of 10:1 for the Erzurum province. This may suggest that the factors affecting the relative abundance of sheep to goats in the Iron Age had altered somewhat from those apparent during the Early Bronze Age.

6.4.6 Sex Ratio

The nature of herd management strategies practised during the Iron Age at Sos Höyük can be further examined using the ratio of males to females among the excavated remains. Thirteen sheep pelvic fragments were complete enough to permit identification to gender. Of these, four came from males and nine from female animals, resulting in a ratio of males to females of 1:2.3. As pelves identified as female are most likely to have come from individuals that have given birth at least once and are therefore at least 24 months of age (Halstead 1992, 38), this ratio suggests that the majority of animals dying beyond 24 months were female. The relatively low sex ratio involved nevertheless indicates that numerous males were also surviving into adulthood. In terms of the herding strategies practised at Sos Höyük, the abundance of adult females suggests that breeding, and perhaps milk products, formed important aspects of the herding economy, while the lesser representation of adult males may suggest that numerous males were removed prior to adulthood, most probably as a source of meat. Those males retained into adulthood would have represented breeding stock and, given that more adult males appear to have been present than would be required for breeding alone, perhaps were also utilised for wool production.

Only two goat pelvic specimens (7.1205, 7.1426) permit identification of gender. Both specimens are from female animals. Any conclusions regarding the sex ratio of the goats present at Sos Höyük during the Iron Age are precluded on the basis of inadequate sample size.

6.4.7 Fœtal and Neonatal Bones

A total of 154 fœtal or neonatal ovicaprid specimens were identified from Iron Age contexts at Sos Höyük on the basis of size, porosity and relative proportions. The specimens were identified as ovicaprid on the basis of their morphology, using the characteristics described by Prummel (Prummel 1987a; Prummel 1987b; Prummel 1988). The poorly developed morphology of fœtal and neonatal bones, however precludes the separation of sheep and goat specimens. The sample is characterised by both the absence of cranial fragments and the fact that the specimens derive from relatively few deposits. Indeed, 141 (91.6%) of the fœtal or neonatal specimens were recovered from a single deposit in trench L16, that also contained adult remains. The absence of cranial fœtal specimens may indicate that at least some fœtal and, perhaps also neonatal and juvenile specimens, are under-represented in the ovicaprid sample due to preservational biases.

Within the sample of ovicaprid fœtal and neonatal bones, thirty two specimens are intact enough to permit estimations of age. The number of days following conception was calculated from diaphysis length using McDonald's Gompertz equation (Prummel 1988). Thirty-two specimens have fœtal ages of between 97.4 and 142.7 days following conception with the majority falling in the last third of the gestation period (Table 53). As the Gompertz equation does not provide the parameters for fœtal age calculation based on the scapula and ulna, approximate fœtal ages for those specimens were calculated using Habermehl's tables of concordance between fœtal age and diaphysis length (Prummel 1988, Table 6, after Habermehl 1975, Tables 11, 13). Based on data from modern sheep scapulae, specimen 7.2659 yields an age of between 90 and 100 days after conception. An ulnar specimen (7.2664) yields an age of approximately 110 days, while a further two ulnar specimens (7.1573, 7.1677) yield ages of between 90 and 100 days following conception. These calculations are all based on dates provided by modern goat fœtuses.[61] Calculated ages for the fœtal specimens from Iron Age levels at Sos Höyük suggest that the remains derive almost exclusively from the last third of gestation.

Twenty-five fœtal specimens for which ages could be calculated were recovered from a pit in trench L16. Examination of the fœtal ages of the specimens from this deposit reveal various groupings (Table 53). Seven

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[61] These estimations were calculated using comparative goat fœtuses, as modern analogous data for sheep specimens was lacking.

specimens were calculated to have died at approximately 100 days after conception, seven at between 110 and 119 days, three at between 123 and 127 days, five at between 131 and 135 days, and three at between 140 and 143 days following conception. It is possible that each of these discrete groupings represents a single individual, with the variation within the groups attributable to the difficulty of estimating a precise age based on different skeletal elements. This deposit therefore contained the remains of at least five different fœtuses.

The remaining 122 specimens are either too fragmentary to permit metrical investigation, or comprise elements that are not accommodated by the current methods of calculation. Based on their porosity, size, and proportions, 109 of these specimens can be identified as fœtal and, through comparison with specimens for which ages could be determined, appear to have derived from fœtuses in the middle to terminal stages of gestation. By contrast, the size and more compact appearance of the bone in the remaining 13 specimens suggest that they came from neonatal animals. These specimens derive from the same pit as the majority of the fœtal bones recovered, and again suggest the presence of animals of various fœtal and neonatal ages within this deposit. It appears most likely that this deposit represents a disused storage pit that served as a dumping area for aborted fœtuses and neonatal carcasses. The preservation of the specimens and recovery of many of the skeletal elements suggests that these carcasses were protected from degenerative forces, such as carnivore gnawing, through such processes as prompt burial.

The absence, within the sample, of bones from young fœtuses may be attributable to two factors. It is possible that remains from this age group did not enter the archaeological record either because mortality was low or occurred in an extramural context. Alternatively, a more likely explanation may lie in the extremely small size and friable nature of specimens from very young fœtuses, which may have acted against their preservation or recovery. In addition, fœtuses in the earliest stages of development would not be represented at all. This may be due either to the lack of bone in embryos or because mortality among fœtuses in the initial stages of development may result in resorption of the foetus within the uterus. It is thus possible either that mortality was higher among fœtuses in the later than earlier stages of development, or that the latter cases are simply not represented due to differential preservation and recovery.

6.4.8 Butchery

Seven ovicaprid specimens (0.4%) display evidence of human modification in the form of chop and cut marks.

A juvenile sheep horn core (7.1514) exhibits a series of deep chop marks on the dorsal edge of the core adjacent to both the frontal bone and line of ancient breakage. These marks may have originated from attempts to remove the horn core from the skull in order to extract the horn in a more efficient manner. The absence of marks of this nature on the other ovicaprid horn cores from Iron Age contexts stands in contrast to the prevalence of these marks on ovicaprid specimens from Early Bronze Age contexts at Sos Höyük. This may indicate either that horn was not as highly valued as a raw material at the settlement by the Iron Age period or that the technique of horn removal had altered between the two periods.

Two ovicaprid distal humeral specimens (7.0153, 7.0467) display evidence of chop marks. Specimen 7.0153 exhibits a series of shallow, transverse chop marks descending the caudal edges of the lateral and medial epicondyles. These marks may have resulted from the disarticulation of the radius and ulna from the humerus. Similar marks have been observed in ethnographic contexts and appear to be associated with the butchery of carcasses that are stiff or frozen (Binford 1981, Figure 4.31; Wheat 1979, Figure 31). In these cases cuts are directed along the margins of the olecranon fossa in order to make the joint more flexible prior to further butchering. Deep transverse chop marks are apparent on the medial surface of the shaft of specimen 7.0467 adjacent to the distal extremity. Although the function of these marks remains unclear, disarticulation of the radius or the removal of meat may constitute possible explanations.

A single proximal radial fragment (7.1279) displays shallow, oblique cut marks on the medial border. Oblique marks such as these, located in 'recessed places' adjacent to long bone extremities where the meat is not readily separable from the bone, are typically associated with filleting activities (Binford 1981, Figure 4.39).

A complete ovine talus bone (7.0679) displays transverse cut marks on the dorso-lateral and dorso-medial edges of the distal articular surface. Marks of a similar nature and location are apparent on four sheep tali from Early Bronze Age levels at Sos Höyük. These marks may reflect skinning activities, that are often characterised by transverse slicing marks on non-meat bearing elements (Clayton Wilson 1982, 303).

A metatarsal fragment (7.1431) displays a series of parallel, oblique chop marks on the planto-distal surface of the shaft. As these marks are adjacent to, and parallel with, an ancient break, it appears that they represent an effort to remove the distal extremity, perhaps in order to extract the marrow from the shaft. Specimen 7.1232 is a metapodial condyle fragment that was separated from the remainder of the bone by a clean linear break. Shallow transverse cut marks are apparent, adjacent to the break, on the medial surface of the condyle. The function of this break is unclear, although the bone may have been modified for some utilitarian or decorative purpose. Alternatively, these marks may be the byproduct of dismembering activities during butchery for food preparation or dispersal (Binford 1981, Figure 4.27).[62]

6.4.9 Tools

Eight specimens (0.5%) had been worked to produce utilitarian or decorative items. An ovicaprid metatarsal specimen (7.0378) that includes a portion of the proximal

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[62] Binford notes that dismemberment marks in this location are typically associated with the use of metal tools where the knife is inserted directly into the joint, whereas stone tool use results in cuts on the dorsal, lateral and medial faces *above* the condyles (Binford 1981 120).

epiphysis and shaft had been modified into an awl or probe. The shaft terminates in a blunt end with polish apparent on the surrounding exterior surface of the bone. That this tool was used on soft materials is indicated by the lack of scratches and striations on the working surface.

Seven first phalanges display various modifications involving the piercing of the bone (Figure 28). Four phalanges, including three sheep (7.0442, 7.0914, 7.1282) and one ovicaprid specimen (7.0403A-B) are pierced in a dorso-volar/plantar direction just proximal to the distal extremity. Some smoothing is apparent around the edges of the hole on the dorsal surface in each of these specimens. A further ovicaprid phalanx (7.0971) illustrates an apparently unsuccessful attempt to pierce the bone, as the hole is present only on the volar/plantar surface, and this had resulted in breakage of the surrounding bone. By contrast a further first phalanx (7.1403) has a hole running mediolaterally at both the proximal and distal extremities. The periphery of the holes present sharp edges and thus provide no evidence of smoothing or wear. A final specimen (7.1023) differs again in the manner of piercing with a hole directed longitudinally through the sagittal groove of the proximal articular surface and terminating inside the medullary cavity. Pierced phalanges recovered from Early Bronze levels at Sos Höyük display a similar variety of typologies. The function of these objects remains obscure although they may have served as utilitarian or decorative items including toggles or beads. The variety of locations of the holes may reflect different uses.

6.4.10 Pathology

Thirty-seven ovicaprid specimens (2.2%) from Iron Age contexts at Sos Höyük display evidence of pathological conditions. Of these, the vast majority comprise dental anomalies, with only three cases of post-cranial conditions.

The most common pathological condition observed among the mandibular remains constitutes inter-dental attrition, which typically results from overcrowding of the teeth. Twenty-six ovicaprid mandibles (14.9%), including eight sheep (25.8%) and two goat (66.7%) fragments, display this condition.[63] Inter-dental attrition is most commonly observed on the third and fourth deciduous and permanent premolars, and first molar. The incidence of inter-dental attrition is comparable to that recorded for ovicaprid specimens from Early Bronze Age contexts at Sos Höyük.

Twelve mandibles (6.9%) including seven sheep specimens (22.6%) display isolated patches of calculus.[64] Its occurrence is not associated with any particular tooth and is equally common on both the buccal and lingual surfaces of the teeth. Calculus at Iron Age Sos Höyük is more common than from Early Bronze Age contexts at the same site.

Eight ovicaprid mandibles (4.6%) display evidence of anomalous crown heights.[65] In each case, weave mouth is present about the deciduous or permanent third or fourth premolar. In six cases, the minority of teeth in the cheek tooth row have a greater crown height than the rest, with only one case of the reverse. Anomalous crown heights result from differential rates of wear between successive teeth in the tooth row. It is slightly more common in the Iron Age than was apparent during the Early Bronze Age at Sos Höyük.

Cases of periodontal disease are extremely rare among the Iron Age ovicaprids, with only three ovicaprid mandibles (1.7%), including one goat specimen (33.3%), displaying varying degrees of the condition. Specimen 7.1475 exhibits ante-mortem shedding of the first molar with the initial stages of infilling and new bone formation apparent in the alveolar cavity. Periodontal disease is also apparent on specimen 7.2191. Both the permanent second and third premolars had been shed ante-mortem, with infilling of the alveolus in initial and advanced stages, respectively. Early evidence of periodontal disease is apparent in a single goat specimen (7.0390) with recession of the buccal margin of the alveolus of the first molar. Little difference is apparent in the frequency of periodontal disease among ovicaprid mandibles from Sos Höyük from the Early Bronze to Iron Age periods.

Seven mandibles (4.0%), including three sheep specimens (9.7%) display extra nutrient foramina.[66] In each case these comprise a small nutrient foramen located basal to the second or third premolar on the buccal surface. Specimen 7.0688 is distinguished by the fact that two extra foramina are apparent on its buccal surface. In addition to the foramen located basally to the third premolar, this specimen displays a further foramen on the basal margin below the fourth premolar. The incidence of extra foramina is slightly lower than was observed among the Early Bronze Age ovicaprid and sheep remains.

Only three cases (1.7%) of tooth malalignment were observed among the Iron Age ovicaprid mandibles. Lingual displacement of the fourth premolar is apparent on both specimens 7.0295 and 7.1507, while specimen 7.2191 displays buccal displacement of the first molar. With only one example of tooth malalignment from Early Bronze contexts, it appears that this condition was extremely uncommon at Sos Höyük during both the Early Bronze and Iron Age periods. Tooth malalignment is typically a symptom of overcrowding. Its low incidence, coupled with the relatively low frequency of intra-dental attrition, indicates that overcrowding of teeth was not prevalent among the ovicaprids at Sos Höyük during the Iron Age.

A fused sheep radius and ulna (7.1671) lacking the portion of the ulna proximal to the interosseous space, constitutes

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[63] The ovicaprid mandibles include 7.0209, 7.0295, 7.0362, 7.0392, 7.0682, 7.0688, 7.0706, 7.0741, 7.0985A-B, 7.1246A-B, 7.1312, 7.1507, 7.1532, 7.1790A, 7.1792A-C, 7.2191. The sheep and goat mandibles include 7.0388, 7.0391, 7.0412, 7.0464, 7.0769, 7.0806, 7.1789, 7.1558A-D, and 7.0390, 7.1050A-B respectively.

[64] The ovicaprid mandibles include 7.0295, 7.0741, 7.1312, 7.1358C, 7.1790A, and the sheep mandibles include 7.0391, 7.0464, 7.0766, 7.1558A-D, 7.1786A-B, 7.1788, 7.1789.

[65] The ovicaprid mandibles include 7.0295, 7.0390, 7.0682, 7.0688, 7.1312, 7.1790A, 7.1792A-B, 7.2191.

[66] The ovicaprid and sheep mandibles include 7.0362, 7.0688, 7.0925, 7.1312, and 7.1558A-D, 7.1787, 7.1985, respectively.

the most extreme case of pathology among the ovicaprid remains (Figures 29a-b). This specimen provides evidence of trauma in the form of a healed fracture in which the mid to distal shaft had become extensively thickened by callus formation, most particularly about the volar surface, while in lateral view, the bone reveals a distinctly bowed appearance. Due to the healed state of the injury, the type of fracture cannot readily be identified. However, based on the nature of the repair and absence of any evidence of infection, a simple or comminuted fracture would seem to be the most probable form of injury. This trauma may have resulted from a variety of causes including damage sustained from human agencies, inter- and intra-specific conflicts, or accidents such as falls. The fact that this injury healed suggests that the ovicaprids at Sos Höyük maintained a reasonable level of health.

A complete sheep second phalanx (7.1064; Figure 30) displays periostitis resulting from an inflammatory process, possibly from infection in the interdigital pouch (Chris Philip, pers. comm.).

The low frequency of identified pathological conditions among the post-cranial remains from Iron Age levels at Sos Höyük suggests that the ovicaprids herded at the site during this period maintained good health. The high incidence of dental conditions however provides some evidence for congenital defects or disease. The correlation between the frequencies of most dental conditions when compared with those from Early Bronze contexts suggests that the ovicaprids at Sos Höyük experienced a comparable level of health between the Early Bronze and Iron Age periods.

6.4.11 Summary

Overall, the ovicaprid remains from Iron Age levels at Sos Höyük suggest a herd management strategy focused on meat production, with some exploitation of secondary products including milk and perhaps wool. Butchery marks suggest the additional exploitation of horn, hides and marrow. Morphologically, the sheep and goats are comparable to those from Early Bronze Age levels at the site, although the sheep in particular are smaller. No evidence of the exploitation of wild ovicaprids is provided by the remains.

6.5 Domestic pig (*Sus scrofa* domesticus).

Four domestic pigs specimens, representing an MNI of three, were recovered from Iron Age contexts at Sos Höyük (Tables 3, 18).

6.5.1 Differentiation of Wild from Domestic Specimens

On the basis of size and robustness, no specimens from Iron Age contexts at Sos Höyük provide evidence of the presence of wild pig remains among the identified specimens.

6.5.2 Mortality Profiles/Sex Ratio

Mortality patterns could not be investigated in pigs due to the extreme paucity of both cranial and post-cranial remains. Based on the unworn state of the mandibular third molars in specimens 7.0352 and 7.0423, subadult animals of approximately eighteen months of age appear to be represented. The fused state of the post-cranial specimen (7.0421) similarly implies an animal of subadult or adult age. No evidence of neonatal or juvenile animals was recovered, although this may be an artifact of either differential preservation or the small sample size. Neither did the identified remains permit identification of gender. The contribution of pigs to the Iron Age economy at Sos Höyük is therefore extremely difficult to assess, although the small number of recovered remains suggests that this taxon played only a minor role in the economy at Sos Höyük during the Iron Age period. Given the small size of the sample and absence of specimens from the younger age categories it is unclear whether pigs were raised at the site.

The pig remains from Iron Age levels at Sos Höyük do not permit the calculation of withers height estimations. No evidence of butchery or pathology was observed on any of the specimens identified.

6.6 Domestic dog (*Canis familiaris*).

Eighteen specimens of domestic dog, representing an MNI of two, were identified from Iron Age contexts at Sos Höyük (Tables 3, 14b, 19).

6.6.1 The Cranial Remains

A number of cranial specimens preserve features that permit the differentiation of the various canid species. A maxillary fragment (7.1306; Table 19a) was recovered that retains the carnassial, and first and second molar teeth. In terms of dental morphology the specimen displays features characteristic of the domestic dog and wolf, rather than of the golden jackal. A small, virtually cuspless lobe is present on the mesio-lingual surface of the carnassial of a kind that can be observed in dogs and wolves, and that contrasts with the pronounced cusp apparent in jackals (Harrison 1991, 115). Similarly the cingulum is low and inconspicuous as would be expected in the former species. The first molar lacks the well developed cingulum between the paracone and metacone that is typical of the jackal. The second molar has the weak cingulum that is characteristic of dogs and wolves. Furthermore, the cheek teeth do not display the trenchant morphology typical of the golden jackal. In terms of its small size and gracile proportions, the specimen reflects dog-like morphology. The breadth of the upper carnassial is significantly smaller than that observed for modern Indian wolves, modern Mediterranean wolves from Israel, and a single Turkish wolf specimen (Lawrence & Reed 1983, Table 38; Dayan 1994, Table 1; Meadow 1983, Table 10). The specimen from Sos Höyük is furthermore smaller than domestic dog specimens from the Iron Age deposits at Hajji Firuz Tepe in Iran and Late Bronze I-II levels at Korucutepe (Meadow 1983, Table 10; Boessneck & von den Driesch

1975, Table 28a). The specimen from Sos Höyük is most similar in size to domestic dog specimens from Early Bronze Age levels from the same site, Middle Bronze to Iron Age Lidar Höyük, and the larger carnassial specimens from Roman levels at Didyma (Kussinger 1988, Table 45; Boessneck & Schäffer 1986, Table 18a). The pronounced curvature apparent in the cheek tooth row further supports an identification as domestic dog.

The mandibular specimen (7.1556A-B; Table 19b) which retains only the second molar, also displays a morphology compatible with its identification as dog rather than wolf or jackal. The second molar lacks the rudimentary fourth cusp and mesial cingular cusp often apparent in jackals (Harrison 1991, 115). The morphology of this specimen more closely resembles that of the domestic dog than the wolf given the pronounced curvature of the cheek tooth row, the markedly distal location of the third molar, which is virtually embedded in the ascending ramus, the medio-lateral thickening of the body, curved basal margin of the body, broad base of the oral border of the ramus, and small proportions of the condyle and angle relative to the remainder of the jaw (Lawrence & Reed 1983, 487). On the basis of the length of the cheek tooth row, the specimen is smaller than the observed range for modern Near Eastern wolves. Instead the Sos Höyük specimen is comparable in size to a domestic dog mandible from Iron Age contexts at Hajji Firuz Tepe in northeastern Iran, and a large specimen from Middle Bronze contexts at Lidar Höyük (Meadow 1983, Table 10; Kussinger 1988, Table 45). The maximum breadth of the jaw basal to the first molar is more robust than the Early Bronze Age specimen 6.1884, and falls toward the upper portions of the range observed among a sample of Near Eastern wolf mandibles (Lawrence & Reed 1983, Table 39). This implies that the teeth of the Iron Age specimen are proportionally smaller relative to the width of the jaw than is apparent in the wolf. The overall dimensions of this mandible are comparable to those of the Early Bronze Age domestic dog mandible from the same site.

6.6.2 The Post-cranial Remains

The post-cranial remains similarly provide no evidence for the presence of the wolf, and can all be confidently identified as the smaller domestic dog. A complete axis (7.1210; Table 19e) is significantly smaller than domestic specimens from a mixed Early Bronze II/Late Seljuk deposit and Late Bronze Age levels at Korucutepe, Iron Age levels at Hajji Firuz Tepe in Iran, and Middle Iron Age Norşun-Tepe (Boessneck & von den Driesch 1975, Table 18e; Meadow 1983, Table 10; Boessneck & von den Driesch 1978b, Table 6b). This specimen is instead comparable in size to specimens from Early Bronze Age Lidar Höyük (Kussinger 1988, Table 45). The distal humeral fragment (7.1130; Table 19h) is comparable in size to the larger specimens from both Late Bronze I-II Korucutepe and Middle Bronze Age Lidar Höyük, and the smallest specimen from Middle Iron Age Norşun-Tepe (Boessneck & von den Driesch 1975, Table 28j; Kussinger 1988, Table 45; Meadow 1983, Table 10). An acetabulum fragment (7.1285; Table 19j) is slightly smaller than specimens from Roman levels at Didyma, and comparable to the smallest specimen, of unknown date, from Korucutepe (Boessneck & Schäffer 1986, Table 18g; Boessneck & von den Driesch 1975, Table 28 m). A fragmentary talus (7.1305; Table 19m) is intermediate in size between the largest and smallest domestic specimens from Korucutepe and comparable to a specimen from Middle Bronze Age Lidar Höyük (Boessneck & von den Driesch 1975, Table 28q; Kussinger 1988, Table 45). A fifth metacarpal bone (7.0200; Table 19n) displays dimensions that are comparable to those from Middle Bronze Age Lidar Höyük and slightly smaller than those from specimens dating to Roman levels at Didyma (Kussinger 1988, Table 45; Boessneck & Schäffer 1986, Table 18 k- l.).

Various specimens cannot be measured due to their fragmentary state. Based on their relative size, gracility and similarity to the associated canid remains from Iron Age levels, these specimens provide no evidence for the presence of the wolf.

Although two long bones, comprising two radii, were preserved intact, withers height calculations could not be performed due to the juvenile state of the specimens. Nevertheless, based on comparison with domestic dog remains from Early Bronze Age levels at Sos Höyük and specimens from other sites, a medium sized dog appears to be represented.

None of the domestic dog specimens from Iron Age levels at Sos Höyük display evidence of butchery. The domestic dogs at Sos Höyük may have functioned as hunting dogs or as guards for the settlement or flocks. Although evidence is lacking that this species was consumed by the inhabitants of the site, such a possibility cannot be disregarded.

6.7 Chicken (*Gallus gallus* domesticus).

A single specimen of domestic chicken was identified comprising a right tarsometarsal fragment (7.1438; Tables 3, 20c). The specimen was identified as female due to the lack of a spur typically absent in females but present on male tarsometatarsi (MacDonald 1992, 315). The domestic chicken was common in the Mediterranean and Asia Minor by the sixth century B.C. (Mason 1984, 301). West and Zhou's study of early domestic chicken remains from Europe and the Near East confirmed that the Iron Age constituted the main period of dispersal throughout Europe (West & Zhou 1988, 525). Domestic chicken remains have been recovered in quantity from Late Bronze I-II levels at Korucutepe and Roman levels at Didyma (Boessneck & von den Driesch 1975, 120; Boessneck & Schäffer 1986, 296).

Based on the least breadth of the diaphysis, the specimen is slightly smaller than a single male specimen each from Roman levels at Didyma and Late Bronze I-II/Medieval levels at Korucutepe and as such represents a small to medium-sized chicken (Boessneck & Schäffer 1986, Table 21f; Boessneck & von den Driesch 1975, 121).

The function of domestic chickens at Sos Höyük during the Iron Age period is unclear. It is generally accepted that the domestic chicken was initially used for cock fighting and later developed religious significance.[67] Considerable time elapsed following domestication before the species was utilised for eggs and meat (Mason 1984, 300). The abundance with which chicken bones have been recovered from Late Bronze to Iron Age sites, in conjunction with the female specimen from Sos Höyük, may imply that chickens contributed eggs to the diet of the settlement's inhabitants.

Wild Taxa

6.8 Fallow deer (*Dama dama*).[68]

Two specimens of fallow deer, representing an MNI of one, were identified from Iron Age contexts at Sos Höyük (Tables 3, 24). These include an adult calcaneus (7.1180) and an adult second phalanx (7.0623). The calcaneus was identified and distinguished from that of a red deer on the basis of its smaller size and the greater extension of the scar on the plantar border, while the second phalanx was identified using of the emargination of the proximal articular facet, which is absent on the second phalanges of red deer (Lister 1996, 132,134). The representation of fallow deer by only two specimens in the Iron Age implies that this animal underwent only a very low level of exploitation.

Fallow deer were rare in the eastern Mediterranean following the last glaciation, with only isolated populations remaining until numbers increased again from the Bronze Age period onwards (Hubbard 1995, 533; MacDonald & Barrett 1993, 206; Uerpmann 1987, 57). The species is currently widespread and abundant throughout much of Europe, but restricted in Turkey to isolated populations in the western and central region of the Taurus Mountains (Smit & van Wijngaarden 1981, 229). The distribution of the Persian fallow deer formerly extended from the east coast of the Mediterranean to the western region of the Irano-Arabian Gulf (Uerpmann 1987, 60). The northern limits of the population appear to have been the southerly perimeter of the Taurus and Zagros Mountains. The Persian fallow deer has survived into modern times in the form of a small population in Iranian Khuzistan. Fallow deer remains have been recovered from numerous sites throughout Turkey including Neolithic Fikirtepe, Aceramic Neolithic phase B, mid to late third millennium and Medieval levels at Gritille, Chalcolithic to Early Bronze Age Hassek Höyük, Early to Middle Bronze Age levels at Demircihüyük, Bronze Age to Hellenistic/Roman Lidar Höyük and Late Chalcolithic to Neo-Hittite levels at Arslantepe (Boessneck & von den Driesch 1979b, 36; Stein 1988; 1989, Table 2; Stahl 1989, 127; Boessneck & von den Driesch 1987, 53; Kussinger 1988, 146; Bökönyi 1993, 351).

The calcaneus from Sos Höyük is virtually identical in size to the smallest adult specimen recovered from Neolithic levels at Fikirtepe and identified as female, but is significantly smaller than specimens from Middle Bronze contexts at Lidar Höyük (Boessneck & von den Driesch 1979b Table 131; Kussinger 1988, Table 152). The second phalanx from Sos Höyük is similarly only slightly larger than a specimen identified as female from Late Neolithic levels at Fikirtepe (Boessneck & von Driesch 1979b, Table 3). Although based on only two specimens, the fallow deer from Iron Age levels at Sos Höyük appear to be most comparable in size to those from Fikirtepe. As Persian fallow deer are larger than European fallow deer (Bökönyi 1993, 351), the small size of the Sos Höyük specimens suggests that the European rather then the Persian variety is represented.

Fallow deer predominantly inhabit mature deciduous, coniferous or mixed woodland with dense undergrowth, in proximity to open grassland (MacDonald & Barrett 1993, 205; Bjärvall & Ullström 1986, 180). The presence of this species among the Iron Age remains may indicate that a mosaic of open and wooded habitats occurred in the region of the site.

6.9 Red fox (*Vulpes vulpes*).

Four specimens of red fox, representing an MNI of one, were recovered from Iron Age contexts at Sos Höyük (Tables 3, 26). These comprise a proximal ulna fragment (7.0655; Table 26a), the distal portion of a tibia (7.1536; Table 26c), and two metatarsal bones (7.1066, 7.0226; Table 26d). The dimensions of the tibial fragment are comparable to a specimen of unknown date from Korucutepe and to another of Late Bronze date from Lidar Höyük (Boessneck & von den Driesch 1975, Table 38f; Kussinger 1988, Table 68). The dimensions of the ulnar fragment from Sos Höyük are slightly larger than those of a specimen from the Middle Ages at Lidar Höyük and comparable in size to two specimens from Early Bronze Age Sos Höyük (Kussinger 1988, Table 68). The foxes from Iron Age levels at Sos Höyük appear to have been of similar in size to, or only slightly larger than, the foxes from Lidar Höyük, and are therefore comparable to the small central European variety (Boessneck & von den Driesch 1975, 142).

Widely distributed throughout Turkey in both ancient and modern times,[69] the red fox is characterised by its

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[67] During the first millennium the function of the chicken included an important role in the religion of Zoroaster as a guardian of good against evil and as a symbol of light due to its morning crowing, while the importance of cock fighting is borne out by a depiction on a sixth century vase from Smyrna (Zeuner 1963, 445).

[68] Two varieties of fallow deer are known to occur in Europe and Western Asia, with the fallow deer (*Dama dama dama*) inhabiting Europe and the Near East, and the Persian fallow deer (*Dama dama mesopotamica*) currently confined to southern Iran (Whitehead 1993, 1846). The Persian fallow deer was formerly considered as a separate species from the fallow deer on the basis of its greater size, differing antler morphology, and the shape of the nasal bones. Some overlap of range between the two varieties has however led to *mesopotamica* being treated as a race of *Dama dama*, with the former subsequently considered as a subspecies of the latter.

[69] For a review of the occurrence of red fox remains throughout Turkey see page 44.

adaptability to a great diversity of environments ranging from scrub, woodland and farmland mosaics to mountainous terrain and areas of human habitation (MacDonald & Barrett 1993, 98). The presence of this species among the Iron Age remains therefore imparts little information concerning the environment surrounding the site.

6.10 Eurasian badger (*Meles meles*).

A single specimen of the Eurasian badger was recovered, consisting of a complete adult atlas (7.0813; Tables 3, 27c; Figure 37). Due to a lack of comparative measurements from contemporary sites, the relative size of this specimen cannot be assessed. The Eurasian badger is widely distributed within the Palaearctic regions of Europe and Asia (Harrison 1991, 134). Badgers are, however, rarely represented from Turkish archaeological sites. Badger remains were identified from Early Bronze Age I levels at Arslantepe and from Chalcolithic and Early Bronze I levels at Norşun-Tepe (Bökönyi 1993, 353; Boessneck & von den Driesch 1976b, Table 1). This species is typically associated with deciduous woodland, alternating with pasture or cultivated ground, or densely wooded terrain (Bjärvall & Ullström 1986, 156).

6.11 Common weasel (*Mustela nivalis*).

Seven common weasel specimens, representing an MNI of one, were identified (Tables 3, 28). These consist of a skull lacking only portions of the zygomatic arches and the majority of teeth (7.0149; Table 28a; Figure 39a-b), a humerus (7.0281; Table 28b; Figure 40ii), a radius (7.0240; Table 28c; Figure 40i), two metapodial bones (7.0242, 7.0243; Table 28d), and two first phalanges (7.0241, 7.0243; Table 28e). The radius, metapodial bones and phalanges all came from a single deposit in trench L16 and may represent the same individual.

The cranial specimen was differentiated from *M. erminea,* which shares a similar size and morphology, on the basis of the following characteristics. The breadth of the canine alveoli is only slightly larger than the facial breadth between the infraorbital foramina, and the infraorbital opening is small, being approximately equal to the breadth of the canine alveolus (Niethammer & Krapp 1993b, 531). The specimen was identified as female on the basis of the lack of development of the saggital crest.

The common weasel enjoys a modern distribution extending across Europe and Asia, in addition to North America and North Africa. This species was similarly widely distributed in ancient times with many sites throughout Anatolia yielding weasel remains. These include Late Bronze I-II Korucutepe, Chalcolithic and Early Bronze I Hassek Höyük, Late Chalcolithic and Early Bronze Age Norşun-Tepe, Late Chalcolithic to Late Bronze Age Tepecik, Hellenistic Lidar Höyük, and Early and Middle Bronze Age Demircihüyük (Boessneck & von den Driesch 1975,143; Stahl 1989, 141; Boessneck & von den Driesch 1976b, Table 1; Boessneck & von den Driesch 1979a, 114; Kussinger 1898, 175; Boessneck & von den Driesch 1978, Table 1).

The skull specimen from Sos Höyük is considerably smaller than male weasel skulls from Roman levels at Didyma, Hellenistic contexts at Lidar Höyük, and a further fragmentary male skull from Korucutepe (Boessneck & Schäffer 1986, Table 20; Kussinger 1988, Table 70; Boessneck & von den Driesch 1975, Table 144). In terms of condylobasal length, the specimen is comparable to the smallest skull from Hellenistic levels at Lidar Höyük, and is slighter above the range of dimensions for female common weasel skulls from Europe (Kussinger 1988, Table 70; Niethammer & Krapp 1993b, 531). The Sos Höyük specimen also displays larger dimensions than two modern weasel skulls of unspecified gender from Lebanon (Harrison 1991, Table 68). Given the female status of the specimen from Sos Höyük, it appears to comprise a larger sized variety than is represented in Europe. Both the humerus and radius from Sos Höyük are similarly slightly larger in size than European specimens (Niethammer & Krapp 1993b, Figure 179C-D).

The weasel can adapt to a wide diversity of habitats from sand dunes and grassland to woodlands and mountains (MacDonald & Barrett 1993, 112). Distribution is dependent only on the provision of cover and an abundance of the rodents that comprise its principal food source. The presence of this species therefore imparts little information regarding the habitat surrounding Sos Höyük during the Iron Age period.

6.12 Beaver (*Castor fiber*).

Two beaver specimens, representing an MNI of one, were recovered from Iron Age contexts at Sos Höyük (Tables 3, 30). These include a mandibular molar (7.0284; Figure 42i), and the diaphysis of a tibia (7.1250; Figure 42ii). Formerly spread throughout Europe and Asia, the beaver is now extinct throughout Turkey and much of Europe (Smit & van Wijngaarden 1981, 225). Within the Near East, archaeological finds suggest a former range extending from the Anatolian highlands south to the Euphrates floodplain, dating from the Pleistocene into historical times (Legge & Rowly-Conwy 1986, 474). Beaver remains are represented by a small number of finds throughout Turkey. Single finds have been identified from Late Bronze I-II levels at Korucutepe, Hittite contexts at Alişar Höyük, and Late Chalcolithic to Late Bronze Age Tepecik (Boessneck & von den Driesch 1975, 146; Patterson 1937, 296; Boessneck & von den Driesch 1976, 114). A small number of specimens were identified from Early Chalcolithic Çavi Tarlası, Late Bronze I-IIA Arslantepe, Late Chalcolithic to Middle Iron Age Norşun-Tepe, and Chalcolithic to Bronze Age Tültintepe (Schäffer & Boessneck 1988, 50; Bökönyi 1993, 354; Boessneck & von den Driesch 1976b, 96; Boessneck & von den Driesch 1976a). The tibia from Sos Höyük is comparable in size to a specimen dating to the Early Ceramic Neolithic from Tell Abu Hureyra in northern Syria (Legge & Rowly-Conwy 1986, Figure 2b).

Beavers show a habitat preference for broad river valleys and floodplains associated with abundant trees and bushes (Bjärvall & Ullström 1986, 77; MacDonald & Barrett 1993, 233). The requirement of softwoods including willows, poplars and aspen and permanent, free-flowing water constitute the principal constraints on distribution. If these conditions are met, the beaver can inhabit any water course ranging from metre wide streams to large lakes. The habitat requirements of the beaver link this species to either the plain or mountain slopes surrounding Sos Höyük, rather than to the mountain tops that would have been characterised by steppe vegetation devoid of permanent water sources. The beaver may have been hunted by the Iron Age inhabitants of Sos Höyük for its pelt or meat.

6.13 Brown hare (*Lepus europaeus*).

Two specimens of the brown hare, representing an MNI of one, were recovered from Iron Age contexts at Sos Höyük (Tables 3, 31). These comprise a fragmentary proximal femur (7.0703; Table 31b; Figure 43ii) and a fourth metatarsal bone (7.0702; Table 31d). Both specimens came from a single deposit in Trench L16 and may derive from the same animal. The depth of the caput femoris from the Sos Höyük specimen is comparable to that of a femur from Aceramic levels at Aşikli Höyük, while the least breadth of the shaft is only slightly smaller than a burnt specimen of unknown date from Korucutepe (Payne 1985a Table 4; Boessneck & von den Driesch 1975, Table 40e). The fourth metatarsal from Sos Höyük yields measurements that are slightly smaller than those from specimens dating to Early Bronze Age levels at Sos Höyük but that are comparable to those from Late Bronze I-II contexts at Korucutepe (Boessneck & von den Driesch 1975, Table 40e). Based on their similarity to specimens from earlier levels at both Sos Höyük and Korucutepe, a hare of small size, although within the range of modern Turkish specimens, appears to be represented in the Iron Age levels at Sos Höyük.

The metatarsal specimen from Iron Age levels is distinguished by being the only wild animal bone from Sos Höyük, apart from red deer antler fragments from the Early Bronze period, to display evidence of human modification (7.0702; Figure 43i). This specimen exhibits a small hole of approximately two millimetres in diameter pierced dorso-plantarly through the shaft adjacent to the distal articular surface. The function of this modification is unclear. Specimens displaying similar treatment include ovicaprid phalanges recovered from both Early Bronze and Iron Age contexts at Sos Höyük and a sheep metacarpal from mixed layers at Dinkha Tepe (Gilbert & Steinfeld 1977, 343). The purpose of the modifications to these specimens is equally obscure, although the items may have served a decorative function.

The frequency with which hare bones are found among the remains excavated throughout Turkey attests to the species adaptability to a great diversity of habitats.[70] Brown hares nevertheless display a preference for temperate open terrain including grassland and cultivated lands, with a tendency to avoid wooded habitats. The species may have been hunted for both its pelt and meat.

6.14 Mountain mole rat (*Nannospalax nehringi*).

Two Mountain mole rat specimens were identified comprising a maxillary (7.1460A-D) and a mandibular fragment (7.0483; Table 3).[71] As this species inhabits underground tunnels, and the specimens failed to exhibit a surface texture and discolouration similar to those of associated specimens from the same context, it is likely that these specimens were intrusive.

6.15 Turkish hamster (*Mesocricetus brandti*).

A femur (7.0642) was the only specimen identified as *Mesocricetus brandti* (Table 3).[72] Due to the burrowing behaviour of this species, it is probable that this specimen is intrusive.

6.16 Wood mouse (*Apodemus sylvaticus*).

A single fragmentary wood mouse skull (7.0316) was identified (Table 3). The wood mouse is a highly adaptable species that may inhabit a diversity of vegetational communities ranging from woodland to arable lands (Bjärvall & Ullström 1993, 260). The burrowing habits of this species and excellent preservation of the specimen recovered suggests that it represents an intrusive find.

Birds

6.17 Mallard (*Anas platyrhynchos*).

A complete right carpometacarpus (7.0973) is the only specimen identified as mallard (Table 3, 33b; Figure 46i). The distal breadth of the Sos Höyük specimen is only slightly larger than that from a specimen from Hasanlu Period X at Hajji Firuz Tepe in northwestern Iran (Meadow 1983, 398).[73] The mallard is the most common duck throughout the Middle East and is well represented in

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[70] See page 44 for a review of the current distribution of brown hares and their representation at archaeological sites throughout Anatolia.

[71] See page 45 for a discussion of this species.

[72] See page 45 for a discussion of this species.

[73] The distal breadth of 13.3 mm for a mallard carpometacarpus from Bronze Age levels at Demircihüyük (Boessneck & von den Driesch 1977, 45) appears to be too large for this species, and may represent a misprint.

archaeological deposits in Turkey.[74] The distribution of this species is restricted only by the requirement of still or slow moving water, and as such the mallard would have been well suited to streams and ponds in and around the Erzurum plain.

6.18 Quail (*Coturnix coturnix*).

Two specimens, representing an MNI of one, were identified as quail from Iron Age contexts at Sos Höyük (Tables 3, 38). These comprise a complete left humerus (7.1457; Table 38a; Figure 47ii) and a complete right carpometacarpus (7.1458; Table 38b; Figure 48). As both these specimens came from a single deposit in trench L16, it is possible that they represent the same individual. Measurements from the humerus are comparable to those from two specimens dating to Bronze Age levels at Demircihüyük (Boessneck & von den Driesch 1987, 47), thus implying a bird of similar size.

The quail is distributed from Europe and North Africa through to western and central Asia, although its distribution is restricted to localised and rare occurrences (Cramp 1980, 496; Heinzel, Fitter & Parslow 1995, 120). With the exception of a small region in southwest Turkey in which it is a permanent resident, the occurrence of the quail in modern Turkey is confined to migratory summer occupancy. In archaeological contexts, quail remains are fairly uncommon and restricted to only a few finds. Quails have been identified from Late Bronze I-II levels at Korucutepe, Late Chalcolithic to Early Bronze Age Norşun-Tepe, and Early to Middle Bronze Age levels at Demircihüyük (Boessneck and von den Driesch 1975, 153; Boessneck & von den Driesch 1976b, Table 1; Boessneck & von den Driesch 1987, 45). The quail favours open habitats such as farmland, grassland, and steppe. Quails represent the smallest species of game bird, and it is probable that they were consumed at Sos Höyük during the Iron Age period.

6.19 Common Crane (*Grus grus*).

A single specimen consisting of a proximal humerus fragment (7.0485A-B) was identified as common crane (Table 3). The fragmentary nature of this specimen precludes analysis of the animal's overall size. The common crane is well represented throughout Turkey in both recent and ancient times, with modern distribution involving seasonal occupation over the summer months.[75] The species inhabits a high diversity of habitats dependent only on the proximity of water.

Reptiles

6.20 Caspian turtle (*Mauremys caspica* caspica).

Four specimens of the Caspian turtle were identified. These included a complete scapula (7.0382), a hypoplastron fragment (7.0717A-B; Table 3; Figure 50), and two plastron fragments (7.0122; 7.0123A-B), representing an MNI of one. *M. caspica* caspica is currently widespread from the eastern Transcaucasus and central and eastern Turkey, throughout Iraq and Saudi Arabia and into the central plateau of the Zagros Mountains in Iran (Ernst & Barbour 1989, 170). Within Anatolia, Caspian turtle remains have been recovered from Early Chalcolithic Çavi Tarlası, Early Bronze Age Hassek Höyük, Bronze Age to Hellenistic/Roman Lidar Höyük, and Early Bronze II to Late Bronze I-II levels at Korucutepe (Schäffer & Boessneck 1988, 50; Stahl 1989, 154; Kussinger 1988, Table 79; Boessneck & von den Driesch 1975, 160). Although measurements are lacking, the scapula from Sos Höyük appears to be comparable in size to a specimen from Early Bronze II levels at Korucutepe.

The Caspian turtle hibernates in burrows in the northern regions of its range and the potential thus exists that these bones represent intrusive specimens. The lack of animal burrows and evidence of disturbance in the deposit in which these specimens were recovered, and the discolouration of the bones, which parallels that of associated specimens, however, argues against their being intrusive.

The Caspian turtle may aggregate in large numbers at any permanent source of fresh to slightly brackish water including irrigation canals and tends to inhabit extremely arid terrain (Pritchard 1979, 187). The low rainfall and proximity of freshwater at Sos Höyük would thus have provided the ideal environment for this species. The presence of turtle bones at Sos Höyük may indicate that this animal was consumed during the Iron Age period, as turtles are today utilised as a food source throughout Turkey (Boessneck & von den Driesch 1975, 158).

6.21 Summary of the Faunal Assemblage from Iron Age Sos Höyük

The Iron Age assemblage from Sos Höyük reveals that subsistence strategies during this period focused on the herding of domestic cattle and ovicaprids, and followed a primary products management system. The presence of castrates among the excavated cattle remains, and some differences between the cattle and ovicaprid mortality profiles and an 'idealised' meat production profile, suggest that secondary products may also have been exploited. The horse, ass, dog and chicken were also utilised at low levels during the Iron Age period.

The incidence of cut and chop marks among the bones from identified domestic taxa is extremely low, and provides only limited insight into butchery patterns. The presence of various bone tools indicates that the skeletal remains of

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[74] See page 46 for a discussion of the distribution and habitat preferences of the mallard.

[75] See page 47 for a more comprehensive discussion of the distribution and habitat of the Common Crane.

domestic taxa were utilised in the manufacture of utilitarian and decorative objects. The generally low frequency of pathological conditions suggests that the animals at the site were maintained a fairly high level of health, although the high frequency of dental anomalies amongst the ovicaprids provides some suggestion that these taxa may have been prone to such factors as congenital defects or parasites.

Various wild taxa were exploited at low levels. These included fallow deer, red fox, Eurasian badger, beaver, brown hare, Caspian turtle and a number of bird species. A lack of butchery marks makes conclusions regarding the nature of exploitation difficult, although it is likely that a variety of resources were utilised including antler, hides, meat and feathers.

Chapter 7
IRON AGE BÜYÜKTEPE HÖYÜK

7.1 Introduction

7.1.1 The Assemblage

A total of 1724 faunal specimens were recovered from Iron Age contexts at Büyüktepe Höyük (Table 4). These include 848 specimens identified to at least genus level, 865 unidentified fragments, and 11 identified intrusive remains. When intrusive finds are excluded from the calculations, the relative representation of identified remains (49.5%) was comparable to the other three assemblages (Table 1bi-ii).

In terms of preservation, ancient breakage is more common among the unidentified as opposed to the identified remains in the Iron Age assemblage from Büyüktepe Höyük (Table 5di-ii). The degree of ancient breakage across the different size categories of the unidentified remains in the sample is reasonably consistent, suggesting that the variation in ancient breakage apparent among the identified remains is due more to the small number of specimens involved for the various taxa, than to real differences in relative preservation. This may suggest that the remains of the various taxa were damaged through either cultural or taphonomic factors at a similar frequency.

The overall frequency of recent, or ancient and recent breakage, from Iron Age Büyüktepe Höyük (22.0%), is comparable to that for the sample from contemporaneous levels at Sos Höyük. The overall level of recent breakage within both these assemblages is only slightly higher than that observed from Early Bronze Age levels at Sos Höyük, but significantly higher than from the Early Bronze Age assemblage from Büyüktepe Höyük. The consistency of recent breakage across the three assemblages indicates that damage sustained during excavation and transport occurred at a reasonably consistent level. The lower level of recent damage apparent at Early Bronze Age Büyüktepe Höyük can be attributed to the small sample sized involved. The sample from Iron Age Büyüktepe Höyük has the second lowest frequency of intact specimens, after Early Bronze levels at the same site. This suggests that specimens from the assemblages from Büyüktepe Höyük were less likely through either cultural or taphonomic factors to be preserved intact. The intact specimens, as with the other assemblages studied, comprised predominantly short bones such as phalanges and carpal and tarsal bones.

7.1.2 Carnivore Gnawing

Three equid specimens display evidence of carnivore gnawing (Table 6d). This includes two caballine specimens (7.1%), and a single fragment identified only to genus (4.1%). The caballine distal metacarpal bone (4.0585) and the equine unfused femoral head fragment (4.0177) reflect reduction of the spongy bone about the epiphyses. The caballine pelvic fragment (4.0176A-B) displays reduction of the crest of the ilium associated with puncturing and furrowing, while the lateral, dorso-caudal edge of the wing displays a number of parallel scoring marks.

Six cattle specimens (2.7%) display evidence of carnivore gnawing. Gnawing was restricted to the reduction of spongy bone, as exemplified by tali, an ilium wing fragment, and the distal epiphyses of long bones. The incidence of gnawing is not associated with any particular deposit or feature, although all cases derives from the area of domestic architecture on the northwestern flank of the mound.

Six ovicaprid specimens (1.2%) display evidence of gnawing, which is principally concentrated about the extremities of shafts as manifested in the characteristic reduction and pitting of the epiphyses and channelling and puncturing of the shaft (Binford 1981). The single cranial specimen to display evidence of gnawing comprises a sheep mandible (4.0499), with channelling and tooth marks concentrated about the basal margin.

Gnawing is less common still among the unidentified remains, being apparent on two large-sized (0.6%) and one medium-sized (0.3%) animal fragment. The infrequency with which carnivore gnawing is apparent on the bones may suggest that access to waste for domestic dogs was restricted in some manner, through such activities as the prompt burial of refuse or the restraining of dogs. The low incidence of gnawing also indicates that this factor did not exert a significant influence over the relative representation and preservation of different taxa and elements within the assemblage.

7.1.3 Burning

The incidence of burning is extremely low for both identified and unidentified specimens (Table 7c). A single cattle (0.5%), and two ovicaprid (0.4%) specimens show evidence of having been affected by fire. Among the unidentified remains, only two large-sized (0.6%), and five medium-sized (1.4%) animal fragments had been burnt. The fragments displaying evidence of burning were neither concentrated in any particular region of the site nor associated with a specific architectural feature.

7.1.4 The Unidentified Remains-Butchery and Tools

Butchery marks are rare among the unidentified remains (Table 8d). Two shaft specimens from large-sized animals (0.6%) exhibit transverse chop marks that may be related to marrow extraction. Two unidentified medium-sized animal specimens (0.6%) display cut marks although the fact that these fragments could not be assigned to element type precludes any assessment of the nature or function of these marks. The low incidence of butchery marks among the unidentified remains suggests that if these remains could be allocated to species, the overall frequency of butchery marks would not be altered significantly.

Four unidentified fragments display evidence of human modification in the form of working to produce tools. These include one large-sized (0.3%) and three medium-sized (0.9%) animal fragments (Table 9c). Three of the specimens exhibit cut marks or worked edges and appear to represent off-cuts, while a shaft fragment had been modified into a point which displays evidence of extensive use in the form of polish.

7.2 Horse (*Equus caballus*), hemione (*E. hemionus*), ass? (*E. asinus*).

Fifty-six equid specimens were recovered from Iron Age contexts at Büyüktepe Höyük including 28 identified as domestic horse and two as hemione, representing an MNI of two and one respectively. Two specimens identified as asinine/hemione and 24 specimens unidentified to species were also recovered (Tables 4, 10c, 15).

7.2.1 The Cranial Remains

Two equid teeth were recovered from Iron Age contexts at Büyüktepe Höyük. A fragmentary molar (4.0434; Table 15a; Figure 20e) was identified as a fourth premolar or first molar. Some post-depositional damage was sustained by this tooth, which affected the mesial portions of the metaconid and protoconid. The portions of enamel underlying the broken regions allow for an approximation of the nature of the enamel folds in these areas. The specimen displays an open, blunted 'V'-shaped linguaflexid, characteristic of hemiones, asses or hydruntines (Eisenmann 1986,75). The ectoflexid is moderately deep, reaching the end of the preflexid while remaining distant from the postflexid. The specimen thus fails to exhibit either the complete penetration by the ectoflexid characteristic of hydruntines and caballines or the shallow ectoflexid characteristic of asses. Instead, the specimen reflects the intermediate level of penetration typical of hemiones. The external walls of the protoconid and hypoconid reflect the flatish morphology apparent in horses, asses and hemiones, in contrast to the greater curvature seen in hydruntines (Davis 1980, 294). The metaconid and metastylid are of rounded appearance and display general symmetry, thus failing to exhibit the asymmetrical double knot with elongated metastylid often found in the cheek teeth of horses (Zeder 1986, 391). The specimen was therefore identified as asinine/hemione tending towards hemione. The occlusal surface of this tooth is worn flat and thus represents an individual of at least five to six years of age, at which stage all permanent cheek teeth are in wear (Levine 1982, 229; Getty 1974, 467). As the roots are not closed an individual considerably younger than fourteen years is suggested.

A fragmentary left third molar (5.0008; Table 15a; Figure 20f) consists of the mesial portion of the crown and occlusal surface. In this specimen the ectoflexid penetrates the stem of the double knot, although it fails to reflect the extremely deep penetration apparent in hydruntines (Davis 1980, 293). The linguaflexid is deep and tends toward the 'V'-shaped pattern apparent in hemiones (Eisenmann 1986, 75). The external wall of the protoconid and hypoconid are flatter as is characteristic of caballines, hemiones and asinines, as opposed to the rounded walls apparent in hydruntines (Davis 1980, 294), and the double knot reflects the symmetry characteristic of hemione and asinine tooth morphologies. This specimen is thus tentatively identified as hemione. The fragmentary state of this tooth does not permit determination of age.

7.2.2 The Post-cranial Remains

The majority of post-cranial equid specimens recovered from Iron Age contexts at Büyüktepe Höyük were identified as domestic horse. A distal scapular fragment (4.0225 A-F; Table 15b) exhibits a concave medial surface, very shallow vascular grooves, a rounded caudal border and an oval glenoid cavity. When viewed laterally, the supraglenoid tubercle is somewhat high and rounded as in modern *E. przewalskii* (Compagnoni 1978, 108) and thus fails to display the straight cranial border and compact angular supraglenoid tubercle evident in hemiones (Meadow 1986, 275). This specimen is comparable in size to a scapula from a domestic horse dating to Hellenistic/Roman contexts at Lidar Höyük, a male specimen from a Middle Iron Age burial from Norşun-Tepe, and the scapula of the Thebes horse (Kussinger 1988, Table 40; Boessneck 1978b, Table 5; Boessneck 1970, Table 2). A further distal scapular fragment (4.0226A-B; Table 15b) displays a high, rounded supraglenoid tubercle and reasonably shallow vascular grooves. The glenoid cavity is oval tending toward the roundness evident in the scapula of modern Przewalski's horses (Compagnoni 1978, 108). The similarity in dimensions of this specimen to those of 4.0225A-F, as well as to the Thebes and Przewalski's horses and to specimens from Lidar Höyük and Norşun-Tepe, suggest a domestic horse.

The most complete scapula recovered (4.0156; Table 15b) has damage confined to the supraglenoid tubercle, the tuberosity of the spine and the most ventral region of the lateral and costal surfaces, although the state of surface preservation was very poor. The rounded caudal rim and lack of an acromion-like edge near the distal end of the spine suggest caballine and hemione morphologies (Uerpmann 1986, 257). Although this specimen is considerably smaller and more gracile than the other caballine scapulae recovered from Büyüktepe Höyük, the dimensions closely resemble those of domestic horses dating to the Middle Ages from Lidar Höyük and of a modern Przewalski's horse from the Smithsonian collection (Kussinger 1988, Table 40; Zeder 1986, Table 4). The specimen also differs only slightly from Przewalski's horse specimens from Rome and from the Soleb horse (Compagnoni 1978, Table 4; Clutton-Brock 1974, Table 1), with the more ovoid glenoid cavity and gracile collum, respectively.

An unfused distal epiphysis of a radius (4.0362A-D; Table 15d) displays the dorso-volar compression characteristic of asses and horses, as reflected in its high distal articular breadth to depth index, in contrast to the blocky appearance typical of hemiones (Meadow 1986, 275). The specimen is comparable in size to radii of domestic horses from Iron Age and Hellenistic/Roman contexts at Lidar Höyük and from Late Bronze I-II levels at Korucutepe and to a male horse radius from Middle Iron Age contexts at Norşun-Tepe (Kussinger 1988, Table 40; Boessneck & von den Driesch 1975, Table 6; Boessneck & von den Driesch 1979b, Table 5).

A left radius (5.1234; Table 15d) lacks only a small portion of the volar border of the proximal extremity. This specimen is most comparable in size to the radii of a male horse from Middle Iron Age levels at Norşun-Tepe, of the Thebes horse, and of a single specimen from Late Bronze I-II levels at Korucutepe (Boessneck & von den Driesch 1979b, Table 5; Boessneck 1970, Table 2; Boessneck & von den Driesch 1975, Table 6h).

The most complete pelvic fragment recovered (4.0176A-B; Table 15h) lacks only portions of the cranial edge of the wing of the ilium, the cranial facet and medial edge of the pubis, and the tabula. The depressions for the attachment of the tendons of the rectus femoris are somewhat shallow as is found in caballines and asses, in contrast to the well developed depression for the lateral rectus femoris muscle typical of hemiones (Uerpmann 1986, 258). This pelvis is comparable in size to that from a domestic horse from Iron Age Lidar Höyük and from a modern Przewalski's horse from the Smithsonian collection, but is larger than those from the Thebes and Buhen horses (Kussinger 1988, Table 40; Zeder 1986; Boessneck 1970, Table 2; Clutton-Brock 1974, Table 1). The adult nature of this bone, the reduced conjugate diameter, the medial robustness of the pubis, the convexity of the cranial portion of the pubis floor, and the obvious concavity of the ischiatic floor, are all suggestive of a stallion or maturely castrated gelding (Getty 1975, 303). A further specimen (4.0228A-B; Table 15h) comprises a well-preserved right pelvis fragment lacking the cranial limits of the ilium wing, portions of the cranial and medial surfaces of the pubis, and the tabula. The fragment is fairly robust in form and exhibits extremely shallow depressions for attachment of tendons of the rectus femoris. The morphological and metrical similarities between this specimen and the previous fragment, in addition to their close stratigraphical association, suggests that they represent the same individual.

A distal tibial fragment (5.1241; Table 15j) displays a robustness compatible with its identification as caballine. The distal breadth is comparable in size to caballine specimens from Level III at Godin Tepe in western Iran, Late Seljuk Korucutepe, Bronze and Iron Age Lidar Höyük, and the Thebes horse (Gilbert 1991, 114; Boessneck & von den Driesch 1975, Table 6o; Kussinger 1988, Table 40; Boessneck 1970, Table 2). A left talus (4.1530; Table 15k) lacking the most proximal portions of the trochlea is comparable in size to caballine specimens from Level II at Godin Tepe in western Iran and Middle Bronze II levels at Korucutepe, and is larger than a modern Przewalski's horse from the Smithsonian collection and a specimen from Late Bronze Age contexts at Deir 'Alla in Jordan (Gilbert 1991, Appendix 3; Boessneck & von den Driesch 1975, Table 6q; Zeder 1986, Table 4; Buitenhuis 1991, Appendix.).

A fragmentary metacarpal bone (4.0585; Table 15l) displays a distal breadth that is comparable to that found in larger modern mules, although the depth of the articular surface tends to be broader in the latter. The specimen is also very similar in size to the Thebes and Buhen horses and falls within the upper limits of the range for modern *E. przewalskii* examples (Boessneck 1970, Table 2; Clutton-Brock 1974 Table 1; Eisenmann & Beckouche 1968). The relative tapering of the medial condyle of this specimen, as illustrated by the contrast between least to greatest depth, is similar to the greater degree of tapering evident in domestic caballines. The specimen, in addition, exhibits the greater distal articular to supra-articular breadth characteristic of domestic forms.[76]

Three caballine first phalanges were also identified.[77] A right forelimb phalanx (4.0733; Table 15n) lacks the medio-volar corner of the proximal articular surface and portions of the distal articular surface. The index of robustness for this specimen falls into the lower range for caballine forelimb first phalanges. The bone is similar in size to the forelimb phalanx of the Soleb horse, although somewhat shorter with a reduced proximal depth, and two female first phalanges from Middle Iron Age Norşun-Tepe (Clutton-Brock 1974 Table 1; Boessneck & von den Driesch 1979b, Table 5). These specimens also have a very similar index of robustness. The left first phalanx (4.0157; Table 15n) is extremely poorly preserved, with extensive damage to the dorsal and palmar/plantar surfaces and to the distal condyles. Due to its heavily eroded state it is impossible to determine whether this specimen comes from the fore- or hindlimb. The specimen is comparable in size to two first phalanges from Middle Iron Age contexts at Norşun-Tepe (Boessneck & von den Driesch 1979b, Table 5). A hindlimb first phalanx (4.0178; Table 15n) yields an index of robustness that falls towards the lower limits of the range for hindlimb caballine phalanges. This specimen is comparable in size to two male specimens from Middle Iron Age contexts at Norşun-Tepe and is also intermediate in size between the Thebes and Buhen hindlimb phalanges (Boessneck & von den Driesch 1979b, Table 5; Boessneck 1970, Table 2; Clutton-Brock 1974, Table 1).

Four second phalanges are also caballine in morphology.[78] A left forelimb phalanx (5.0070; Table 15o) lacking only the lateral articular cavity of the proximal surface, is robust in form, being comparable in size to the forelimb second phalanges of the Thebes horse, and to two male specimens from Middle Iron Age Norşun-Tepe (Boessneck 1970, Table 2; Boessneck & von den Driesch 1979b, Table 5). A complete forelimb phalanx (4.0179; Table 15o) is also robust in form and larger than the forelimb phalanx of the Thebes horse. A complete hindlimb second phalanx (4.0229; Table 15o) is comparable to domestic caballine specimens from Middle Iron Age Norşun-Tepe (Boessneck & von den Driesch 1979b, Table 5). A further hindlimb second phalanx (4.0363A-B; Table 15o) lacks portions of the

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[76] With the preservation of only the distal epiphysis and a very small portion of the shaft, many of the diagnostic characteristics for species identification are unfortunately lacking (for example as in Eisenmann & Beckouche 1986; Meadow 1986 276).

[77] The separation of forelimb from hindlimb first phalanges is based on the following morphological and metrical features: hindlimb phalanges tend to be shorter, wider proximally and more narrow distally than forelimb phalanges (Getty 1975 317) and thus the greatest length to proximal breadth, and proximal to distal breadth ratios of the forelimb phalanges tend to be higher and lower, respectively, than those of the hindlimb phalanges; the hindlimb phalanges tend to have more pronounced morphological characteristics such as the eminence for the collateral ligament and the ridges for the attachment of the middle distal sesamoid ligament.

[78] Hindlimb second phalanges are narrower, and slightly longer than forelimb second phalanges (Getty 1975, 317).

medial surface of the proximal extremity. This specimen is of a size comparable to the Thebes phalanges, although it is significantly narrower at the distal end.

Three third phalanges were identified as caballine. A left forelimb specimen (5.0003; Table 15p)[79] has a rounded sole, thus paralleling the modern Przewalski's horse discussed by Compagnoni (1978, 116), and a reasonably developed extensor process. Of similar size to the forelimb third phalanx of the Thebes horse (Boessneck 1970, Table 2) although somewhat higher, this specimen may be confidently identified as *E. caballus*. The forelimb specimen (4.0709A-B; Table 15p) also exhibits a rounded sole and well developed extensor process. This specimen is most comparable in size to a Middle Elamite caballine phalanx from Malyan and is somewhat smaller than the Thebes horses, but it is larger than the Period I horses from Bastam (Zeder 1986, 401). A hindlimb third phalanx (4.0180; Table 15p) displays a rounded sole and a reasonably developed extensor process and lacks a median notch. Falling toward the bottom of the size range of caballine third phalanges plotted by Zeder, the specimen is slightly broader but shorter than a modern *Equus przewalskii* specimen and longer although narrower proximally than the Bastam horses (Zeder 1986 402, Figure 21). In terms of dimensions, and based on the fact that these specimens originated from the same deposit, the hindlimb first (4.0178), second (4.0229), and third (4.0180) phalanges, and a distal sesamoid (4.0230) appear to represent a single individual.

A number of additional specimens were also identified as caballine on the basis of various morphological and metrical characteristics. A caudal vertebra fragment (4.0003) displays a robustness compatible with its identification as caballine. Two complete left radial carpals (4.0719, 5.0045; Table 15e) are most similar in dimensions to a specimen from a modern Przewalski's horse (Zeder 1986, Table 4). A complete third carpal bone (4.0937; Table 15f) is slightly larger than that from the same Przewalski's horse. An incomplete, left intermediate carpal (4.0746; Table 15g) is similarly larger than a specimen from a modern Przewalski's horse, although somewhat smaller in dimensions than the caballine specimen from Early Bronze Age levels from Sos Höyük. A femur specimen (5.1574) preserves the lateral portions of the distal shaft and extremity. Although fragmentary, the size and robustness of this specimen permits identification as caballine. Two distal sesamoids (4.0154, 4.0230; Table 15m) also exhibit a size compatible with their identification as caballine.

A single post-cranial specimen displays hemione morphology. A right hindlimb third phalanx (4.0129; Table 15p) exhibits a less well developed extensor process than was apparent for the caballine specimens. The specimen also displays a correspondingly steep articular surface, the solar surface is pointed, and the specimen appears to lack a median notch. These features are hemione in character (Compagnoni 1978, 116). The dimensions of this phalanx resemble closely those of a modern hemione hindlimb specimen from the Smithsonian Collection and the hemione hindlimb third phalanx from Shahr-i Sokhta (Compagnoni 1978, 115).

The extremely poor state of preservation of the ulnar fragment (4.0732) precludes any detailed analysis. As this specimen is smaller than would be expected for caballines, it was tentatively identified as asinine/hemione.

Twenty-four equid specimens are too fragmentary to permit any species identification and are thus identified only to genus level.

7.2.3 Physical Characteristics of the Domestic Horses

A single equid specimen permits determination of stature. An estimation of withers height can be made using the lateral length of the bone multiplied by Kiesewalter's conversion factors (Boessneck 1970, Table 1 after Kiesewalter 1888). The caballine radius (5.1234) from Büyüktepe Höyük yields a withers height of 141.9 centimetres, thus representing a fairly large horse. The Büyüktepe Höyük animal is comparable in withers height to the Thebes horse and falls toward the middle of the range of estimated withers heights for the horses from Korucutepe (Clutton-Brock 1974, Table 1; Boessneck & von den Driesch 1975, 35). When the withers height is considered in conjunction with the various breadth and depth dimensions for this bone, a horse of slender stature is suggested.

7.2.4 Butchery

Two of the total number of *Equus* sp. specimens (8.3%) provided evidence of butchery. Two rib fragments (4.0002, 4.0233) displayed transverse chop marks that resulted in breakage of the body. These marks may have resulted from butchery to obtain cuts of meat during carcass preparation.

7.2.5 Pathology

Two caballine specimens (3.6%) display evidence of pathological conditions. Two third phalanges (5.0003, 4.0709A-B) exhibits grooving on, and extension of, the articular surface by bone deposition and periarticular exostoses. These features are suggestive of osteoarthritis (Baker 1984, 254). This condition is particularly common in interphalangeal joints and is of uncertain cause. Heavy draught work or prolonged use of the animal on hard surfaces resulting in trauma to the articular cartilage are possible causes.

7.2.6 Summary

At least two equid species, the domestic horse and the hemione, are represented in Iron Age contexts at Büyüktepe Höyük. As the majority of specimens identified to species are caballines, it is probable that the majority of specimens that were identified only to genus level also represent the domestic horse. The presence of butchery suggests that equid meat may have been consumed. Evidence of

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[79] Hindlimb third phalanges are distinguishable from forelimb on the basis of the following criteria (Getty 1975, 317): they are narrower; the angle of inclination of the dorsal surface tends to be greater; the plantar surface is more concave; the plantar processes are less prominent and closer together.

pathology may provide some insight into the use of equids at Büyüktepe Höyük, with osteoarthritis implying draught work.

7.3 Domestic cattle (*Bos taurus*) and aurochs (*B. primigenius*).

Two hundred and twenty-one domestic cattle and a single aurochs specimen, representing an MNI of nine and one, respectively, were recovered from Iron Age contexts at Büyüktepe Höyük (Tables 4, 11d, 16).

7.3.1 Differentiation of Wild from Domestic Specimens

A single specimen among the large bovid remains from Iron Age levels at Büyüktepe Höyük displays a size and robustness compatible with its identification as wild. The forelimb first phalanx (4.0450; Table 16y) has a greatest length which is beyond the range for domestic cattle from Early Bronze to Hellenistic/Roman levels at Lidar Höyük, and Middle to Late Bronze Korucutepe (Kussinger 1988, Table 9; Boessneck & von den Driesch 1975, Table 10). Instead, the specimen is only slightly smaller than aurochs' first phalanx specimens dating to the Middle Ages at Lidar Höyük, and comparable in size to a burnt specimen from Middle Bronze II contexts at Korucutepe (Kussinger 1988, Table 58; Boessneck & von den Driesch 1975, Table 33).

The mandibular third molars from Iron Age contexts at Büyüktepe Höyük were examined to determine their wild or domestic status (Table 43). The range and mean of the four specimens from Büyüktepe Höyük are appreciably lower than those for a sample of aurochs specimens from the Boreal period in Denmark (Degerbøl & Fredskild 1970, 87). The specimens from Büyüktepe Höyük are instead within the range of domestic cattle dimensions from Bronze and Iron Age contexts from sites in eastern Turkey. The range and mean of the sample from Büyüktepe Höyük are most comparable to those from Iron Age levels at both Lidar Höyük and Sos Höyük.

7.3.2 Physical Characteristics of the Domestic Cattle

The remains were analysed using a log ratio diagram, with the female *Bos primigenius* skeleton dating to the Boreal period from Ullerslev in Sweden again employed as a standard (Degerbøl & Fredskild 1970). The graph of size indices from Iron Age levels at Büyüktepe Höyük was based on 19 and 10 breadth and length measurements, respectively (Figure 9c; Table 42ci-ii). Both plots of size indices fell to the left of the zero line indicating domestic animals of considerably smaller stature and size than the wild standard. The plots of size indices based on breadth measurements display a similar range and median to those of the assemblages from Iron Age levels at Sos Höyük, suggestive of medium sized animals. The range and median of the length size indices however fell slightly closer to the standard than was apparent for the Sos Höyük assemblage. This may indicate that the cattle from Büyüktepe Höyük were taller at the shoulder than those from Sos Höyük for the same period. The small size of the sample of measurements from Büyüktepe Höyük however requires that this conclusion remain tentative. When compared with the assemblage from Iron Age Lidar Höyük, the Büyüktepe Höyük assemblage appears to represent cattle of lighter weight, although the lack of length indices from the former site precludes further investigation of a difference in overall stature.

The plots of size indices of breadth and length measurements from Büyüktepe Höyük display a reasonable level of variation when compared with those of assemblages from Bronze Age contexts at other Anatolian sites (Figure 9di-vi). The cattle from Büyüktepe Höyük are comparable in weight to the cattle from Late Bronze Age Lidar Höyük, but lighter and taller than the cattle from Late Bronze Korucutepe. The graphs suggest that the cattle from Büyüktepe Höyük were taller than those from the Middle Bronze Age but comparable in height to cattle from the Early Bronze Age assemblages. In terms of breadth size indices, the Büyüktepe Höyük graph shows a lower median than those of Middle and Early Bronze Age assemblages. These data suggest that the cattle present at Büyüktepe Höyük in the Iron Age were somewhat taller and generally lighter than those from the Middle and Late Bronze Age levels, suggesting perhaps the development of a diversity of breeds by the Iron Age period.

Further determination of the stature of the domestic cattle based on withers height calculations is not possible due to the absence of intact limb bones from Iron Age contexts at Büyüktepe Höyük. An impression of the stature of the cattle was obtained instead through comparison of the greatest length of the talus bones and first and second phalanges with those from contemporary and earlier contexts elsewhere in Anatolia (Table 44a-e). The mean of the sample of talus bones from Büyüktepe Höyük is higher than those from contemporaneous levels at Sos Höyük and Lidar Höyük, and earlier contexts including Early Bronze Age Sos Höyük and Bronze Age Lidar Höyük and Korucutepe. Whether this reflects a real difference in stature or is simply an artifact of the small size of the sample from Büyüktepe Höyük is unclear. The few measurements available from the phalanges provide little opportunity to investigate this trend further. The large size of the talus bones from Büyüktepe Höyük, as an indicator of stature, appears to accord with the results provided by the ratio diagram, with its approximately comparable range and mean to those of the Iron Age samples from Sos Höyük. The fragmentary nature of the cattle specimens recovered from Iron Age levels at Büyüktepe Höyük however precluded further analysis of this issue.

7.3.3 Mortality Profiles

The mandibular teeth were investigated in order to obtain a picture of mortality (Table 45a). Although the analysis is based on only nine specimens, the resulting mortality profile provides a clear indication that mortality was highest among adults. Six specimens (66.7%) exhibit fully erupted adult dentition and therefore represent animals of at least 30 months of age. The infant, juvenile, and subadult categories are each represented by a single specimen. Given the small size of the sample, it is unclear whether infants are under-represented due simply to chance or if some preservational bias may have been acting against this particular group. A comparable pattern of mortality is observable in Late Bronze I-II levels at Korucutepe and Chalcolithic contexts at Hassek Höyük, suggestive of a similar herding strategy (Tables 45b i-ii). The profile from Büyüktepe Höyük was also similar to, although with slightly lower adult mortality than, those from Early Bronze and Iron Age levels at Sos Höyük, Early Bronze contexts at Hassek Höyük, and Late Bronze Lidar Höyük. Only a poor level of correlation was found between the dental data from Büyüktepe Höyük and that from Early and Middle Bronze Age contexts from Demircihüyük. The significance of the differences observed between the mortality pattern at Büyüktepe Höyük and the other sites examined, however, is difficult to assess due to the small size of the samples on which many of the calculations are based. It is consequently unclear whether the lower adult mortality at Büyüktepe Höyük, when compared with both the Early Bronze and Iron Age samples at Sos Höyük, indicate an underlying shift in the economy or is due only to the vagaries of sampling. The relatively small differences in the overall percentages for the different age categories however, argues for the latter scenario.

The pattern of mortality as suggested by the dental data was further examined in terms of the epiphyseal fusion data. Analysis is based on 41 specimens allocated according to four broad age categories (Table 46c).[80] Although the sample is small, an obvious trend toward adult mortality is apparent, which is thus in agreement with the results obtained from the dental analysis. The epiphyseal fusion data suggest that at least 95.0% of animals survived beyond 12 months, while at least 81.8% survived beyond 24 months. At least 40.0% of animals survived beyond 42 months. A distinct increase in mortality between approximately 24 and 48 months is thus suggested by the epiphyseal fusion data. The general agreement between the mortality patterns suggested by the epiphyseal fusion and dental data provides support for the validity of the results of each. The evidence therefore suggests that mortality was highest among adults, with many animals dying between 24 and 48 months.

An impression of many cattle dying just prior to or just following maturity is thus provided for the Iron Age levels at Büyüktepe Höyük. This profile appears compatible with a herd management emphasis on primary products, with the majority of surplus males, those not required for breeding or perhaps traction, being culled just prior to maturity. The majority of females are retained into adulthood for breeding purposes with the auxiliary function of milk production. The distinct increase in mortality between two and four years, suggested by the epiphyseal fusion data, may therefore provide evidence for the culling of surplus male stock.

7.3.4 Sex Ratio

With no horn cores, and few tali or pelvic specimens, the cattle assemblage from Büyüktepe Höyük is clearly too small to permit definite conclusions to be drawn regarding the sex ratio. Of the pelves identified to gender, one male and two females are represented which may imply that adult females were more abundant than males. The greater representation of adult females to males in the sample would provide support for the suggestion of a primary products management strategy, as the majority of preadult mortality would be expected to occur among males in this scenario.

7.3.5 Butchery

Eleven cattle specimens (5.0%) from Iron Age levels at Büyüktepe Höyük display evidence of butchery.

A horn core fragment (4.0453) has a small cut mark on the dorsal surface of the base of the cornual process. This mark probably resulted from skinning activities. Similar marks are apparent on cattle skulls from Early Bronze and Iron Age levels at Sos Höyük.

A right mandibular angle fragment (4.1027A-F) displays extensive chop marks on the aboro-buccal edge of the ramus directly adjacent to the mandibular foramen. These marks may be related to the removal of the mandible from the skull, as has been observed in ethnographic studies (Binford 1981, 109). In these cases, ease of transportation of the skull from a distant kill site to the habitation or consumption area constituted the motivation for the removal of the mandible. The presence of mandibular fragments among the excavated remains from Büyüktepe Höyük, however, appears to preclude this possibility. It is therefore likely that the mandible was removed during preparation of the skull for cooking.

A rib fragment (4.0337) displays evidence of butchery in the form of a clean transverse chop mark that resulted in the breakage of the bone. This mark may have resulted from butchery of the carcass into manageable portions for food preparation or distribution. Similar marks were observed on cattle ribs from Iron Age contexts at Sos Höyük and equid ribs from contemporaneous levels at Büyüktepe Höyük.

A proximo-lateral radial fragment (4.0418) displays extensive chop marks where the proximal shaft and epiphysis had been separated from the remainder of the bone. This may have occurred in order to facilitate the extraction of marrow. In addition, oblique cut marks are apparent both on the tuberosity for the attachment of the lateral collateral ligament of the elbow joint and on the lateral edge of the articular surface. Marks along the margin of the proximal articular surface of the radius may be associated with the disarticulation of the radius and ulna from the humerus.

Butchery marks are apparent on a single ulnar specimen (4.0612A-C). The olecranon fragment displays cut marks on its medial surface adjacent to the trochlea notch. Comparison with ethnographic observations of modern Eskimos suggest that marks in this region may have resulted during the process of disarticulating the radius and ulna from the humerus (Binford 1981, 124).

The pelvic fragment (4.0755) exhibits a deep chop mark on the medio-ventral edge of the shaft of the ilium opposite the

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[80] The first category is based on primary fusion of the pelvis. The second group is based on the fusion of the proximal radius, first and second phalanges and the distal humerus. The third group is based on the distal metapodial bones and tibia. The final group is based on the proximal tibia and distal radius and femur.

cranial edge of the acetabulum. Marks of this nature tend to occur during initial butchery of the carcass as a result of the disarticulation of the head of the femur from the acetabulum.

A talus (4.0469) displays a cut mark of the distal condyle. Located on the medial edge of the dorsal surface, this mark may have originated either through an attempt to disarticulate the metatarsal from the upper leg or, more probably, from skinning activities. Similar marks were apparent on a specimen from Early Bronze Age contexts at Sos Höyük.

The proximal metacarpal fragment (4.0592) displays extensive chop marks on the medio- and latero-volar edges of the shaft. These marks probably originated from an apparently successful attempt to break the shaft in order to extract the marrow. A distal metapodial (5.1340) displays a series of cut marks on the plantar margin, just proximal to the distal epiphysis. Butchery activity in this region resulted ultimately in breakage of the bone, possibly also for the purposes of marrow extraction. The distal metatarsal fragment (4.0379A-B) exhibits numerous deep chop marks on the medial surface of the shaft, directly adjacent to the line of ancient breakage. These marks again possibly indicate an effort to remove the distal extremity in order to extract the marrow. Marrow extraction, involving breakage of the bone either mid-shaft or adjacent to the epiphyses may therefore have comprised an important feature of the processing of cattle metapodial bones in the Iron Age at Büyüktepe Höyük.

A final metacarpal fragment (5.1648) displays shallow cut marks on the volar margin of the proximal shaft. These marks may have resulted from attempts to remove the digital flexor tendons.

7.3.6 Tools

A single specimen (4.1700; 0.45%) consisting of a femoral head fragment, was perforated through the fovea capitis femoris to form a spindle whorl. This specimen is similar to spindle whorls manufactured from humeral and femoral head fragments from both Early Bronze and Iron Age levels at Sos Höyük.

7.3.7 Pathology

No pathological conditions were observed among the Iron Age cattle bones from Büyüktepe Höyük, although the extremely fragmented nature of the sample may have obscured some cases.

7.3.8 Summary

Examination of the bovid bones from Iron Age levels at Büyüktepe Höyük indicates that the majority of the specimens came from medium-sized managed according to a primary products strategy. Meat production may have been augmented by traction work and secondary products. Investigation of the sex ratio, although based on a small sample, indicates that adult females may have been more numerous than males. The small size of the sample involved, however, makes these conclusions necessarily tentative. A single aurochs specimen was identified, suggesting that this species did not contribute significantly to the subsistence of the inhabitants of Büyüktepe Höyük.

7.4 Domestic sheep (*Ovis aries*) and domestic goat (*Capra hircus*).

A total of 491 ovicaprid remains, representing an MNI of nineteen, were recovered from Iron Age contexts at Büyüktepe Höyük (Tables. 4, 12d, 17). Eighty-two sheep and 11 goat specimens were identified, representing an MNI of seven and two respectively. The remaining fragments were classed as ovicaprid.[81]

7.4.1 Differentiation of Wild from Domestic Specimens

Based on their size and morphology, the ovicaprid specimens from Iron Age level at Büyüktepe Höyük provide no suggestion of the presence of wild stock.

7.4.2 Physical Characteristics of the Domestic Ovicaprids

The fragmentary nature of the sheep specimens necessitates examination of the metrical characteristics of the remains by means of a log ratio diagram. The standard measurements were obtained from a wild sheep described by Uerpmann (1979, 175).[82] The lack of breadth and length measurements for the goat remains precludes investigation of the assemblage using this technique.

The log ratio diagram for the Iron Age sheep sample from Büyüktepe Höyük is based on 17 breadth measurements only, due to the lack of length measurements in the assemblage (Figure 12c; Table 48c). The breadth size indices display a small range which falls about the zero line, implying sheep of similar size to the wild standard. This is similar to the results from the assemblage from Iron Age Sos Höyük. The mean is comparable to that from Iron Age Sos Höyük, but is slightly lower than that from Bronze Age contexts including Early Bronze Age Sos Höyük. This suggests that the sheep at Büyüktepe Höyük were comparable in size to those at Sos Höyük for the same period although the lack of height data from the former site precludes further investigation of this.

The absence of data from other Iron Age deposits in northeastern Anatolia also precludes determination of whether the sheep represented at Büyüktepe Höyük were characteristic of the northeast or were typical of sheep throughout the eastern Anatolia region.

Metrical analysis of the ovicaprid bones excavated at Büyüktepe Höyük was undertaken in order to obtain a further impression of the size and stature of the animals represented.

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[81] See page 29 for a discussion of the methods used to identify sheep and goat specimens to species.

[82] See page 30 for a description of these skeletons.

Withers height was estimated by multiplying the greatest length of each specimen by a factor specific to that long bone element (Teichert 1976). Calculation of estimated withers height of the sheep specimens from Büyüktepe Höyük was based on the greatest length of eight long bone specimens including one radius (4.0871), three metacarpal (4.0303, 4.0606, 4.0728) and four metatarsal bones (4.0031, 4.0859, 4.1026, 5.1282) (Table 49c). These calculations yielded a mean of 63.65 centimetres with a reasonably broad range and low standard deviation. The statistics for sheep from Iron Age contexts at Büyüktepe Höyük are similar in terms of both range and mean to those for Middle Bronze and Iron Age Lidar Höyük, and Late Bronze I-II levels at Korucutepe, thus reflecting animals of comparable stature (Tables 49d i-ix). The sheep from Büyüktepe Höyük were smaller in stature than those from Chalcolithic to Early Bronze Age Hassek Höyük and Early Bronze Age Sos Höyük, but slightly larger than those from Middle Bronze II Korucutepe and Iron Age Sos Höyük. The domestic sheep from Iron Age contexts at Büyüktepe Höyük thus appear to represent a small to medium sized breed. Overall, these results provide some evidence for size diminution from the Chalcolithic to Iron Age periods, but, as with Sos Höyük data, suggest that variation in breed may also have contributed to size differences between the domestic sheep of the Bronze and Iron Age periods.

Withers height estimation for goats at Büyüktepe Höyük is based on a single metatarsal bone (4.1016; Table 50b). The calculated withers height of 62.7 centimetres for this specimen is comparable to the mean withers heights for samples from Early and Middle Bronze Age Lidar Höyük, Middle and Late Bronze Korucutepe, and Early Bronze Age Hassek Höyük and to the withers heights derived from single specimens from Early Bronze Age Sos Höyük, Chalcolithic Çavi Tarlası and Hassek Höyük, and Early Hittite/Early Bronze II-III Ikiztepe (Tables 50c i-x). The specimen from Iron Age levels at Büyüktepe Höyük is thus representative of a medium sized breed. This result provides no indication of size diminution in goats between the Chalcolithic and Iron Age periods, although the use of only a single specimen in the calculation clearly dictates caution in the interpretation of these results.

7.4.3 Horn Cores

A single goat horn core specimen (4.0285; Table 17a) provides further information on the domestic status of the goats from Iron Age levels at Büyüktepe Höyük. This specimen, with medial flattening, a sharp frontal keel, rounded nuchal edge, and a small degree of twist, displays morphology characteristic of domestic stock (Redding 1981, 248). This specimen displays a morphology comparable to goat horn cores from contemporaneous levels at Sos Höyük, although the Büyüktepe Höyük specimen reflects a greater degree of twist and may therefore represent a male.

7.4.4 Mortality Profiles

The economic contribution of the domestic ovicaprids was investigated through the construction of mortality profiles based on mandibular remains and epiphyseal fusion data. Based on 17 specimens, the dental data reveal that mortality was highest among adults, with 41.2% dying beyond 48 months of age (Table 51c). Infant mortality was relatively low (11.8%), with an increase observed among juveniles (29.4%), resulting in a total of just over 40% herd mortality by the end of the second year. Subadult mortality appears to have been relatively low (17.7%). Overall the data derived from analysis of the dental remains suggest high mortality among adult animals and juveniles, coupled with low subadult mortality. The clear representation of mortality for each of the age categories strongly suggests that the ovicaprids were raised primarily for local consumption rather than for trade with other settlements.

When the mortality profile for the ovicaprid dental remains is compared with those from contemporary and earlier contexts throughout Anatolia, only a poor level of correlation is found (Tables 51di-ii). The profile from Büyüktepe Höyük differs substantially from those derived from Early Bronze Age levels at Demircihüyük, Korucutepe, Lidar Höyük, Hassek Höyük, and Middle Bronze Age levels from Demircihüyük, Lidar Höyük and Korucutepe. The profile from Büyüktepe Höyük instead bears a closer similarity to those from Late Bronze I-II Korucutepe and Early Bronze and Iron Age levels at Sos Höyük. The Büyüktepe Höyük profile differs to some degree from that at Late Bronze Korucutepe, with lower infant and subadult mortality, relative to juvenile and adult mortality, and Iron Age Sos Höyük, where infant mortality is somewhat lower relative to juvenile mortality. Similarly, the profile from Büyüktepe Höyük displays lower infant and higher adult mortality than is apparent from Early Bronze Age Sos Höyük. The similarities between these four profiles nevertheless suggests comparable herding strategies.

When the nine sheep mandibles are considered in isolation, the data suggests a greater frequency of mortality among juvenile than adult animals, relative to the combined ovicaprid profile (Table 51c). This may imply that a greater number of sheep than goats died prior to adulthood. The apparently higher preadult mortality of the sheep, relative to the ovicaprid, profile however, is probably attributable to the much greater ease with which sheep and goat mandibles with deciduous teeth can be differentiated, relative to adult specimens. As only two mandibles are assignable to *Capra*, investigation of the relative contribution of goats is precluded.

Analysis of epiphyseal fusion data involved 106 specimens divided into four broad age categories (Table 52c).[83] The epiphyseal fusion data for the ovicaprid bones from Iron Age contexts at Büyüktepe Höyük suggest that few animals died as infants with at least 80.9% of animals surviving to 12 months. The data furthermore suggest that few ovicaprids survived well into mature adulthood, with at least 85.7% of animals dying prior to 42 months. The anomalously high mortality between 30 and 36 months, can be considered a product of the small sample size, with only eight specimens represented in that age group. When the pattern of mortality is calculated for only the sheep specimens, the general trend is similar to that of the ovicaprid sample as a whole although no juvenile deaths are recorded and the sample

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[83] The elements on which the groups are based are the same as those utilised previously in the analysis of epiphyseal fusion of the Early Bronze Age ovicaprid specimens from Sos Höyük (See page 33).

indicates higher mature adult mortality than is apparent in the ovicaprid sample. It is unclear whether the discrepancy between the two profiles is due to the influence of goats in the latter sample, or merely attributable to the small size of the samples examined. Due to the almost complete absence of bones that could be identified as *Capra* among the specimens used for epiphyseal fusion analysis, the relative contribution of goats to the structure of the derived age profile cannot be assessed.

The results derived from examination of epiphyseal fusion accord broadly with those obtained from analysis of the dental remains. While the two data sets correspond in terms of the mortality of animals under 12 months of age, the dental data imply significantly higher juvenile mortality, with a third of the herd dying prior to 24 months. Due to the higher susceptibility of infant post-cranial over mandibular remains to destructive forces, it is likely that the dental data provide a more accurate picture of mortality within these younger age categories. In contrast to the epiphyseal fusion data, which suggest that the majority of herd mortality occurred between 36 and 42 months, the dental data record relatively low mortality within this age group, with a total of 60% of the herd dying by 42 months, and the remaining 40% surviving as mature adults. The mortality profile revealed by the epiphyseal fusion data would not result in a viable herd, because there would be inadequate adult breeding stock to ensure growth in, or indeed maintenance of, herd numbers. The over 40% of stock retained as adults suggested by the dental data is taken as providing a more accurate estimate of the overall herd mortality pattern. With virtually no neonatal and infant deaths represented by the dental or epiphyseal fusion data, the younger age categories are clearly under-represented in the sample from Iron Age Büyüktepe Höyük.[84] This may be attributable to a variety of preservational and cultural influences. Infant bones are significantly less dense than adult specimens and are therefore more susceptible to destruction. In addition, due to their small size and greater propensity to fragmentation, infant bones may have less chance of recovery than adult specimens in non-sieved excavations (Payne 1972). Alternatively, neonatal and infant bones may be under-represented due to cultural reasons that might include mortalities away from the site or the removal of neonatal carcasses.

The mortality profile of the ovicaprids from Iron Age Büyüktepe Höyük does not appear to conform to the predicted herd profiles representative of secondary products herding (Payne 1973, 282). The low level of neonatal and infant mortality seems to preclude a herding strategy focused on milk production, while the levels of both infant and adult mortality appear to be too high and low respectively for a wool production profile. The Büyüktepe Höyük data instead bear the closest resemblance to the meat profile.[85] Generally the highest return of meat for the amount of fodder provided results if the animal is killed in its second or third year (Payne 1973, 281). The high mortality evident among juveniles therefore accords with a meat production strategy. In contrast to the males, most females in a herding strategy focused on meat production are retained as adult breeding stock. The herd mortality of approximately 60% prior to four years of age, and 40% surviving into maturity, thus conforms well with the meat scenario. When compared with an 'idealised' meat production profile, however, both infant and subadult mortality appear to be under-represented in the Büyüktepe Höyük sample. The over-representation in the dental data of the adult age class from Iron Age Büyüktepe Höyük relative to the model may have resulted from preservational and recovery biases against infant and immature specimens. Alternatively the higher representation of mature adults relative to the expected profile may have been a consequence of the herding of ovicaprids in order to permit some exploitation of secondary products including wool or milk.

7.4.5 *Ovis: Capra* Ratio

Sheep bones outnumbered goat specimens in a ratio of 7.45:1. The small number of goat specimens contributing to the fusion data does not permit examination of the relative ratio of sheep to goats in broad age groups.

7.4.6 Sex Ratio

Analysis of the sex ratios for the ovicaprid data provides further suggestions of herd management focused on primary production. Of the eight sheep pelvic fragments, all are female. As all the pelvic specimens utilised in the analysis came from adult animals, the results suggest that the majority of adults were female. Given the high frequency of subadult mortality suggested by the dental and epiphyseal fusion data, and assuming a 1:1 ratio of males to females at birth, the greater abundance of adult females, as suggested by the pelvic remains, may indicate that a greater proportion of males died prior to attaining maturity. The pelvic specimens therefore indicate that mortality was higher among subadult males than females. The lack of goat specimens does not permit investigation of gender ratios for this group.

A predominance of adult females over males would be expected where meat production constituted the principal focus of the herding strategy (Payne 1973, 281). This is due to the fact that while the surplus stock of both males and females may be culled for meat during subadult to early adult development, a greater proportion of adult females will be retained for breeding stock. The majority of the excavated ovicaprids from Büyüktepe Höyük died between their second and fourth year. The sex ratio suggests that this mortality occurred predominantly among males.

7.4.7 Butchery

Seven specimens (1.4%) within the excavated sample of ovicaprid bones from Iron Age Büyüktepe Höyük display evidence of butchery. A number of parallel, transverse chop marks are apparent on the fronto-medial surface towards the base of a goat horn core (4.0285). These marks may reflect an unsuccessful attempt to separate the horn core from the

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[84] See page 35 for discussion of natural mortality amongst infants and neonatals.

[85] See page 33 for a discussion of the characteristics of the wool, milk and meat profiles.

skull to facilitate later horn removal. Similar marks are apparent on ovicaprid horn cores from Early Bronze and Iron Age contexts at Sos Höyük. This specimen also featured a shallow cut mark on the frontal bone running almost parallel to the inter-frontal suture. This mark probably resulted from skinning activities.

A sheep humeral fragment (5.1299) displays a series of cut marks on the proximo-medial margin of the trochlea. These marks probably originated from an attempt to disarticulate the radius and ulna from the humerus. Ethnographic accounts suggest that marks of this nature can result from disarticulation of the radius and ulna during initial butchery of the carcass (Binford 1981, 124; Kent 1993). A proximal radial fragment (4.0340) displays evidence of a shallow cut mark on the medial edge of the proximal articulation. This mark most probably resulted from the same kind of activities that produced the marks on the distal extremity of the humerus involving the disarticulation of the radius and ulna.

Two further radial fragments (4.0210, 4.0380) display deep chop marks on the lateral and medial edges of the shaft adjacent to ancient breaks. These marks may reflect an attempt to shatter the bone in order to obtain the marrow.

Cut marks are evident on the dorsal surface of the distal trochlea of two tali (5.13130, 5.1652). These marks probably resulted from skinning activities that took advantage of the placement of skin against a non-meat-bearing bone. Tali reflecting similar marks were recovered from Early Bronze and Iron Age levels at Sos Höyük.

The low frequency of butchery marks in the assemblage of Iron Age ovicaprid specimens from Büyüktepe Höyük provides little scope for the reconstruction of carcass processing activities. The marks identified nevertheless suggest a variety of butchery activities including marrow extraction and the processing of carcasses.

7.4.8 Tools

Eight ovicaprid specimens (1.6%) bear modifications resulting from the manufacture of functional or decorative items. This is restricted to the first phalanges. Four ovicaprid (4.2002, 4.2003, 4.2004, 5.2007) and two sheep specimens (4.2000, 4.2005) each display a hole pierced medio-laterally through both the distal extremity and proximal shaft. The diameter of these holes varies in size from one to six millimetres. Two of these specimens also provide evidence of further modification. Specimen 4.2002 exhibits a series of shallow transverse cut marks arranged in a line down the dorsal surface of the bone and the smoothing of the plantar/volar surface, particularly about the distal extremity. Specimen 4.2003 similarly displays shallow transverse cut marks, although arranged somewhat more haphazardly, down the dorsal surface. Additionally, a small perforation passing into the central cavity of the bone is present mid way along the dorsal surface.

A further specimen (4.2006) exhibits what perhaps is an incomplete example of the modifications apparent on the other phalanges recovered. While a medio-lateral hole perforates the distal extremity, only faint signs of boring are apparent on the proximal portion of the shaft. A further ovicaprid phalanx displays modifications, although of quite a different nature. Specimen 4.2001 has a perforation running diagonally from the saggital groove of the proximal articular surface to the proximal portion of the plantar/volar surface of the bone. Similar modifications to first phalanges were found at both Early Bronze and Iron Age levels at Sos Höyük, although the specimens from Büyüktepe Höyük are distinguished by the relative uniformity in the placement of the perforations. Again, the function of these items is unclear.

7.4.9 Pathology

Evidence of pathological conditions is rare in terms of the total number of ovicaprid remains from Iron Age contexts at Büyüktepe Höyük (2.0%). Instances of pathology however are restricted to cranial remains, being apparent on ten of the ovicaprid mandibles (16.1%), with the result that the frequency of pathology is reasonably high within this group.

Plate-like deposits are apparent on the buccal surface of an infant sheep mandible, (4.0499; 8.3%) near the alveolar margin. This condition is particularly common among immature individuals, and is thought to reflect disturbances due to the development and eruption of the permanent cheek teeth (Levitan 1985, 50).

A single sheep mandible (4.0998; 8.33%) lacking a permanent second premolar, provides the only instance of partial anadontia. Recognised as occurring only when a tooth has never developed, the condition is most probably congenital. The absence of the second premolar is common among ungulates (Levitan 1985, 46).

An extremely well developed bony prominence is evident on the lingual surface of the mandible near the junction of the body and the ramus of two ovicaprid specimens (4.0849A-C, 4.0946; 3.2%) including one ovine mandible (4.0849A-C; 8.3%). Taken in conjunction with the fully erupted sequence of permanent cheek teeth and advanced wear on the third molars, individuals of advanced adult age appear to be represented. This condition is paralleled on a single sheep mandible from Early Bronze Age Sos Höyük.

A small perforation of approximately two millimetres diameter on the buccal surface of the mandible, oral to the mental foramen, was apparent in two ovicaprid specimens (4.0998, 4.0711; 3.2%) including one ovine mandible (4.0998; 8.3%). In both cases, the damage appears to have resulted from the penetration of the mandibular surface by the root of the unerupted second incisor. This may have resulted from the retarded evulsion of the deciduous tooth, premature maturation of the permanent tooth, or limited ramal space for the developing tooth (Levitan 1985, 49). Congenital disorders or developmental defects resulting from conditions such as malnutrition may also initiate or exacerbate such an occurrence.

Two ovicaprid mandibles (4.0608, 4.0946; 3.2%) including one sheep specimen (4.0608; 8.3%) display a small additional mental foramen. In each case a smaller foramen, approximately one millimetre in diameter, was situated on the lateral surface just oral to the second premolar. Extra foramina constitute a discontinuous trait, the occurrence of which is highly variable even within a single population (Levitan 1985, 48-9). The frequency of extra foramina was slightly lower than was apparent at Early Bronze levels at Sos Höyük, but comparable to that from Iron Age levels at Sos Höyük.

Dental calculus is apparent on four ovicaprid specimens (4.0027A-E, 4.0608, 4.0998, 4.0990; 6.4%), including three sheep mandibles (4.0027A-E, 4.0608, 4.0998; 25.0%). In all cases the degree of calculus is limited to small, light to medium deposits of less than three millimetres diameter, with the incidence being slightly higher on the lingual than on the buccal surfaces of the teeth. The incidence of calculus on the ovicaprid Iron Age remains from Büyüktepe Höyük is comparable to that from contemporaneous levels at Sos Höyük but higher than that from Early Bronze Age contexts at the same site.

Anomalous crown heights are displayed by five ovicaprid specimens (4.0757, 4.0608, 4.0849A-C, 4.0946; 5.1283; 8.1%), including one goat (4.0757; 50.0%), and two sheep mandibles (4.0608, 4.0849A-C; 16.7%). In all cases a minority of teeth are greater in height than the other teeth in the cheek tooth row. Three mandibles exhibit 'weave mouth' while a sheep specimen shows a 'step mouth' configuration. Three of the specimens have their highest crown heights in the area of the first and second premolars, while the peak occurs at the first molar in a single specimen. An extreme case is evident in a third molar, where the occlusal surface of the mesial cusp is over one and a half centimetres lower than that of the second cusp, while the distal ancillary cusp has not even come into wear. The frequency of anomalous crown height is comparable to that observed for Early Bronze Age ovicaprid remains from Sos Höyük, but somewhat higher than is apparent for the Iron Age remains from Sos Höyük.

Inter-dental attrition is apparent on four ovicaprid mandibles (4.0608, 4.0849A-C, 4.0946, 5.1492; 6.5%), including two ovine specimens (4.0608, 4.0849A-C; 16.7%). In all cases the condition is restricted to the first and second molars and is probably due to overcrowding, as all the mandibles represented adult animals with fully erupted cheek teeth. That overcrowding was responsible for the intra-dental attrition in these mandibles is further suggested by the single case of tooth rotation. Although inter-dental attrition may potentially result from congenital defects and developmental disorders, the first molar of the mandible 4.0946 also displays buccal rotation, a condition compatible with over crowding. The frequency of intra-dental attrition was lower than is apparent among the ovicaprid remains from either Early Bronze or Iron Age contexts at Sos Höyük.

Periodontal disease was apparent in two ovicaprid mandibles (4.0757, 4.0946; 3.23%) including one goat specimen (4.0757; 50.0%). Specimen 4.0757 displays a widening of the alveolus and loosening of all the permanent premolars. Mandible 4.0946 reflects advanced periodontal disease, as all of the premolars were lost ante-mortem and infilling of the alveoli with bone was in the final stages. The disease is also apparent on this specimen at the junction between the second and third molars by the widening of the alveolus. In both cases at Büyüktepe Höyük, periodontal disease is linked to the permanent teeth. The link between periodontal disease and permanent teeth was also detected by Levitan in his investigation of 1055 ovicaprid mandibles from first millennium AD contexts at West Hill (Levitan 1985). It was apparent from the West Hill mandibles that periodontal disease most frequently began with the eruption of the permanent premolars, particularly that of the fourth permanent premolar. The small sample size from Büyüktepe Höyük, however, precludes any definite conclusions regarding the influence of the eruption of permanent teeth on the occurrence of periodontal disease.

The small number of specimens from Büyüktepe Höyük makes it very difficult to identify patterns in the frequency of the various pathological conditions. Overall, however, the frequency of pathological conditions appears to be most comparable to that for the ovicaprid remains from Early Bronze Age Sos Höyük, but is slightly higher than is apparent for the Iron Age specimens from Sos Höyük. As with the ovicaprid remains from Early Bronze and Iron Age contexts at Sos Höyük, the incidence of the various pathological conditions in the dental remains tends to be concentrated on adult mandibles.

7.4.10 Summary

Small to medium-sized domestic sheep and medium-sized domestic goats were present at Büyüktepe Höyük during the Iron Age period. Although the sample size precludes separate analysis of the economic importance of these two species, an economy focused on primary products, but with some exploitation of secondary resources, is implied by the excavated ovicaprid sample as a whole. Evidence of butchery activities and carnivore gnawing is limited. While the dental remains reflect various pathological conditions, evidence of post-cranial pathologies is lacking. No suggestion of the presence of wild sheep or goat is provided by the excavated ovicaprid remains.

7.5 Domestic pig (*Sus scrofa* domesticus).

Fifty-four domestic pig specimens, representing an MNI of ten, were identified among the excavated remains from Iron Age levels at Büyüktepe Höyük (Tables 4, 13b, 18).

7.5.1 Differentiation of Wild from Domestic Specimens

Examination of the metrical characteristics of the assemblage was based on the length of premolar, molar and cheek tooth rows, and the length and breadth measurements of individual molars, due to the lack of post-cranial remains (Tables 18b-d). Shortening of the muzzle as manifested in reduction of the length of the cheek tooth row constitutes the principal means by which the process of domestication is observable in early domestic pigs (Flannery 1983). The specimens from Büyüktepe Höyük, comprising four mandibular (4.0314, 4.0724A-C, 4.0793, 4.0809A-Q) and three maxillary (4.0794, 4.0536, 5.0060A-M) remains, provide dimensions which fall significantly below those recorded for Near Eastern wild pigs (Flannery 1983, 170), and can thus be identified as domestic. In addition the dimensions of the mandibular fragments from Büyüktepe Höyük are of a size comparable to the domestic pig remains from Chalcolithic to Early Bronze Age Hassek Höyük, Iron Age contexts at Korucutepe, and Bronze and Iron Age Lidar Höyük, and are consistently smaller than the domestic pig maxillary and mandibular remains from Early Bronze II-III levels at Ikiztepe (Stahl 1989, Table 14; Boessneck & von den Driesch 1975, 104; Kussinger 1988, Table 33; Tekkaya & Payne 1988, 236). The pig remains from Büyüktepe Höyük thus appear to derive from animals of comparable size to domestic pigs from contemporaneous and earlier levels at other sites in eastern Turkey.

A number of specimens are too fragmentary to permit metrical analysis. Based on their relative size and morphology, however, no evidence of wild pig is apparent.

7.5.2 Mortality Profiles

The pig remains from Büyüktepe Höyük are principally confined to elements of the mandibular and maxillary region. Although derived from a sample of only six specimens, the mortality profile based on the mandibular remains provides a clear suggestion of predominantly preadult mortality (Table 54a). Five specimens died prior to 24 months, with the remaining specimen dying at between 24 and 48 months. It is not possible to test the validity of this data through analysis of epiphyseal fusion, due to the lack of post-cranial material. The figures obtained from the analysis of the dental data accord remarkably well with the 80% immature mortality expected of a characteristic meat production herd management strategy for pigs (Greenfield 1991, 179). In this system, the much greater food conversion efficiency of young, relative to adult, pigs dictates that the most effective economic strategy involves slaughter prior to the attainment of maturity (Rolett & Chiu 1988, 385). When compared to the Iron Age profile from Lidar Höyük, which comprises the only other pig mortality profile dating to contemporaneous contexts from eastern Turkey, a high level of concordance is apparent (Table 54b).

Further evidence of trends in the age structure of the excavated remains was obtained through morphological examination. The most complete cranial fragment excavated (4.0034 A-L) consists of the left and right frontal bones, the left and right parietal bones, the squamous part of the occipital bone, the squamous portions of the left and right temporal bones, and the presphenoid and basisphenoid bones. The immature age of this animal is indicated by the lack of development of the frontal sinuses, which typically penetrate the parietal bones in the adult (Getty 1978, 1239). Two further cranial specimens (4.0212, 4.0391) comprising the parietal and occipital bones preserved about the nuchal crest and a fragment of the left frontal bone, respectively, also exhibit immature development of the caudal frontal sinuses. No neonatal or infant bones were recovered, although this may be the result of the higher susceptibility of bones of this age class to destructive forces.

Pigs are unique among the modern domesticates because they are not herded for secondary products. As such, the mortality profile obtained from pig remains is uncomplicated by the influence of herding strategies directed toward a variety of outcomes. The extremely small sample size of pig bones from Büyüktepe Höyük dictates caution regarding any interpretation of herding practices. If, however, the excavated remains are representative of the population at Büyüktepe Höyük, they suggest that the majority of pigs died prior to attaining maturity. Indeed the third molar of the oldest specimen displays only minimal attrition on the enamel, and thus represents a animal not much beyond three years of age.

The problem of the absence of an adult breeding population may be explained in terms of the nature of the pig keeping strategy practised at the site. Pigs may be kept according to either sty husbandry or pannage. The former consists of an intensive system in which the pigs are permanently confined to sties and subsist on feed supplied by humans. By contrast, pannage involves the less intensive keeping of stock, which range freely in forest areas adjacent to the settlement and receive limited supplemental feeding. Pannage was the predominant system for pigs up to the eighteenth century A.D. (Zeder 1996, 302). While pannage may involve confinement of the sows within the settlement during gestation and suckling, this system is characterised by a general absence of adults from the settlement. By contrast, the sty system would involve the confinement of all the pigs within the vicinity of the site. The absence of mature adult pigs from the Büyüktepe Höyük sample may therefore indicate that these animals were not located within the vicinity of the settlement and were subsequently butchered in an extramural context, as would be likely for the pannage as opposed to the sty system.

7.5.3 Sex Ratio

Sexing of individuals is based on the morphology of the canines (Mayer & Lehr Brisbin, 1988). Of the five specimens identified to gender, four are from females (4.0192A-G, 4.0159, 4.0615, 4.0724A-C) and one from a male (4.0809A-Q). Despite the small number of specimens, a predominance of females is implied by the dental remains. Both of the female specimens that permit determination of age came from animals that died prior to 24 months, while the oldest mandibular specimen from the site came from a male animal. The possibility of predominantly preadult female mortality among the excavated remains may suggest that the adult female breeding stock was located away from the site. Although the small number of specimens clearly necessitates tentative conclusions, the gender and age of the female specimens may indicate that adult females died and were butchered in an extramural context.

Only three post-cranial specimens, comprising two second metatarsal bones (4.0102, 5.1419) and a first phalanx (5.1526) were recovered from Iron Age contexts at Büyüktepe Höyük. The extreme paucity of post-cranial remains may be the result of either preservational or cultural factors. As pig bones are larger and more robust than ovicaprid bones, the likelihood that all the post-cranial pig remains deposited at the site were destroyed either completely or at least beyond the point of permitting positive identification seems remote. In addition, while pig cranial bones tend to be more resilient to destructive forces than post-cranial elements, the excavation of the nearly complete, and extremely porous and soft, skull fragment

(4.0034A-L) argues against destruction forces alone accounting for the absence of post-cranial elements. The robustness and size of pig bones would in addition imply that pig specimens are no more likely than ovicaprid bones to be overlooked in non-sieved excavation (Payne 1975, 15). The lack of post-cranial elements therefore appears to have been the result of cultural influences related to the butchering of pig carcasses or to the selective removal and deposition of post-cranial bones in a predominantly extramural context. The former scenario would imply, however, that the consumption of pig flesh took place at the site, after the meat had been removed from the bone at an alternative location, as may have occurred in a pannage system.

None of the pig remains from Büyüktepe Höyük exhibit any direct evidence of butchery in the form of cut or chop marks.

7.6 Camel (*Camelus* sp.).

A single specimen identified as *Camelus* was recovered consisting of a right distal humerus (5.1587A-E; Tables 4, 21; Figure 33). Although the wild camel is now extinct in the Middle East, there is no definite evidence that the wild ancestor of either the dromedary or Bactrian camel occurred in Turkey (Mason 1984, 108; Uerpmann 1987, Figure 18). The specimen from Büyüktepe Höyük thus probably represents a domestic animal.

Originally domesticated in the region of Turkmenistan and Iran prior to 2500 B.C., the Bactrian camel, *Camelus bactrianus*, had spread to the south Urals and northern Kazakhstan by the mid second millennium, to western Siberia by the tenth century, and to the Ukraine by the ninth century B.C. (Gauthier-Pilters & Dagg 1981, 129; Mason 1984, 108). Assyrian royal inscriptions document the spread of the domestic Bactrian camel further south into Iran and Mesopotamia beginning in the eleventh century B.C., and artistic evidence may imply an earlier date in the second millennium (Wapnish 1984, 174).

The dromedary, *Camelus dromedarius,* is likely to have been domesticated in the Arabian peninsula, although this date is currently disputed (Gauthier-Pilters & Dagg 1981, 115). It is nevertheless clear that the distribution of the dromedary was limited prior to 1100 B.C. Within Turkey the domesticated dromedary was known by the seventh and sixth centuries B.C. from Neo-Hittite Carchemish, and appears to have spread into Anatolia with the expansion of the Persian empire (Zeuner 1963, 347). At present both dromedary and Bactrian camels occur in north-east Turkey (Mason 1984, Figure 13.1). Both species may potentially have been utilised in the region of Büyüktepe Höyük during the Iron Age.

Considerable uncertainty exists regarding the taxonomy of the domestic camel. On the basis of various anatomical and physiological traits, it is currently unclear whether the dromedary and Bactrian camels represent morphological variants of the same taxon or distinct species (Mason 1984, 106). Furthermore, difficulties exist regarding separation of the post-cranial skeleton of dromedary and Bactrian camels, with no criteria proving consistently reliable for differentiation of the two varieties (Wapnish 1984, 181). Physical differences between dromedary and Bactrian camels, as embodied in the shorter, stockier stature of the latter, have been used with variable success as a means of separation, as high individual variation in both Bactrian and dromedary camels obscures consistent differences. Applications, such as Lesbre's criteria for separation based on a length/breadth index of the limb bones, are clearly inapplicable to the fragmentary specimens recovered in many archeological contexts. The specimen from Büyüktepe Höyük was compared to skeletons of both *C. bactrianus* and *C. dromedarius* and was found to display no features that permitted it to be conclusively assigned to either species.[86]

Ecologically, at least, the Bactrian camel appears to be more suited to the environs of Büyüktepe Höyük than does the dromedary. Bactrian camels are adapted to the low winter temperatures and rugged, mountainous topography of the central Asian steppe (Wapnish 1984, 174). By contrast, dromedary camels are poorly adapted to cold and wet environments, in which they are highly susceptible to fatal respiratory infections resulting in particularly high neonatal and infant mortality (Russell 1988, 57). Dromedary camels instead prefer hot, desert plains as exemplified by their distribution throughout north Africa and the Middle East (Mason 1984, 107; Wapnish 1984, 174). The possibility exists however that dromedary camels were at the site only seasonally during the drier summer months.

Camel bones are rarely represented at sites in Anatolia. Specimens of camel unidentified to species have been recorded from Medieval levels at Korucutepe and from Middle Bronze to Hellenistic/Roman Lidar Höyük (Boessneck & von den Driesch 1975, 97; Kussinger 1988, 132). The recovery of few or isolated camel specimens is not an uncommon feature of archaeological sites as, for various physiological and functional reasons, they are not traditionally closely linked to urban settlements. The slow breeding and valuable status of camels as transport and pack animals ensures that they are only slaughtered when necessary, while, perhaps due to their odour, these caravan animals tend to be maintained extramurally (Mason 1984, 109 after Köhler 1981; Zeuner 1963, 363). Furthermore due to their connection with nomadic economies and general use as pack and transport animals, camels have tended to serve an extra-urban function and are consequently poorly represented in urban contexts (Compagnoni & Tosi 1978, 100). It is thus extremely difficult to extrapolate the precise frequency, function and importance of camels at Büyüktepe Höyük. The camels are nevertheless likely to have fulfilled a transportation function, either for the settlement itself or as part of a passing caravan or trade group.

7.7 Domestic dog (*Canis familiaris*).

Two specimens, representing an MNI of one, were identified as domestic dog from Iron Age levels at Büyüktepe Höyük (Tables 4, 19). These comprise an atlas fragment (5.0033; Table 19d) and a left femur (4.0639; Table 19k) lacking the

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[86] Comparative skeletons included a *Camelus bactrianus*, R1559, and *C. dromedarius*, R5444, specimen from the Museum of Victoria.

proximal extremity and exhibiting a severely eroded distal epiphysis. The atlas fragment (5.0033) from Büyüktepe Höyük exhibits a size and proportion similar to the largest domestic dog atlas from Early Bronze Age Sos Höyük and is also comparable to specimens from Middle Bronze to Iron Age Lidar Höyük (Kussinger 1988, Table 45). Measurements from the femur are comparable to those of specimens from an undated context at Korucutepe and from Middle Bronze and Hellenistic/Roman contexts at Lidar Höyük, as well as to the larger specimens of Late Roman/Byzantine date from Didyma (Boessneck & von den Driesch 1975, Table 28; Kussinger 1988, Table 45; Boessneck & Schäffer 1977, Table 18h).

Withers heights estimations could not be determined for the dog bones from Büyüktepe Höyük due to the absence of complete long bones. Similarity between the dimensions of the two specimens from Büyüktepe Höyük and those from Korucutepe and Lidar Höyük, however, may imply that medium-sized dogs are represented.

No evidence of butchery was observed on the specimens. The function of the domestic dogs from Iron Age levels at Büyüktepe Höyük is unclear, although they may have assisted with hunting or herding activities.

7.8 Chicken (*Gallus gallus* domesticus).

Four domestic chicken bones were recovered from Iron Age levels at Büyüktepe Höyük (Tables 4, 20). These consist of a proximal humeral fragment (5.1384; Table 20a), a radius lacking the proximal extremity (4.0961; Table 20b), a female right tarsometatarsus (4.0153; Table 20c; Figure 49ii), and a synsacrum fragment preserving a portion of the ischium and ilium (4.0449). The breadth of the proximal humerus is comparable to that of specimens from Hellenistic/Roman and Middle Age levels at Lidar Höyük and is slightly larger than that of a specimen from Late Bronze I-II levels at Korucutepe (Kussinger 1988, Table 75; Boessneck & von den Driesch 1975, Table 29). This indicates the presence of a medium-sized chicken. The measurements from the tarsometatarsus are considerably smaller than those of female specimens from Iron Age Sos Höyük and from Middle Ages levels at Lidar Höyük (Kussinger 1988, Table 76). This specimen thus represents a small sized chicken. Both small and medium sized chickens therefore appear to be represented at Büyüktepe Höyük during the Iron Age period.

The domestic chicken was common in the Near East by the Iron Age period (Mason 1984, 301), although their function within the agricultural economy remains unclear. Whether they were maintained for cock fights, as a source of eggs, feathers and meat, or held some religious significance cannot be ascertained given the limited nature of the evidence.[87]

Wild Taxa

7.9 Bison (*Bison bison*).

A single specimen tentatively identified as bison was recovered from Iron Age contexts at Büyüktepe Höyük (Tables 4, 22a). Using comparative skeletons, and characteristics outlined by Balkwill and Cumbaa (1992) for the separation of bison and cattle post-cranial elements,[88] the large bovid bones from Büyüktepe Höyük were examined to detect the possible presence of bison among the Iron Age remains. Only one fragment, a distal radius (4.0128; Figure 34) exhibits features compatible with the remains of bison. As bison bones display a tendency to greater robustness and size than domestic cattle bones, the considerable size and robustness of this specimen suggest that it is representative of the former. The specimen also displays the convex medial edge on the styloid process of the ulna, seen in bison. This is in contrast to the flat edge typical of *Bos*. As the dorsal edge of the articular surface, however, has a linear rather than concave appearance (representative of domestic cattle and bison, respectively), and as a considerable degree of overlap exists between the characters of *Bos* and *Bison* bones, the identification remains tentative. This specimen displays no evidence of butchery.

7.10 Red deer (*Cervus elaphus*).

Seven red deer specimens, representing an MNI of four, were identified among the excavated remains from Büyüktepe Höyük (Tables 4, 23). These consist of an antler beam fragment (4.0001), an antler burr fragment (4.0814), four further antler fragments lacking diagnostic features (4.0337, 4.0120, 4.1534A, 4.1541), and a radial fragment (4.0154).

The red deer was widely distributed throughout Anatolia from the Neolithic periods onwards.[89] Red deer are highly adaptable to a wide diversity of habitats with a preference for woodland and adjacent grassland (Bjärvall & Ullström 1986 184).

The antler fragment (4.0814) preserves the proximal portion of the antler incorporating the burr. As this specimen constitutes a cast antler it provides no direct link between the inhabitants of the site and the animal. The proximal surface, or seal of the cast antler displays a distinctly convex surface. As the shape of the seal correlates well with the maximum testosterone levels in the blood achieved by the male deer in the previous rut, the convex morphology suggests a strong stag of high prime age, holding a dominant rank within the herd (Bubenik 1990b, 477; Bubenik 1990b, 476; Bubenik 1990a, 67; Bartos 1990, 458). The circumference of the burr is representative of a medium to large antler, comparable in size to specimens from Late Bronze Age to Neo-Hittite Arslantepe and Late Bronze Age Lidar Höyük (Bökönyi

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[87] See page 66 for a discussion of the roles of the chicken.

[88] See page 41.

[89] See page 43 for a discussion of the distribution and vegetational preferences of red deer.

1993, 349; Kussinger 1988, Table 53). The specimen from Büyüktepe Höyük is also somewhat larger than specimens dating to the Early Bronze II period from Korucutepe, Middle Bronze Lidar Höyük, and Early Bronze Age Sos Höyük (Boessneck & von den Driesch 1975,124; Kussinger 1988, Table 53; See Table 23a). However, as there has been shown to be no correlation between antler size and body weight (Bartos 1990, 459), the stature of the animal remains uncertain. This specimen displays an extensively chopped region on the surface opposite the seal, where the burr had been removed from the antler presumably so that the latter could be worked.

Three further antler fragments display evidence of modification. The antler beam fragment (4.0001) shows evidence of the removal of sections of the beam leaving two flat regions around the periphery. Two additional antler fragments (4.1534A, 4.1541) were recovered that preserved no diagnostic features, although the size of both suggests that they derived from reasonably robust antlers. Both specimens exhibit chop marks and intentional modification, presumably resulting from efforts to obtain fragments for the manufacture of tools or ornaments.

The single post-cranial specimen excavated comprise a left distal radius fragment (4.0154; Table 23b). Based on distal breadth, this specimen is smaller than those from Chalcolithic to Early Bronze Age Hassek Höyük but of comparable size to the smaller red deer from Late Bronze Age levels at Korucutepe and Hellenistic/Roman Lidar Höyük (Stahl 1989, Table 37; Boessneck & von den Driesch 1975, 128; Kussinger 1988, Table 53). The small size of this specimen may imply that it came from a female. The recovery of a single post-cranial specimen suggests that at least some deer may have been hunted during the Iron Age period at Büyüktepe Höyük. The greater frequency of antler remains and the worked nature of those specimens nevertheless indicates that the red deer were valued primarily for their antlers. Their exploitation may have been in the form of direct hunting, scavenging of carcasses, or the retrieval of cast antlers. Evidence of at least one cast antler establishes the possibility of no direct link between the site's inhabitants and at least some of the red deer represented. A similar picture of exploitation is provided by the red deer remains from Early Bronze Age levels at Sos Höyük, where again worked pieces of antler substantially outnumber post-cranial remains.

7.11 Eurasian badger (*Meles meles*).

Three cranial fragments of badger, representing an MNI of two, were identified among the excavated remains from Büyüktepe Höyük (Tables 4, 27). These comprise the lateral portion of a skull including fragments of the maxillary and zygomatic bones and the upper first molar (4.0523A-B; Table 27a), an aboral mandibular fragment preserving the lower first molar (4.0523C; Table 27b; Figure 38), and a cranial specimen (4.0421A-B) preserving fragments of the frontal, parietal and zygomatic bones. This last specimen is too fragmentary to permit the taking of meaningful measurements, although based on the unfused sutures and thin nature of the bones, it appears to represent an infant. The greatest length of the lower first molar from Büyüktepe Höyük is indicative of an animal slightly larger than that represented at Early Bronze Age Arslantepe (Bökönyi 1993, 353). The dimensions of the Büyüktepe Höyük specimen are suggestive of an animal tending toward smaller stature and may, like the Arslantepe mandibular specimen, represent a female.

Badgers favour deciduous woodland,[90] and may have been hunted for their meat and pelt.

7.12 Marbled polecat (*Vormela peregusna*).

A single specimen (4.0669) of marbled polecat was identified consisting of a skull lacking portions of the zygomatic processes as well as the incisors, canines and first and second premolars (Tables 4, 29; Figure 41a-b). The large size of the specimen combined with the pronounced ridges and angular morphology of the cranium, and the well developed postorbital processes and saggital crest reflect a male animal (Harrison 1991, 130). The marbled polecat is spread from south-east Europe, southern Russia and Turkey through Iran to northern China and Mongolia, although their numbers have decreased due mainly to habitat destruction and a decline in the numbers of steppe rodents because of human disturbance (Harrison 1991, 131; MacDonald & Barrett 1993, 119). Within Turkey, distribution is mainly concentrated in the south, from central to eastern Turkey, with isolated occurrences along the Black Sea coast (Niethammer & Krapp 1993b, Figure 230A). Remains of the marbled polecat are extremely poorly represented archaeologically, consisting of only two post-cranial specimens from Hellenistic levels at Lidar Höyük (Kussinger 1988, 174). This implies that this species was reasonably rare in areas of human habitation in antiquity. While showing high adaptability to a diversity of habitats ranging from wooded river valleys and forest edges, to semi-arid lands, the marbled polecat shows a preference for dry and open biotopes including steppe and cultivated lands (MacDonald & Barrett 1993, 118; Parker 1990, 408).

7.13 Asia Minor suslik (*Citellus xanthoprymnus*).

Two cranial specimens of the Asia Minor suslik were identified among the excavated remains from Büyüktepe Höyük (Table 4). Although single specimens of *C. xanthoprymnus* are virtually indistinguishable from *C. citellus,* the widely separated zygomatic arches, relatively narrow interorbital space, and the narrow postorbital and temporal width of the excavated specimens, are suggestive of the former species (Vinogradov & Argiropulo 1968, 102). Distributed throughout modern Turkey, the Asia Minor suslik inhabits mountain steppe at altitudes of 1500-2500 metres above sea level. The burrowing behaviour of this species and the fact that the bones failed to display the discolouration characteristic of associated specimens, make it likely that the recovered examples constitute intrusive

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[90] For a more extensive discussion of the distribution and habitat preferences of the badger see page 68.

specimens.

7.14 Mountain mole rat (*Nannospalax nehringi*).

Six specimens, representing an MNI of four, were identified, comprising three cranial fragments (4.0969, 5.1542, 5.1672A-B), two almost complete left mandibles (4.0770, 5.1442), and the oral region of a right mandibular fragment (4.0751; Table 4). The burrowing nature of this species and the excellent preservation of the specimens argue for their probable intrusiveness.[91]

7.15 Turkish hamster (*Mesocricetus brandti*).

Three specimens were identified as *Mesocricetus brandti*, including a highly fragmentary cranial specimen (4.0442A-N), a cranium preserving the oral regions (5.1462), and a right mandibular specimen (4.0485; Table 4). Due to the lack of discolouration on these specimens relative to associated finds, and the burrowing habits of the species concerned, they were considered to be intrusive.[92]

Birds

7.16 Mallard (*Anas platyrhynchos*).

Two adult mallard bones were identified, including a left distal humeral fragment, (4.0767) and a further left humerus lacking only a portion of the proximal extremity (5.1464; Tables 4, 33a).[93] Both specimens are comparable in size to a humerus from Medieval levels at Korucutepe (Boessneck & von den Driesch 1975, 150).

7.17 Golden eagle (*Aquila chrysaetos*).

A single adult golden eagle bone was recovered consisting of a left coracoid lacking the furcular facet, lateral angle, and the acrocoracoid and procoracoid processes (4.0019; Tables 4, 35; Figure 45ii).[94] Lack of comparative measurements precludes further analysis of the relative size of this specimen.

7.18 Grey partridge (*Perdix perdix*).

Two specimens of grey partridge were recovered from Iron Age levels at Büyüktepe Höyük (Tables 4, 36). These included a left femur lacking the proximal extremity and a portion of the distal extremity (4.0112; Table 36a) and a left tibiotarsus lacking the proximal extremity and a portion of the distal epiphysis, (4.0348; Table 36b). The femur is comparable to single specimens from both Middle Bronze II levels at Korucutepe, and Early Bronze Age Demircihüyük (Boessneck & von den Driesch 1975, 153; Boessneck & von den Driesch 1987, 47).

The grey partridge is the most widespread of the partridges and is widely distributed across Europe and Eurasia. Modern distribution within Turkey is confined to the western regions. Grey partridge remains have been recovered from Chalcolithic to Early Bronze Norşun-Tepe, Middle Bronze II levels at Korucutepe and Early to Middle Bronze Demircihüyük (Boessneck & von den Driesch 1976b, Table 1; Boessneck & von den Driesch 1975, 153; Boessneck & von den Driesch 1987, 47). Essentially a ground dweller, the grey partridge does not tend to inhabit arboreal habitats, instead preferring the low vegetational coverage characteristic of arable land, steppe, and heaths (Heinzel, Fitter & Parslow 1995, 116). The species tends to avoid semi-desert, precipitous and rocky terrain, swamps, marshes and forests (Cramp 1980, 487). Grey partridges can be commensal, tolerating a reasonable degree of human disturbance. Due to its favouring of arable lands, its presence at Büyüktepe Höyük would be consistent with the propinquity of cultivated lands to the settlement. The species may have been hunted as a game bird. The specimen displays no evidence of butchery.

7.19 Carrion crow (*Corvus corone*).

A single specimen was identified as carrion crow, consisting of a left coracoid lacking the furcular process and lateral angle (5.1445; Table 4).

Carrion crow is widely distributed throughout Europe and the Middle East (Cramp 1994, 172). *Corvus corone* remains have been excavated from Late Bronze I-II Korucutepe, Chalcolithic and Early Bronze Age Norşun-Tepe, and Chalcolithic and Bronze Age Tültintepe (Boessneck & von den Driesch 1975, 155; Boessneck & von den Driesch 1976b, Table 1).

The opportunistic nature of the carrion crow and its omnivorous diet permits the occupation and exploitation of a vast diversity of habitat types and ecosystems, including sub-arctic, boreal, temperate, Mediterranean, steppe and desert habitats from lowlands to mountainous zones. The presence of this species at Büyüktepe Höyük therefore imparts little information regarding the environment surrounding the site. The commensal habits of the crow may imply that its occurrence at Büyüktepe Höyük was due merely to chance rather than from hunting.

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[91] See page 45 for a review of this species.

[92] See page 45 for a review of this species.

[93] See page 46 for a review of the distribution and habitat preferences of this species.

[94] See page 46 for a review of this species.

7.20 Summary of the Faunal Assemblage from Iron Age Büyüktepe Höyük.

The assemblage from Iron Age levels at Büyüktepe Höyük reveals an emphasis on domestic taxa with cattle and ovicaprids being the most abundantly represented species. These taxa were managed according to a primary products herding strategy, although secondary products, and traction or cartage work in the case of cattle, appear to have have been exploited as well. These species also contributed to the economy of the settlement in terms of such resources as hides, marrow and bones for tool manufacture. Pig, dog and chicken are also represented, although in significantly lower numbers than the cattle and ovicaprids. As was the case with the other assemblages studied, evidence of butchery and pathological conditions is reasonably infrequent. The horse, camel and possibly also ass probably served a transportation function. The role of the horse may have been related to the apparently military function of the tower.

Wild taxa are poorly represented. The presence of aurochs, hemione, red deer and possible bison bones suggests that some exploitation of larger wild taxa took place, although it is unclear to what degree these taxa contributed to the subsistence requirements of the settlement's inhabitants. In the case of red deer, antler appears to have formed the focus of exploitation. Small mammals and birds are represented by a limited number of finds. These taxa may have contributed hides and feathers in addition to meat.

Chapter 8
DISCUSSION

The assemblages from Early Bronze Age and Iron Age Sos Höyük and Iron Age Büyüktepe Höyük are further analysed to compare the similarities and differences between the various features of the economies. These features are also placed within the context of assemblages from contemporaneous levels elsewhere in Anatolia in order to establish if the two sites studied provide any evidence for the presence of economic traditions in northeast Anatolia that differed from those elsewhere during the same periods. The extremely limited size of the sample from Early Bronze Age levels at Büyüktepe Höyük largely precludes the inclusion of the results from that assemblage in the analysis.

8.1 Wild:Domestic Ratio

The relative representation of domestic to wild species from Early Bronze Age Sos Höyük and Iron Age Sos Höyük and Büyüktepe Höyük are presented in terms of NISP, MNI and weight (Figure 13). Examination of the results reveals a consistently low level exploitation of wild resources across all three assemblages, in terms of both the NISP and weight. By contrast, the MNI values show a greater emphasis on wild resources than is apparent from either the NISP or weight. Given the nature of the samples involved, with wild species represented by few specimens, relative abundance as measured by NISP and weight can be expected to more readily reflect actual proportions. This is due to the fact that an MNI measure based on few or single specimens tends to overemphasise the relative importance of the species concerned (Grayson 1973).

Figure 13 suggests that there was little change in emphasis in terms of the relative exploitation of wild to domestic species from the Early Bronze to Iron Age periods at Sos Höyük.[95] Nevertheless, based on the NISP counts, a small decrease in the exploitation of wild resources is apparent from the Early Bronze to Iron Age periods.

A small difference is also evident from the graph in terms of the proportion of wild to domestic specimens from Iron Age levels at Sos Höyük and Büyüktepe Höyük, with the Büyüktepe Höyük sample illustrating a slightly greater relative exploitation of wild resources than is apparent at Sos Höyük. Although it appears that wild resources may have been exploited to a greater extent at Büyüktepe Höyük during the Iron Age, the relatively small difference in the abundance of domestic to wild specimens between the two sites does not suggest a significant variation in economic strategies.

All three assemblages provide clear evidence of an overwhelming emphasis on domestic taxa for subsistence needs. This conclusion is supported by the nature of the wild remains identified. The majority of wild taxa across all three assemblages are represented by few finds. These taxa appear to have been exploited at only a very low level and in some cases may represent opportunistic additions to the diet. In addition, it is possible that a number of the wild species represented, including the red fox, weasel and marbled polecat, may have been commensal, and therefore may represent natural as opposed to cultural additions to the assemblage. A number of the rarer taxa may also have been exploited for non-dietary purposes such as the provision of skins or feathers.

Of those taxa that are more abundantly represented, there exists little evidence that they contributed significantly to subsistence requirements. Red deer, which figure among the more abundant wild remains from both Early Bronze Age Sos Höyük and Iron Age Büyüktepe Höyük, are mostly represented by antler fragments, which constitute 78% and 86% of red deer specimens, respectively. The red deer remains display no evidence of butchery marks in terms of the preparation of carcasses for consumption. Instead, of the antler fragments, six specimens (67%) from Sos Höyük and four specimens (57%) from Büyüktepe Höyük exhibit modifications that resulted from the use of antler in the manufacture of tools or decorative objects. This species therefore appears to have contributed in only a minor capacity to the subsistence needs of the settlements' inhabitants and instead functioned primarily as a source of raw material for the manufacture of utilitarian items.

The presence of hare, turtle and various bird species nevertheless suggests that a number of wild animals may have contributed to the diet. Again, evidence of butchery marks is absent on bones from these species, although this does not preclude their use as a meat source. Overall, wild species appear to have occupied a minor role in the subsistence activities of the inhabitants of Sos Höyük and Büyüktepe Höyük. Indeed, the main function of the non-domesticates may have comprised the provision of raw materials such as antler and skins.

When the relative abundance of wild to domestic specimens from Sos Höyük and Büyüktepe Höyük are compared to contemporaneous Anatolian sites for which figures were available, it was clear that the level of exploitation is fairly uniform both spatially and temporally. The ratio of wild to domestic animals from the Early Bronze Age levels at Sos Höyük are comparable to those from Chalcolithic levels at Hassek Höyük, Chalcolithic and Early Bronze Age levels at Hayaz Höyük, Early to Late Bronze Age levels at Lidar Höyük, and Middle II to Late Bronze I-II levels at Korucutepe (Stahl 1989, Table 2; Buitenhuis 1985; Kussinger 1988, Table 1; Boessneck & von den Driesch 1975, Table 3). The Early Bronze Age assemblage from Sos Höyük, however, does suggest less dependence on wild resources than those from Early Bronze levels at Korucutepe and Gritille (Boessneck & von den Driesch 1975, Table 3; Stein 1988, Table 5.1).

The ratio of wild to domestic specimens from Iron Age levels at both Sos Höyük and Büyüktepe Höyük are comparable to contemporaneous contexts at both Lidar Höyük and Korucutepe. The level of exploitation of wild and domestic resources within the studied assemblages therefore accords with levels observed at contemporaneous contexts elsewhere. This uniformity is particularly interesting when the topographical and climatic diversity of these sites is considered, ranging from low altitude to

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[95] Statistical tests were not performed on these comparisons due to the difficulties of interdependence in NISP counts.

highland sites, with climates as disparate as semi-arid, Mediterranean and continental. The consistently low level of exploitation may have resulted from a reduction in the proximity of habitat suitable for some wild species through processes including increased agricultural intensification, land clearance and deforestation for wood resources, with the result that many wild taxa were confined to more remote and perhaps inaccessible environments. The small number of specimens representative of wild taxa from Sos Höyük and Büyüktepe Höyük, however, precludes further analysis of this possibility.

8.2 Environmental Setting

The environmental setting of a given site is important in terms of assessing the wild taxa that may have been available for exploitation in the region and in providing insight into the relative suitability of different domestic species. Reconstructions of the environment are necessarily dependent on the species recovered in the context of the site. A large proportion of the taxa that characterise the ecosystem in which the site is located may therefore be unrepresented in the faunal assemblage. In addition, the presence of species that display wide environmental tolerance provides little insight into the specific features of the ecosystem that they inhabited. Given due consideration of the limitations of the data, the presence and abundance of different taxa within the assemblage may nevertheless be utilised to reconstruct aspects of the environment.

The presence or absence of wild species is of obvious value in environmental reconstruction due to the narrow habitat preferences of many species. Wild taxa recovered in Early Bronze Age contexts at Sos Höyük variously display preferences for both open and wooded environments. Species including the whitefront goose, white stork, marsh harrier, golden eagle, little owl, chukar and great bustard favour open terrain including steppe, grasslands and agricultural lands (Heinzel, Fitter & Parslow 1995). Conversely, the bison, aurochs, red deer, wild pig and brown bear favour principally wooded environments, including coniferous and deciduous forests, juxtaposed with open terrain for feeding (Bjärvall & Ullström 1986; MacDonald & Barrett 1993). These wild taxa thus suggest a habitat mosaic encompassing open terrain such as steppe and agricultural lands, as well as more wooded areas.

The presence of a number of species imparts specific information concerning the environs of the site. The golden eagle, white stork and marsh harrier avoid dense vegetation and woodlands. The white stork and marsh harrier, in addition, display a preference for shallow still or slow flowing bodies of water, implying the proximity of these features to the site and linking these species to the plain or lower slopes in which such features are more likely to be located. The simultaneous avoidance of woods and favouring of still and slow moving water by these species may further suggest that these features of the environment were separated spatially, with the bodies of water located in the plain and the woods confined predominantly to the mountain slopes and more inaccessible regions. The impression of wooded regions located away from the site is furthermore implied by the nature of the wild taxa that reflect a preference for wooded environments. All of these species, including the brown bear and red deer, comprise larger animals that would have displayed reclusive behaviour in reaction to human activity. These species are likely to have favoured regions that provided the maximum degree of cover and minimum degree of human contact. Clearly the mountainous regions surrounding the plains of Sos Höyük and Büyüktepe Höyük would have provided the most favourable habitat.

Little change in the habitats surrounding Sos Höyük are apparent from the Iron Age remains. A mosaic is again implied by species such as the Eurasian badger and fallow deer, with deciduous woodland juxtaposed with pasture or steppe providing the most likely association. The presence of beaver, which inhabit floodplains in valley floors and favour willow, aspen and poplar trees for construction of their lodges, suggests that stands of deciduous trees were present in the plain. The presence of brown hare and quail again imply open habitats including grassland, farmland or steppe. A similar mosaic is apparent at Büyüktepe Höyük during the Iron Age period. Red deer, bison, aurochs and badger suggest wooded terrain associated with grass or agricultural lands, while the marbled polecat, golden eagle, grey partridge and carrion crow have a preference for open habitats.

The environment surrounding Sos Höyük thus appears to have remained relatively unchanged from the Early Bronze to Iron Age periods in terms of its vegetation systems. There appears, furthermore, to be some similarity between the vegetational environments surrounding Sos Höyük and Büyüktepe Höyük in the Iron Age period. The small sample sizes of wild taxa from all three assemblages, however, precludes further analysis of differences in relative representation and abundance.

8.3 Domestic Abundance

Trends in the abundance of the main domesticates for each assemblage may provide insight into changes in the focus of subsistence strategies through time that may be commensurate with cultural differences (Figure 14a-c). When the relative abundance of the main domesticates from the three assemblages is compared in terms of both NISP and MNI counts, a clear predominance of ovicaprids is apparent, followed typically by cattle, with pigs and horses relatively poorly represented. Ovicaprids therefore comprise the most abundant exploited taxa at Iron Age Büyüktepe Höyük and Early Bronze and Iron Age Sos Höyük.

The MNI counts indicate that there was little change in the relative abundance of the main domesticates from the Early Bronze to Iron Age periods at Sos Höyük. By contrast, both NISP and bone weight suggest that cattle decreased in importance relative to sheep and goats over this period. The Iron Age ovicaprid assemblage however included a deposit that comprised the virtually complete skeletons of a number of ovicaprids. As a result, it is likely that the MNI counts provide a more accurate picture of relative species abundance as, in contrast to the NISP, the total MNI for the ovicaprid assemblage would not be affected by this deposit. It therefore appears that a comparable emphasis on ovicaprid herding, supplemented by cattle, was practised at Sos Höyük during both the Early Bronze and Iron Age periods.

The Iron Age sample from Büyüktepe Höyük reflects a number of differences in relative species abundance when compared with that from Sos Höyük. Based on MNI and weights, ovicaprids appear to have been relatively less important at Büyüktepe Höyük than they were at Sos Höyük for the same period In terms of MNI, cattle similarly show a slight decrease in importance at Büyüktepe Höyük relative to Sos Höyük. This is probably due primarily to the fact that pigs are more abundant relative to cattle and ovicaprids at Büyüktepe Höyük than Sos Höyük in terms of NISP, MNI and weight. This suggests that a slightly greater emphasis was placed on pig keeping at Büyüktepe Höyük than at contemporaneous levels at Sos Höyük. The MNIs suggest an even greater importance of pigs relative to ovicaprids and cattle than is indicated by weight or NISP. This is due primarily to the fact that the pigs in the Iron Age sample are represented predominantly by mandibular remains which yielded a high MNI relative to the size of the entire sample. Assuming that these cranial remains were ultimately representative of entire animals herded at the site, it is likely that the MNI value provides a more accurate estimate of pig abundance.

Examination of the abundance of the main domesticates at Sos Höyük and Büyüktepe Höyük in relation to various sites throughout Anatolia was conducted by compiling a tripolar graph (Figure 15).[96] The sites form a fairly homogeneous cluster on the right hand side of the graph with low to medium percentages of cattle, medium to high percentages of ovicaprids and consistently very low percentages of pigs. When the sites are considered in terms of environmental and climatic factors, various trends in relative species abundance are apparent from the diagram.

With the exception of Early Bronze Age Karataş-Semayük and Hassek Höyük and Iron Age Korucutepe, sheep and goats emerge as the most abundant taxa at every site, although this predominance varies from between 46% to 80%. The favouring of ovicaprids as the principal herded domesticate may have occurred for two reasons. Firstly, these animals are able to adapt to a wide diversity of habitats, and secondly they provide multiple products. The suitability of ovicaprids to marginal environments including steep and mountainous terrain and their ability to graze very low vegetation allow for the utilisation of the hilly lands adjacent to the plains in which the majority of the sites are located. As neither cattle nor pigs can effectively utilise these regions, the keeping of ovicaprids allows for the exploitation of what would be an otherwise underutilised resource. Sheep and goats may also yield a variety of products including milk, wool, hair, meat, hides and horn. An emphasis on the herding of ovicaprids could potentially provide a wide array of returns. Both Sos Höyük and Büyüktepe Höyük display an intermediate abundance of ovicaprids relative to the other sites. This may be attributed to the additional suitability of the upland environments of these sites for the keeping of cattle.

With the exception of Early Bronze Age Lidar Höyük, sites from semi-arid ecosystems show a consistently lower abundance of cattle, relative to sheep and goats, than is apparent at either Sos Höyük or Büyüktepe Höyük. This accords well with the fact that cattle have a lower tolerance for semi-arid conditions (Spooner 1973, 8), and thus will tend to occupy a less significant role in the subsistence strategies of herders occupying such areas. This is in part due to the high water requirements of domestic cattle. Animals kept in the semi-arid lowland regions of east Africa are able to survive only two to three days without water, after which they require twenty to thirty litres per animal (Dahl & Hjort 1976, 239). The higher altitude, lower temperatures, and decreased aridity of the highlands surrounding both Sos Höyük and Büyüktepe Höyük would clearly favour the herding of a greater proportion of cattle than at sites in semi-arid environments. The location of many of these sites on plains adjacent to mountain ranges would also limit the grazing land available for cattle, as the species is best suited to flat ground or land with only low undulations. In addition, their method of feeding in which they wrap their tongue around the grass, in contrast to the close grazing undertaken by ovicaprids, would favour the lush grasses more characteristic of the better watered and deeper soils of plains, in contrast to the lower and poorer vegetation characteristic of hill slopes.

With pig abundance ranging from between one to twenty percent at most sites, a clear concentration on domestic cattle and ovicaprids is evident. The consistently low representation of pigs suggests strong cultural or ecological pressures discouraging the large scale herding of pigs during the Early Bronze and Iron Age periods. The relatively low representation of pigs is a trend apparent throughout the Near East for many millennia following their initial domestication (Zeder 1996, 298). Zeder has attributed the relative representation of pigs at sites in the Near East primarily to changes in the level of integration of the site into the regional economy, with autonomous, largely self-sufficient sites showing higher levels of pig farming. Her contextual analysis of the pig bones from Tell Halif, however, appears to neglect the fact that, although the numbers of pig bones change throughout the periods represented at the site, relative to the other main domesticates, pigs remain consistently poorly represented. Thus, changes in the degree of integration of the settlement of Tell Halif into the regional economy over time are not accompanied by a concomitant and dramatic change in the relative representation of pigs, which remains below five percent in each context. Indeed, the consistently low representation of pigs throughout eastern Anatolia has been documented from sites as diverse as the administrative district centre of Lidar Höyük during the Early Bronze Age, the large urban settlement of Early Bronze Age Korucutepe, the large village settlement of Early Bronze Age Karataş-Semayük (Yakar 1985), and the small-scale settlement of Early Bronze Sos Höyük.

Without written documentation to confirm a cultural aversion to the keeping of suids, the relatively narrow environmental requirements of pigs may provide the best explanation for their widespread lack of abundance at Early Bronze and Iron Age sites in eastern Anatolia. Pigs require

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[96] The relative abundances of cattle, ovicaprids and pigs from the different sites is based on raw fragment counts due to the diversity of counts displayed in the reports and the failure of numerous reports to explicitly state the method of calculation of MNI counts, thus rendering comparison of counts impossible. It must be noted that the Dinkha Tepe figures are based on an aggregated Bronze Age sample (Gilbert & Steinfeld 1977), and those from Hayaz Höyük are based on figures provided by preliminary findings (Buitenhuis 1985, 61).

shelter, typically in the form of vegetation, from both sun and extremes of weather and the propinquity of a reliable water source, soft ground and, in harsh sun, mud wallows. With a dietary preference of acorns and beech-mast, their ideal habitat comprises moist, open woodland (Diener & Robkin 1978; Grigson 1982a, 300). Pigs have much higher water requirements than do the other main domesticates, with daily watering of three parts water to one part feed necessary. Even higher levels are required by pregnant sows (Zeder 1996, 301). Their low abundance within most assemblages may suggest that these sites were lacking in one or more of these characteristics. Indeed, the low annual precipitation apparent at the sites, in addition to their location on plains which may have lacked directly adjacent woodland or vegetational coverage, may indicate potentially unfavourable environmental conditions for the keeping of pigs.

Abundance may also have been influenced by the productive limitations of pigs, with their use restricted primarily to meat production. This lack of productive versatility may have contributed to the relative unimportance of pigs in contrast to multi-functional cattle and ovicaprids in the Bronze and Iron Age economies. It is nevertheless clear that both Sos Höyük and Büyüktepe Höyük conform to a high degree with contemporary sites in terms of the minimal importance of pigs in the agricultural economy. Redding has argued that increasing agricultural intensification is accompanied by a declining importance in pig production (Redding 1991). This is attributed to the damage that unconfined pigs may cause to crops and pastures. The low percentage of pigs at Sos Höyük and Büyüktepe Höyük may therefore also reflect the possibility that agriculture was economically important at both sites during both the Early Bronze and Iron Age periods.

8.4 Skeletal Part Representation

The skeletal part representation of the cattle and ovicaprids at both Sos Höyük and Büyüktepe Höyük was examined in terms of element MNI, as a percentage of the highest element MNI for the species for a given context. The low number of specimens recovered for the remaining taxa precludes analysis of skeletal part representation.[97] Ribs and vertebrae may potentially provide evidence concerning the location of kill and butchery activities relative to the habitation site. If the animal was butchered within the settlement, elements of the axial skeletal will tend to be deposited at the site, whereas butchery in an extramural context will generally result in only the high meat-bearing elements of the skeleton being brought back to the site. Ribs and vertebrae were not included in the analysis however, due to difficulties associated with assigning fragmentary specimens of these elements to species.

The low representation of the smaller elements including carpal and tarsal bones and phalanges for all of the species considered may be in part due to the lack of sieving during the excavation of either site (Figures 16-17). Recovery techniques therefore may have exerted some influence over skeletal part representations for the various taxa. That these influences appeared to be fairly uniform for the cattle and ovicaprid remains in terms of the skeletal elements most affected, however, argues against the likelihood that differential recovery had a significantly greater influence over one taxon's representation relative to another. A number of variations evident in the skeletal part representation between the different assemblages may nevertheless imply real differences in the way carcasses were treated.

8.4.1 Domestic Cattle

Examination of the skeletal part frequencies of the cattle remains reveals that, throughout all samples, forelimb and hindlimb elements are approximately equally well represented (Figure 16a-c). In addition, the representation of cranial and non meat-bearing elements implies that entire animals were butchered at both Sos Höyük and Büyüktepe Höyük in contrast to the transport of select portions of the carcass from extramural butchery sites. The Early Bronze Age sample from Sos Höyük reveals an high representation of humeral, radial, tibial and talus fragments. This may be an artifact of the greater survivability of these earlier fusing, and therefore denser elements. The lower frequency of the early fusing metapodial bones, however, argues that the high representation of humeral, radial and tibial specimens was due to cultural factors. This may be attributed to the fact that these elements are among the main meat-bearing bones of the skeleton. The Iron Age levels revealed, by contrast, a slight preponderance of metapodial bones relative to other elements, which may be associated with the butchery evidence for marrow extraction.

8.4.2 Domestic Ovicaprids

All three ovicaprid assemblages reveal a fairly consistent representation of skeletal elements, compatible with the conclusion that either live animals or whole carcasses were butchered at the site (Figure 17a-c). Both the Early Bronze Age and Iron Age assemblages of ovicaprids from Sos Höyük reveal an approximately even representation of forelimb and hindlimb elements. By contrast the Iron Age assemblage from Büyüktepe Höyük reveals a slightly greater representation of forelimb over hindlimb elements, which may indicate a preference for the higher meat-bearing bones of the former relative to the latter. The Iron Age sample from Büyüktepe Höyük also reveals a high representation of metapodial bones suggestive of the importance of marrow extraction. The high representation of mandibles for both the Early Bronze Age sample from Sos Höyük, and Iron Age sample from Büyüktepe Höyük is noteworthy. This may be an artifact of the high survivability of the mandible relative to other skeletal elements or, alternatively, imply that cranial remains were selectively retained at the site. The high frequency of marks compatible with the removal of horn cores at Early Bronze Age Sos Höyük, and on the single horn core specimen from Büyüktepe Höyük, may suggest that cranial remains were kept at the site for the purpose of horn removal.

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[97] The elements for which MNI counts are included are provided in Table 55.

8.5 Subsistence Strategies

8.5.1 Domestic Cattle

Based on dental and epiphyseal fusion data, all three cattle assemblages produced mortality profiles indicative of herding strategies focused on meat production with the exploitation of secondary products from adult breeding stock also possible. The talus evidence from Early Bronze Age Sos Höyük implied that some stock in the form of subadult males may have been traded with other settlements although a lack of data precludes further investigation of this possibility. The lack of data from Iron Age levels at Sos Höyük and Büyüktepe Höyük precludes examination of this feature for these assemblages. The mortality profiles from Early Bronze and Iron Age Sos Höyük bear a striking similarity to each other, suggesting that little change occurred in the nature of exploitation between these two periods. The profile from Iron Age Büyüktepe Höyük generally corresponds to those from Sos Höyük, although displaying somewhat lower adult mortality. As the profiles from both Sos Höyük and Büyüktepe Höyük conform most readily to a meat production strategy, the differences between the profiles may suggest that some variation may have occurred in the nature of this exploitation. The apparent differences between the profiles may also have been influenced by the small size of the samples from which the profiles were derived. The mortality profiles from Sos Höyük and Büyüktepe Höyük bear greatest similarity to those from Chalcolithic and Early Bronze Age Hassek Höyük, Late Bronze Age Lidar Höyük and Late Bronze Age Korucutepe. These profiles have been interpreted as representing herd management strategies focussed on milk production and traction work (Stahl 1989, 15; Boessneck & von den Driesch 1975, 38; Kussinger 1988, 19). While these products may have been exploited at both Sos Höyük and Büyüktepe Höyük, the high mortality within the 24 to 48 month age range for all three assemblages, as highlighted by the epiphyseal fusion analyses, suggests that meat production comprised an important aspect of the economy at both sites. The skeletal part representation analysis reveals that entire carcasses were present at the site, suggesting that meat from the entire animal, rather than select cuts, was consumed at the settlement. The indication of entire carcasses furthermore implies that the meat derived from local production rather than exchange. As cattle yield on average four times more meat than small ruminants such as sheep, the NISP and MNI counts indicate that beef would have been consumed in greater quantities than the meat of ovicaprids at Sos Höyük and Büyüktepe Höyük in both the Early Bronze and Iron Age periods.

Evidence that the utilisation of cattle did extend beyond the supply of marrow and meat, to various other resources during the Early Bronze and Iron Age periods is provided by numerous facets of osteological evidence. Skinning marks detected on radii, tali, metatarsal bones, and phalanges from Early Bronze Age levels at Sos Höyük and on frontal bones from Iron Age levels at both Sos Höyük and Büyüktepe Höyük suggest the utilisation of hides. All three assemblages reveal evidence for the use of cattle horn as a raw material through the removal of horn cores from the skull. Various post-cranial specimens had been modified into either tools or decorative items. These included a scraper, awl and numerous spindle whorls from Early Bronze levels at Sos Höyük, awls and a whorl from Iron Age levels at Sos Höyük, and a single whorl from the Iron Age levels at Büyüktepe Höyük. There is furthermore little difference in the frequency with which cattle bones were used to manufacture decorative or utilitarian items between the Early Bronze and Iron Age periods at Sos Höyük, with 1.8% and 1.9% of specimens from each site modified into tools. The modification and use of skeletal remains as tools will result in different cultural and taphonomic influences acting on those specimens, than if they had been discarded as waste during butchery or food preparation. If specific skeletal elements are favoured for tool manufacture, this may affect their representation relative to other elements within an assemblage. The equally low frequency of tools between Early Bronze and Iron Age levels at Sos Höyük suggests that the manufacture of tools did not significantly affect the representation of cattle skeletal remains recovered within either assemblage, and also indicates that the frequency with which cattle bones were used in tool manufacture did not alter appreciably over time. The small number of tools recovered from Iron Age levels at Büyüktepe Höyük does not allow for investigation of the changes in the abundance of tools, relative to the total number of cattle specimens, between Iron Age levels at Sos Höyük and Büyüktepe Höyük. The small number of tools from all levels similarly precludes analysis of changes in the frequency of different tool types between the samples.

The exploitation of additional resources is also suggested by horn core morphology which indicates the presence of castrates in Early Bronze and Iron Age levels at both Sos Höyük and Büyüktepe Höyük. These animals would presumably have fulfilled the functions of transport or traction. If cattle were used for traction this may have exerted a substantial impact over the agricultural economy of the settlements concerned. Traction exerts a multiplicative effect over potential productive capacity. Tillage and cartage constitute two of the most labour intensive activities within an agrarian economy (Bogucki 1993, 498). The use of traction animals thus expands output either in terms of the transport of bulk goods such as firewood or fodder or by increasing the amount of land able to be cultivated within a given period. Given the current lack of information concerning cultivation at Sos Höyük during the Early Bronze and Iron Age periods, the role of traction animals is difficult to ascertain. The presence of castrates however implies that either, or perhaps both, transport and tillage comprised a significantly important part of the economy to warrant the maintenance of otherwise non-productive animals. A further secondary product that may have been exploited was manure, which may either have fertilised cultivated lands or served as fuel.

8.5.2 Domestic Ovicaprids

Mortality profiles for the ovicaprid assemblages from both Sos Höyük and Büyüktepe Höyük conform primarily to a meat production strategy, although this may have been supplemented by the exploitation of secondary products from adult breeding stock. The age representation of mortality from each of the sites indicates that ovicaprids were raised and consumed locally with no evidence for the trading of stock with other settlements. The Early Bronze and Iron

Age profiles from Sos Höyük show a high degree of correlation suggesting that, as with the cattle herding systems, little variation in the nature of exploitation occurred during these periods. The profile for Iron Age Büyüktepe Höyük shows a small degree of divergence from that for Sos Höyük, although the significance of this is unclear, especially given the small sizes of the samples involved. The profiles from Sos Höyük and Büyüktepe Höyük tended to be dissimilar to those of broadly contemporaneous contexts from sites elsewhere in Anatolia. Profiles from Late Bronze Korucutepe and Middle Bronze Age Demircihüyük however are comparable to the Büyüktepe Höyük and Sos Höyük profiles. These assemblages suggest a similar predominance of adult females and reflect the exploitation of primary and probably also secondary products. It appears likely that a similar herd management strategy was being practised at these sites during the Bronze Age as was evident at Sos Höyük and Büyüktepe Höyük.

The absence of profiles structured entirely toward wool production from Sos Höyük and Büyüktepe Höyük is not surprising given the small size of the settlements involved and the evidence for local production and consumption. People practising pastoralism geared toward local consumption would be able to obtain adequate fibre resources from their animals without the necessity of structuring their herds towards the production of this resource (Redding 1981, 48). Twentieth century Lur nomads, who raise flocks of ovicaprids primarily for subsistence, with fibre constituting a by-product, obtain enough wool and goat hair from their stock to supply their own needs plus furnish a surplus that is sold either to itinerant dealers or in the local townships (Mortensen 1993, 279). Indeed, that wool was utilised by the inhabitants of Sos Höyük is indicated by the recovery of numerous bone spindle whorls from Early Bronze and Iron Age contexts. Fluctuations in the level of exploitation of wool as indicated by the number of spindle whorls could not be investigated due to the statistically inadequate sizes of the bone samples involved.

Direct evidence, in the form of the large scale culling of surplus male infant and juvenile stock, for the exploitation of additional secondary products such as milk is lacking for both the cattle and ovicaprid samples. This does not preclude the use of milk products, instead suggesting that the emphasis in herding did not focus on these products. Ethnographic accounts suggest that offspring may still be raised in conjunction with the exploitation of milk resources by humans. Black-Michaud provides an account of the regime undertaken by Lur nomads to permit simultaneous use of sheep milk resources by offspring and humans, including the restriction of suckling time and milking prior to suckling (Black-Michaud 1986, 43). The necessity does not therefore exist to slaughter surplus male stock in order to eliminate competition between offspring and humans for milk. The excess male stock may therefore be retained until they attain near maximum weight and or pose an unnecessary source of competition to other stock for fodder. In addition, the amount of milk required for domestic consumption would be significantly lower than the production levels necessary for an economy geared toward surplus production intended for exchange.

8.5.3 Domestic Pigs

Iron Age contexts at Büyüktepe Höyük provided the only sample of sufficient size to permit the construction of a mortality profile. As pigs traditionally yield a single product, meat, the primary products profile suggested by the data from Büyüktepe Höyük is unexceptional.

Beyond the obvious provision of meat, pigs posses a number of behavioural traits that may provide insight into further potential functions of this species within the settlements of Sos Höyük and Büyüktepe Höyük. The rooting of pigs aerates the soil and retards the regeneration of trees through the removal of under-storey under which seedlings germinate (Grigson 1982a, 300). Thus pigs may have aided in forest clearance for agricultural purposes. The omnivorous diet of pigs, which may include spoilage and faecal matter, also allows them to fulfil the function of mobile waste disposal units during periods of confinement at the site.

8.6 *Ovis:Capra* Ratio

Of those ovicaprid remains that could be identified to species within the three samples, a significant shift in the ratio of sheep to goat is apparent from the Early Bronze to Iron Age periods. While the sheep to goat ratio for the Early Bronze Age sample from Sos Höyük is 2.6:1, both Iron Age samples display a significant increase in the relative representation of sheep, with ratios of 8.3:1 and 7.5:1 for Sos Höyük and Büyüktepe Höyük, respectively. This shift in the relative abundance of sheep to goats may have resulted from either cultural or ecological factors, with the physiological traits of the species being fundamental to both explanations.

Cultural influences over whether sheep or goat comprise the most abundant species are most frequently concerned with economic production and fecundity. Ethnographic observations from modern contexts including Aşvan Kale in the central Anatolian highlands, Luristan in western Iran, and Mongolia reveal a distinct hierarchy, with sheep being of greater economic worth than goats (Khazanov 1984, 25 after Zhagvaral 1974, 98; Mortensen 1993, 188; Payne 1973, 299). Sheep products are more highly valued than those of goats, whereas goats, due to their hardier constitution, are favoured by the poorer herders. Among modern pastoralists in western Iran, sheep herding is perceived as the only means through which wealth could be accumulated, and through the range of products they yield, sheep afford both a financial and nutritional advantage (Mortensen 1993, 189). Perceived economic worth, however, is dependent on the requirements and circumstances of the stockholders. Goats are favoured by some Iranian nomadic pastoralists located at a distance from trading centres due to the absence of market potential and the easier handling of the species relative to sheep (Stauffer 1965, 292). Goats are also more prolific breeders than sheep, with fecundity rising with improved pasturage and with a greater tendency towards twinning (Redding 1981). Goats thus offer greater potential than sheep for herd growth and replacement of stock losses.

Sheep meat carries higher calorific potential, although goat meat exceeds that of sheep in the content of all other nutrients (Redding 1981, 154-9). By contrast, the reverse is true of milk, with sheep milk being a superior nutritional source (Redding 1981, 166-184). Although goats are more prolific producers of milk, the nutritional deficiencies of their milk relative to that of sheep ensures that goat milk is of lesser overall value. Whether or not relative nutritional value would have been recognised by early pastoralists is questionable. Modern Luristan nomads hold goats in esteem due to their greater milk yields (Mortensen 1993, 188).

Sheep yield more fibre than goats on an annual basis, and the extreme versatility of wool ensures that sheep are of considerably greater value than goats as fibre producers (Redding 1981, 48). Goat hair, however, may be valued in its own right. It is essential, for instance, in the weaving of tents, and screens and for rope making among modern Luristan nomads (Mortensen 1993, 188). A disincentive for the use of goat hair, however, is that once shorn, goats may be susceptible to exposure.

Interrelated with these physiological and cultural factors are ecological variables in the form of the species suitability to the environment. Sheep show a greater suitability to, and tolerance of, high altitudes than goats This is due to the greater ability of a sheep's fleece to withstand extremely low temperatures and winds. Goats exhibit the added disadvantage, in snow covered ground, of being unable to uncover food, thus requiring the presence of sheep, which can expose vegetation at up to seventeen centimetres depth (Khazanov 1984, 46; Redding 1981, 207). Clearly the presence of browse may be crucial to goats feeding in snow covered environments. Goats are more tolerant of heat stress and water deprivation and are thus better suited to hot, dry environments. In terms of climate, therefore, sheep appear to be better suited to colder and snowier environments than goats. Sheep and goats also display distinct differences in the manner in which they feed, which enable goats to thrive in habitats that are inadequate for the survival of sheep (Redding 1981, 53). Goats depend primarily on browse, although the diet may be highly variable and include up to 90% grasses and forbs, taking advantage of seasonal variation and vegetational diversity in plant communities (Redding 1981, 74). Goats thus display a greater ability to utilise areas of high browse and low graze. By contrast, sheep are conservative feeders, relying primarily on grasses and forbs. The higher nutritional value of browse, in conjunction with the different feeding habits of sheep and goats, results in the enhanced ability of the latter to inhabit a greater diversity of habitats. That pastoralists determine the species composition of herds according to the biological characteristics of their stock is exemplified by the Tuareg who herd more sheep than goats in the Southern Ayr, while the reverse is true of Tuareg herds in Tassili (Khazanov 1984, 27 after Nicolaisen 1963, 45-6).

In the absence of written records it is extremely difficult to detect economic incentives favouring the herding of one species over another. It is furthermore possible that both cultural and ecological factors influenced herd composition. The greater abundance of sheep, relative to goats, in the samples from both Sos Höyük and Büyüktepe Höyük clearly makes sense in view of the ecological requirements of sheep compared with goats, and in terms of their greater tolerance of low temperatures and ability to feed in snow covered pastures This trend may furthermore reflect the greater availability of graze over browse, which may have resulted from extensive land clearance for pasture and cultivation within the regions surrounding the sites.

The relative increase in the sheep to goat ratio from the Early Bronze to Iron Age periods at Sos Höyük is more enigmatic. This may reflect changes whereby sheep increased in economic or cultural worth relative to goats. This may have been in the form of increased external trading opportunities in which, based on ethnographic accounts, sheep are of considerably higher value than goats, or alternatively, an increased reliance on, or appreciation of, the superior versatility and nutritional content of sheep products such as wool and milk. Alternatively, ecological factors may have enhanced the value of sheep herding. This may have been in the form of an increase in the amount of available graze relative to browse. This latter circumstance may have occurred, for instance, with more widespread deforestation for the purposes of expanding arable and grazing lands, and the obtaining of wood resources. Indeed the grazing of ovicaprids in regions surrounding the site may have contributed to increasing deforestation. Compaction of the soil, which retards germination of seeds and revegetation of existing plants, results from trampling by grazing animals, while goats especially will retard or prevent growth of seedlings and vegetation through cropping (Köhler-Rollefson & Rollefson 1990, 10-11).

8.7 Butchery

Butchery marks were detected on the bones of various taxa from the Early Bronze and Iron Age levels at Sos Höyük and Iron Age levels at Büyüktepe Höyük. Within these assemblages, the incidence of butchery marks is consistently low both across the represented taxa and throughout both periods (Table 8a-d). Among the domestic species, cattle bones tend to exhibit the highest incidence of butchery marks, which are remarkably consistent in terms of both frequency and location across all three assemblages. Ovicaprids illustrate the second highest frequency of butchery marks, with a consistently low representation of marks throughout all three samples. A single specimen from Early Bronze Age levels at Büyüktepe Höyük, consisting of a proximal cattle horn core, displays evidence of butchery marks. Horse bones from Early Bronze and Iron Age levels at Büyüktepe Höyük comprise the only other instances of butchery among the domestic taxa.

The frequency of butchery marks on the skeletal elements of the various taxa was examined in order to detect trends in butchery patterns and perhaps reconstruct overall butchery procedures (Figures 18a-d, 19a-c). While it is apparent that butchery marks tend to appear in the same locations throughout the skeleton both within and between taxa, it is clear that the frequency with which marks were detected on the different elements is quite variable, although this may be an artifact of the small numbers of specimens recovered. For both domestic ovicaprids and cattle, marks are concentrated about the junction between the proximal horn core and the frontal bone and at the articulations between the humerus, radius and ulna, and tibia and metatarsal bone. Metapodial bones also display concentrations of marks resulting from skinning and marrow extraction. The frequency with which marks were detected on ovicaprid bones tend to be lower than for cattle bones. The low frequency of marks on bones of domestic taxa at both sites preclude anything more than the most general of impressions regarding butchery practices. Remains of domestic ovicaprids and cattle from the Early Bronze and Iron Age periods at both Sos Höyük and Büyüktepe Höyük nevertheless appear to reveal consistent butchery patterns in which the removal of horn cores and disarticulation of the lower, non-meat bearing bones figured prominently. Marrow extraction and skinning activities also appear to have been practised with some regularity. Butchery marks were uncommon on bones of wild taxa, with the two wild ovicaprid specimens from Early Bronze Age Sos Höyük comprising the only identified instances. Both specimens display marks consistent with those apparent on the domestic taxa for the disarticulation of the lower limb bones from the humerus.

8.8 Gnawing

The frequency of carnivore gnawing is extremely low both across taxa and throughout all four samples (Table 7a-d). Evidence of gnawing is more common on cattle than ovicaprid specimens, although the frequency remains extremely low for both taxa. As smaller ovicaprid bones are more likely to be completely destroyed or rendered unrecognisable through gnawing than those of larger taxa, the incidence of gnawing on ovicaprid bones may be under-represented relative to that on the cattle bones. Three equid specimens from Iron Age levels at Büyüktepe Höyük provided the only other instances of gnawing.

8.9 Pathology

Examination of the Sos Höyük and Büyüktepe Höyük assemblages reveal that evidence for pathological conditions is rare (Table 56). Disorders of the soft tissues typically result in little or no modification of the skeleton and are thus likely to remain undetected among osteological remains. The extremely low incidence of pathology apparent on the skeletal remains nevertheless implies that the animals at both Sos Höyük and Büyüktepe Höyük were kept in a state of relatively good health. The exception to this was provided by the dental remains for the ovicaprids which illustrate quite high levels of pathology. These anomalies may be related to various factors including congenital defects and parasites, although the impact that these conditions would have had over the health of the animals is unclear. With the exception of one specimen, every instance of pathology observed among both cattle and horse bones involved osteoarthritis of the phalanges, which may have resulted from traction or transport work. The slight reduction in dental pathologies among ovicaprids from the Early Bronze Age to Iron Age periods may imply improvement in the quality of fodder.

8.10 Pastoralism

8.10.1 Definition

The nature of the pastoral economies practised at Early Bronze and Iron Age Sos Höyük and Iron Age Büyüktepe Höyük may be further elucidated in terms of the extent of mobility or sedentariness of the human and animal populations. While this is in many respects an elusive feature of archaeological assemblages, various techniques permit assessment of a number of factors that vary depending on the degree of mobility of the community concerned. Of fundamental importance to this is a definition of the various types of pastoral economies that may potentially have been practised during the Early Bronze and Iron Age periods.

Pastoralism exists in a myriad of forms that, although classifiable into broad categories, nevertheless in many respects escape precise definition. A useful summary of the essential credentials of each broad system is provided by Khazanov (1984, 19-25). In its purest form nomadism exists as 'pastoral nomadism proper' characterised by a complete absence of agriculture. This system is rare due to the fact that it must coexist with other less specialised forms of pastoralism through which the products of agriculture can be obtained. 'Semi-nomadic pastoralism' is characterised by extensive pastoralism, involving periodic changes in pasture for the majority of the year, supplemented by agriculture. This system may involve either permanent segregation of groups within the society into agriculturalists and pastoralists, or group members functioning simultaneously in both spheres. The supplementary role of agriculture in this system similarly precludes complete autonomy and demands coexistence with more agriculturally based economies, as the level of output is not sufficient to fully meet the demands of the group.

Reflecting a fundamental shift in relative importance, 'semi-sedentary pastoralism' involves predominantly agriculture, supplemented either by seasonal migrations of stock or the pastoral activities of certain groups within the society. Migrations in this system tend to be of shorter distance and duration than for semi-nomadic pastoralism. 'Herdsmen' or 'distant-pastures husbandry' involves a predominantly sedentary community focused on agriculture, with some of the livestock maintained continuously on pastures some distance from the settlement and the remainder stalled or penned involving the provision of fodder. A variant on these categories is the specialised mountain variant of herdsmen husbandry termed 'Yaylag' or transhumant pastoralism. In this system agriculture, which is confined to specific ecological zones, is supplemented by the use of seasonally available pastures at times when they are at their most productive. This term has been used erroneously to describe seasonal pastoral migrations or seasonal utilisation of different ecological niches. This system often coexists with both nomadic and semi-nomadic pastoralism.

Requisite for both 'pure' nomadic and semi-nomadic pastoralism is specialised production that permits a system of exchange with more agriculturally based, typically sedentary, economies in order to obtain essential non-animal foodstuffs and household items (Halstead 1993, 22). Agricultural activities are considered to be grossly subordinate to herding by many nomads such as the Tuareg of north Africa (Orme 1981). Nevertheless, economic relationships with agriculturalists are an essential ingredient in the maintenance of nomadic systems (Barfield 1993, 94; Lees & Bates 1974, 191). Indeed, evidence of nomads subsisting entirely on animal products is lacking (Khazanov

1984, 52). This system of exchange necessitates specialisation for nomadic pastoralists through which predominantly renewable resources may be derived from the herd for exchange. These items thus primarily comprise primarily secondary products including wool and milk, with primary products occasionally manifest as carcasses, hides or livestock. Sarakatsani nomads from Greece obtained their dietary mainstay of flour through the trading of milk, supplemented by wool (Halstead 1993, 22). Similarly, the Basseri from south Persia obtain the substantially agriculturally based mainstays of their diet through the trading of butter, wool and lambskins, and to a much lesser extent, livestock. No evidence exists within the assemblages from Early Bronze and Iron Age Sos Höyük and Iron Age Büyüktepe Höyük for the specialised economies of wool or milk production that may be required for such a system of exchange. The absence of specialised herding economies geared towards milk or wool among the main domesticates in all of the three assemblages examined therefore argues against their being predominantly nomadic pastoral economies.

8.10.2 Species Representation

The relatively high representation of cattle in Early Bronze and Iron Age contexts at both Sos Höyük and Büyüktepe Höyük argues that at least a portion of the pastoral economy at both sites was sedentary. Although cattle herding comprised the dominant nomadic economy of the expansive Eurasian steppes north of the Black Sea from the beginning of the first millennium B.C. (Khazanov 1978, 119), numerous ethnographic accounts highlight the unsuitability of cattle herding for nomadic systems in areas south of the Black Sea. The Basseri nomads of South Persia do not keep cattle due both to the length of their migrations and the rocky nature of the terrain along the migration route (Barth 1965, 6). Cattle are perceived by various Eurasian nomads as 'too capricious and ill-suited to long distance migration', while the species is unpopular among modern Turkish nomads of mountainous regions as they are deemed difficult to move about (Khazanov 1984, 47; N.I.D. 1943, 169). Indeed, a large representation of bovine stock has typically been linked with more intensive agricultural production. The appearance of cattle has, for instance, accompanied a shift to sedentariness by formerly nomadic peoples. While formerly the Khazakhs did not keep cattle because 'cows cannot pasture in the steppes', either due to inadequate forage or the difficult topography of the pasture, a shift to sedentariness in the eighteenth century precipitated the appearance of cattle among the Khazakhs livestock (Khazanov 1984, 47). Similar increases in the percentage of large stock on the adoption of some form of sedentariness has been observed among the Lokai Uzbek, Karakalpak and Kalmuck nomads. The small percentages of cattle associated with nomadic pastoralists furthermore appear to represent largely transport animals. The Lur keep cattle in small numbers as beasts of burden with the frequency increasing only with the practice of agriculture (Mortensen 1993, 193).

The presence of pigs within all three assemblages is further suggestive of essentially sedentary settlements. Pigs are rarely encountered in the corpus of species herded by nomads. Ethnographic accounts from the Near and Middle East are of little value in this context, as the absence of pigs in the modern subsistence systems of this region is clearly due to pervading religious beliefs. Despite this, various facets of evidence exist to discount the importance of pigs within the subsistence systems of nomadic pastoralists. Pigs are not generally considered to be of importance in pastoral systems due primarily to fact that they constitute recalcitrant and reluctant nomads (Galaty & Johnson 1990, 11; Grigson 1982, 299). Although wild pigs may undertake relatively small attitudinal shifts to take advantage of feeding opportunities (Zeder 1996, 301), they appear to be unsuited to long distance movement. Furthermore, pigs are not naturally gregarious, with wild sows congregating in groups of no more than three or four, plus related piglets and juveniles, while adult males are typically solitary. Pigs therefore display no predisposition to being herded, which would subsequently exacerbate the difficulties already associated with herding domestic animals over long distances.

The diversity of domestic species herded at both Sos Höyük and Büyüktepe Höyük argues against a predominantly nomadic economy. Small scale mixed farmers maintain a diversity of domestic species as insurance against stock losses and disease and to provide an optimal range of products (Halstead 1996, 24). By contrast, large scale nomadic herders tend to specialise in a single species, due in part to the difficulty of providing for the needs of a number of species with diverse nutritional and watering requirements during a migration. The focus on a single taxon prompts continued mobility as the large size of the herds places great pressure on the available pastures. The primary species is supplemented by additional taxa that are typically represented by few individuals, such as transport animals including horses or donkeys, and guard dogs. The diversity of domesticates represented in the assemblages from Early Bronze and Iron Age Sos Höyük and Iron Age Büyüktepe Höyük therefore argues against their reflecting large scale herding and instead indicates the expected characteristics of small scale mixed farming economies.

8.10.3 Seasonality

Settlement patterns are affected by seasonal availability of subsistence resources either in terms of directly exploited and consumed taxa or in terms of indirect resources such as pastures or water. In addition to cultural and political influences, this is a chief impetus for the adoption and maintenance of migratory and nomadic subsistence systems. It is obviously of fundamental importance therefore to establish indicators of seasonality within a faunal assemblage in order to assess the degree of sedentariness represented.

One of the simplest methods of determining seasonality comprises the presence or absence of seasonally available resources based on the use of modern ecological analogues. It must be remembered that only presence, rather than absence, can be used as an indicator in this context. For instance, the presence of a summer species indicates that the site was occupied at least during the summer, while the absence of winter species cannot be interpreted as meaning that the site was unoccupied during this season. Migratory taxa are of obvious value in this context, with birds frequently being the most informative. The wild remains from Early Bronze Age contexts at Sos Höyük point to the presence of migratory species that are variously restricted to summer, winter, and autumn or spring occupations. The white stork, mallard, and common crane indicate summer occupation, the whitefront goose and great bustard over-winter in eastern Turkey, and the marsh harrier's presence in this region is largely restricted to part of its autumn and spring migrations. As the evidence for winter, and spring or autumn, occupation is based on the presence of single species, these conclusions must remain necessarily tentative. Quail, common crane and mallard specimens from Iron Age Sos Höyük and mallard from Iron Age Büyüktepe Höyük suggest that these sites were occupied at least during summer.

Various species, such as animals that hibernate, are only seasonally available despite being present in a region throughout the year. The recovery of remains of the Caspian turtle, which hibernates throughout winter, from Iron Age levels at Sos Höyük therefore indicates exploitation of this resource during the summer.

Red deer remains from Early Bronze Age Sos Höyük and Iron Age Büyüktepe Höyük provide the only mammalian evidence of a seasonally exploited resource. As antlers are cast from March to May (MacDonald & Barrett 1993, 202; Bökönyi 1972, 125), the presence of a cast antler specimen from Büyüktepe Höyük may indicate spring or summer occupation. This specimen, however, may have been retrieved some time after casting, and is thus of limited value. Two uncast antler fragments from Sos Höyük are also of little value, as they may derive from an animal at any stage of antler development, from the growth period in spring and summer to the last phase of casting in the following March to May. The high level of intraspecific variation in the timing of casting of antlers also complicates these results (Banfield 1974, 383). These remains therefore offer poor temporal resolution and contribute little insight into the extent or duration of site occupation.

Only rather scanty indicators are supplied by the wild species regarding season of occupation. The presence and absence method of detecting seasonality has the disadvantage of indicating only the degree of sedentariness of peoples rather than herds. Herd mobility does not necessarily equate with human mobility as, for instance, the majority of the human component of a community may remain at the same site throughout the year, while the domestic herds are driven by a few individuals to distant locations for grazing. Some investigation of the seasonality of the domestic stock is therefore required. Various methods for assessing herd seasonality exist, including the analysis of epiphyseal fusion, tooth eruption and attrition, and incremental structures (Monks 1981).

Due to the extremely limited application of analysis of epiphyseal fusion in the context of determination of seasonality, this technique was not attempted. This is because only epiphyses in the process of fusing can offer an approximation of the age of the animal at death. As most epiphyses which fuse at a given age may do so at any time within a period of weeks to months, even specimens that are in the process of fusing can provide only approximate results. For specimens displaying fused or unfused epiphyses the most that can be extrapolated is that the animal is at least as old as, or has died some time prior to the beginning and end of the fusion range, respectively.

Seasonal increments in dental cementum have been used with considerable success in archaeology to estimate age and season of death through analysis of the number and type of annual rings, or annuli, in thin-sectioned teeth (Lieberman 1994; Rissman 1986). Of fundamental importance to this technique is the use of a modern control sample. The control ideally should come from a population of identical species and habitat to that in the archaeological sample (Rissman 1986, 264). This is because factors such as climate, hormonal cycles, and diet will impact in complex ways on annular formation. The relationship, timing and rate of annular formation relative to the specific environment from which the archaeological samples were derived should be established through analysis of modern specimens of known age and season of death, in order to establish a control by which the archaeological specimens can be evaluated. The lack of an appropriate standard sample of domestic cattle, pigs and ovicaprids from eastern Turkey precludes the application of this technique in the current study.

Dental eruption remains the best method for assessment of seasonality of the domestic remains from Sos Höyük and Büyüktepe Höyük. Due to the difficulties of assessing attrition, including such factors as the influence of gender, differential diet, and attempting to link particular wear stages to a specific age, the analysis was conducted only in terms of eruption. This clearly concentrates the analysis on the younger age groups and most particularly the ages covered by the first and second molars, as these provide the narrowest time intervals in which teeth erupt and thus can yield the most precise estimates. With a six month time span over which the third molar can erupt, this tooth is of little value in determining season of death.

The ovicaprid dental remains from Early Bronze and Iron Age Sos Höyük provide the only samples of adequate size to permit analysis. From examination of the dental data from Early Bronze Age levels at Sos Höyük it is clear that three animals died at the time of eruption of the first molar at approximately five to six months, while a further seven specimens died during the eruption of the second molars, at between nine and twelve months. Similarly, the ovicaprid dental remains from Iron Age levels at Sos Höyük reveal two and six specimens dying at the time of eruption of the first and second molar, respectively. Whether or not these events represent year round mortality or can be interpreted as coinciding, and thus representing a specific period of the year, as would occur at a seasonally occupied site, depends largely on whether birthing occurred as a single and reasonably discrete season for the herd, or was spread over a longer period of time.

While sheep and goats in tropical climates can breed throughout the year, those from a continental climate are likely to exhibit a far more restricted breeding and thus birthing season (Legge & Rowly-Conwy 1988, 108). Aside from environmental and climatic considerations, husbandry techniques will influence timing depending on whether males have restricted access to the females or are permitted to run with the flock throughout the year. The wild sheep, *Ovis orientalis*, and wild goat, *Capra aegagrus*, display a rut in October/November with parturition in April/May

(MacDonald & Barrett 1993, 219). Domestic descendants exhibit a slightly extended birthing season with the Awassi sheep of the Middle East lambing from December to March with most births occurring in January/February (Redding 1981, 86; Hirsch 1933, 24; Rottensten & Ampy 1971, 371). Similar cycles are evident among Middle Eastern domestic goats (Hirsch 1933, 58; Epstein & Herz 1964, 240). The ovicaprids from which these data were collected generally comprised well fed, modern animals farmed under a regime of extensive husbandry. The birthing season of early domestic ovicaprids from Sos Höyük is thus likely to have been somewhat more restricted and thus more comparable to the two month birthing season of wild ovicaprids in April to May.

Given a reasonably discrete birthing season occurring during spring, the evidence from the dental remains from Early Bronze and Iron Age Sos Höyük, with mortality occurring among animals of six, and nine to twelve months of age, implies mortality and thus the presence of the animals in autumn and late winter to early spring. This indicates that during the Early Bronze and Iron Age periods, ovicaprids were present at the site throughout the year.

Year round occupation is furthermore indicated by the presence of fœtal and neonatal bones at both Early Bronze and Iron Age levels at Sos Höyük. The fœtal remains from both deposits indicate mortality extending from the last third of gestation to the initial weeks following birth while neonatal specimens imply spring to summer occupation. These specimens therefore clearly indicate the presence of both pregnant ewes and young lambs within both samples. Given a limited birthing season for the ovicaprids at Sos Höyük, this indicates the presence of ovicaprids at the site during spring and summer. The dental and post-cranial fœtal remains therefore corroborate the year round occupation suggested by the wild remains.

The presence of fœtal bones at both Early Bronze and Iron Age Sos Höyük, when considered in relation to ethnographic accounts of the yearly cycle of nomadic subsistence systems, also argues against seasonal occupation of the site. Ethnographic accounts of nomadic systems suggest that the birthing season of ovicaprids is typically timed to occur just prior to the migration to the mountain pastures. Among the sheep of the Basseri nomads of south Persia, rutting seasons occur in June, August/September and October, with ewes lambing in November, January/February or March (Barth 1965, 7). Some sections of the tribe who winter further north however, separate the ewes and rams during the August/September rut to prevent early lambing. As the commencement of the main migration coincides with the spring equinox, with the mountain encampment reached in June, all lambs are born some time prior to reaching the summer settlement site. As these summer encampments are again abandoned by the end of August, this permits only three months of a twelve month cycle to be represented in the faunal remains. Similarly, for the Lakenkhel nomads, lambing occurs in March in the spring grazing of the lowland areas, prior to ascent to the Hindu Kush mountain range for the summer pastures in June (Balikçi 1990, 307). Within the flocks of the Lur nomads the rut occurs between early August and mid-October with the majority of lambs dropped between late December and early March (Black-Michaud 1986, 43). The majority of lambs accomplish the migration, which commences between mid-March and early April, on the hoof. The lambing season has therefore finished three to four weeks prior to the arrival of the flocks in the summer camps in late April. The high altitude of the Sos Höyük site implies that it would function as a summer encampment within a nomadic system.[98] The presence of fœtal ovicaprids bones from Early Bronze and Iron Age Sos Höyük however argues strongly against the site occupying this role.

The available evidence from Early Bronze and Iron Age Sos Höyük and Iron Age Büyüktepe Höyük therefore indicates that these sites were occupied year round, although this does not necessarily imply that all stock were herded in the immediate vicinity of the sites throughout the year. Inadequate sample size within the three assemblages precludes assessment of whether all stock stayed permanently within the vicinity of the settlements. Whether or not these other taxa were herded on short migrations however is irrelevant to the fact that at least some of the stock appear to have been maintained in the vicinity of the site throughout the year. It therefore appears that the inhabitants of Early Bronze and Iron Age Sos Höyük and Iron Age Büyüktepe Höyük would have practised some from of semi-sedentary or sedentary pastoralism.

The apparent presence of stock throughout the year raises the issue of how the animals were protected from the extremely harsh winters characteristic of the region. Over-wintering of stock by stabling is common in modern villages in northeastern Turkey, with a room of the house devoted to the stalling of animals (pers. observ.). Similar practices are common throughout the alpine areas of the Near East (Feilberg 1952, 46; Watson 1979, 129). It is also possible that some stock may have been over-wintered in extramural contexts such as caves, subterranean shelters or corrals (Solecki 1979; Kramer 1979, 150; Watson 1979, 160).

8.10.4 The Archaeological Context

Given that at least partially sedentary economies appear to be represented by the faunal remains from Early Bronze Age Sos Höyük and Iron Age Sos Höyük and Büyüktepe Höyük, it remains to consider these conclusions with reference to the other archaeological evidence from these contexts.

The architectural evidence from Iron Age levels at both Sos Höyük and Büyüktepe Höyük, with apparently permanent domestic structures of comparable plan and type, accords well with the semi-sedentary or sedentary animal economies suggested by the faunal remains. The excavation of annexed rectangular dwellings with internal features including hearths, storage pits and benches at both sites, in addition to the substantial tower structure at Büyüktepe Höyük, are compatible with a year round occupation such as that

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[98] Nomadic migration within the context of mountainous regions is characterised by altitudinal zonation where summer and winter pastures correspond to 'the zones of.greatest climatic extreme' (Cribb 1991, 134). Higher altitudes are occupied during summer to take advantage of the mountain pastures and favourable weather conditions. The extremely harsh winters at Sos Höyük argue that this settlement, if part of a nomadic system, would have served as a summer encampment.

implied by the faunal remains in terms of such features as the range of exploited species, evidence of age distributions among the main domesticates, and the primary products herd management strategies practised at the sites.

The relationship between the architectural and faunal remains from Early Bronze Age Sos Höyük is more enigmatic. Lack of evidence for permanent occupation is implied by the architectural remains involving flimsy wattle and daub structures, lacking internal features. It is difficult to reconcile this with the indicators of sedentariness provided by the faunal remains. A number of explanations exist as to why these two forms of evidence do not seem to be congruent.

Variation in architectural traditions apparent throughout the Early Bronze Age deposit, ranging from the wattle and daub structures to rectilinear buildings with internal features, may also underlie changes in the agricultural and pastoral economy that have been obscured in a cumulative analysis of the Early Bronze Age sample. The degree of sedentariness of the community may have been variable in response to various climatic, political or cultural influences. Modern ethnographic accounts illustrate that the level and nature of nomadism and sedentariness may be a fluid aspect of a community, the extent of which can be dictated by factors including land availability and ownership, tribal affiliations, political stability and policy, and demographics (Cribb 1991, 59; See for example Bates 1973, 219; Barth 1965, 3; Edmonds 1957, 146; Irons 1971, 147; Tapper 1979). The current lack of availability of detailed contextual data precludes the possibility of determining the precise temporal relationship of the animal remains to the recovered architectural evidence. Future studies of the faunal assemblage incorporating the contextual data will clarify the relationships between the faunal and architectural evidence, determining if variations in the nature of the pastoral economy and degree of sedentariness of the Early Bronze Age community took place, and establishing whether the apparently more sedentary aspects of the economy, as suggested by the faunal remains, were separated temporally from the architectural tradition that has been interpreted as signifying a nomadic system.

Alternatively, as the majority of the Early Bronze Age deposit is unexcavated and inaccessible due to the presence of extensive deposits from later levels, it is possible that the temporary dwellings in the northeastern portion of the mound are not characteristic of the entire settlement in terms of contemporaneous structures. Thus more permanent structures may exist in the unexcavated regions of the settlement, with the disparity in architectural traditions reflecting cultural, social or functional differences between the two areas of the mound. Cribb discusses numerous examples of the juxtaposition of 'temporary' and more permanent architecture within the confines of a single settlement (Cribb 1991, 154). This dichotomy may result from a number of factors including a gradual process of sedentarisation of a nomadic population, seasonal occupation of temporary dwellings adjacent to a permanent village as part of an annual cycle of migration, and the congregation of various communities at centralised trade points or defensive locations. The faunal remains studied therefore may represent refuse that is functionally distinct from, but spatially linked to a nomadic sector of the community, or they may come from a mixing of refuse from both the temporary and permanent areas of the settlement. As the specimens studied include only a portion of the faunal remains derived from ongoing excavations of the Early Bronze Age deposits, subsequent analysis of the remainder of the assemblage should allow for greater clarity concerning the characteristics of the economy.

Finally, both the architectural and faunal remains may provide an accurate picture of the nature of the settlement at Sos Höyük during the Early Bronze Age period. This would necessitate some reinterpretation of the nature of the architectural evidence in the light of the findings from the animal remains, in terms of how the apparently impermanent nature of the architecture and permanency of the economy formed part of a cohesive system, or why, given the nature of the climate in this region and the sedentariness of the community, more permanent structures were not constructed. The year round occupation implied by the faunal remains is supported by initial findings from analysis of the obsidian tools from Early Bronze Age contexts. The characteristics of the stone artifact assemblage indicate conservation of tools throughout periods of inaccessibility to the obsidian source during winter, and the presence of types for plant harvesting during summer (Sagona *et al.* 1998). This may suggest that the conclusions of permanency of occupation derived from the faunal remains are accurate, although the preliminary state of research into the stone tool industry, and the as yet unexcavated Early Bronze Age contexts from Sos Höyük, dictate that these suggestions remain tentative.

It is unfortunate that the deposit from Early Bronze Age Büyüktepe Höyük, which provides the strongest evidence for temporary occupation in the form of a possible nomadic encampment, yielded only negligible animal bone finds. The small number of animal remains precludes anything more than the most superficial assessment of the faunal remains in terms of such characteristics as domestication and morphology, and thus provides little evidence concerning the nature of economy.

Chapter 9
CONCLUSION

9.1 The Results of the Current Study

The assemblages from Early Bronze and Iron Age levels from Sos Höyük and Büyüktepe Höyük were analysed to reconstruct subsistence patterns and economic strategies. With the exception of the Early Bronze Age sample from Büyüktepe Höyük, which proved to be of inadequate size for anything more than the most rudimentary of conclusions, the assemblages reveal a high level of spatial and temporal consistency and comparability in terms of the essential characteristics of the subsistence economy. These features could furthermore be readily placed within the wider economic patterns of the eastern Anatolia region, and as such reveal a level of economic conformity for this region between the Early Bronze and Iron Age periods.

A clear reliance upon domestic taxa, principally ovicaprids and cattle, is apparent throughout all assemblages and appears to confirm trends for the preferential exploitation of domestic over wild taxa elsewhere in eastern Anatolia. Herd management for the main domesticates focused on primary products in each of the studied assemblages. This appears to differ somewhat from contemporaneous sites which reflect mixed economies yielding both primary and secondary products. Various facets of evidence from Sos Höyük and Büyüktepe Höyük, including the presence of castrates amongst the cattle, evidence of butchery patterns, and the recovery of spindle whorls, however, indicates that animal exploitation also involved various secondary and non-renewable resources. These included traction or cartage work, use of wool and dairy products, and the exploitation of hides, marrow and horn cores. The animal economies of Sos Höyük and Büyüktepe Höyük therefore illustrate a comparability with those from contemporaneous levels elsewhere in eastern Anatolia, despite vast differences in topographical and climatic characteristics and the functional diversity of the sites concerned, ranging from large administrative centres such as at Early Bronze Age Lidar Höyük to the small scale settlements of Iron Age Sos Höyük and Büyüktepe Höyük.

Domestic taxa other than cattle, sheep and goats were used at a lower level of exploitation, with the corpus of species being comparable throughout the assemblages. The relative representation of domestic taxa is also comparable across the studied assemblages. Comparison with the relative abundance of domestic taxa at other Anatolian sites reveals that the results from Sos Höyük and Büyüktepe Höyük are comparable.

The nature of exploitation of wild taxa remains somewhat elusive, with little direct evidence of the resources for which species were hunted or trapped. Comparable finds from contemporaneous levels at other eastern Anatolian sites indicates that the corpus of exploited taxa was similar throughout the region. Meat, pelts, and feathers comprise probable exploited resources, whilst in the case of red deer, antlers were clearly a favoured and much utilised commodity.

Although some variation is apparent in the corpus of wild taxa exploited between the two sites of Sos Höyük and Büyüktepe Höyük, the ecological preferences of the species represented provide little evidence for variation in the vegetational environment through either time or space. This suggests that this variable did not influence, to any great extent, the nature of exploitation of domestic taxa in terms of the herding strategies practised or the taxa exploited.

Analysis of the assemblages indicate the presence in each case of essentially sedentary economies. Indeed, a number of characteristics of the studied assemblages do not appear to comply with the expected characteristics of a fully or semi-nomadic economy, including the range of taxa present, the physical and dietary requirements of these taxa, the presence of fœtal and neonatal domestic animals, and the nature of exploitation of seasonally available wild resources within the vicinity of the sites. All of these features combine to suggest that a semi- or fully sedentary mixed economy was practised during the periods studied. The changes apparent in the architectural traditions from the flimsy architecture of Early Bronze Age Sos Höyük, to the more permanent mud brick structures of Iron Age Sos Höyük and Büyüktepe Höyük, therefore contrast with the continuity and comparability in herding strategies and management.

9.2 Problems Encountered during the Current Study

In many aspects of the current study, sample size proved to be problematic in terms of the range of analytical techniques that could be applied to assemblages or to the extent to which results could be interpreted. The limitations of inadequate sample size were overcome to some extent through the application of techniques, such as the logarithm ratio diagrams, that permit patterns to be evaluated from fragmentary and poorly represented finds. Future inclusion of remains from ongoing excavations of Early Bronze and Iron Age levels at Sos Höyük will increase sample size and subsequently reduce the tentativeness of some of the conclusions relating to that site in the current study. The samples from Büyüktepe Höyük however represent the entire assemblage of excavated faunal remains from that site. The extremely small size of the Early Bronze sample cannot therefore be augmented through further excavation work and thus must unfortunately be taken as providing only limited insights into the nature of subsistence patterns at the site during this period. The lack of comparative material and measurements from contemporaneous contexts also hampered analysis in many instances. Continued publication of the results of zooarchaeological analyses, including the incorporation of exhaustive quantitative and qualitative data, will greatly enhance efforts to compare the results of a given study to those of contemporaneous assemblages.

9.3 Directions for Future Research

Further analysis of the archaeological and artifactual remains from the sites will enhance interpretation of the economic strategies and patterns practised at the settlements during the Early Bronze and Iron Age periods. Analysis of the architectural evidence from the Early Bronze Age levels may serve to clarify the degree of permanency or duration of occupation of the dwellings, while analysis of the artifactual evidence, including the ceramic traditions and lithic assemblages, may reveal the nature and seasonal availability of exploited resources. Analysis of detailed contextual information will serve to clarify the seemingly incongruous relationship between the faunal remains and the architectural evidence and will help determine temporal and spatial variation. This will also permit a more in-depth consideration of the influence of taphonomic factors over the assemblages, including assessment of what impact differential deposition or preservation exerted over the characteristics of the excavated assemblages. Finally, the apparent comparability of the economic patterns of the eastern Anatolian sites, whilst beyond the scope of the current study, requires further investigation. Environmental considerations seem to have exerted some influence over the selection and relative abundance of the domestic and wild taxa exploited. An investigation of the level of comparability of cultural factors such as political or social mechanisms may provide insights into the influence of these characteristics over the economic patterns of the sites concerned. The influence of the level of development of farming over the nature of economic patterns also requires investigation. For instance, the extremely low degree of exploitation of wild resources probably resulted from the fact that herding of domesticates could provide a fairly reliable and predictable source of resources, requiring only minimal supplementation from wild taxa. The level of development of herding practices during the Early Bronze and Iron Age periods may therefore have exerted an impact over the characteristics of the subsistence economy in terms of the taxa exploited and the main products for which they were kept.

9.4 Concluding Remarks

The comparability of the faunal assemblages from Sos Höyük and Büyüktepe Höyük through both space and time argues that a degree of economic conservatism existed in northeast Turkey during this period. This conservatism may have been either culturally or environmentally dictated. The differences in architecture between the Early Bronze and Iron Age period at both sites, when viewed in relation to the apparent lack of change in the environment as implied by the nature and relative abundance of the wild and domestic resources, may however argue that cultural influences provided the main impetus to economic comparability between different assemblages. In order to extrapolate as to what extent the sites of Sos Höyük and Büyüktepe Höyük are representative of economic patterns for the northeastern region, analyses of assemblages from additional sites are required. The essential comparability of the assemblages to those from elsewhere in eastern Turkey, involving settlements with vastly differing functions, however, suggests that the results from Sos Höyük and Büyüktepe Höyük may be representative of the region and, indeed, underlie a conservatism of economic approach across the eastern region as a whole.

BIBLIOGRAPHY

Abdul-Aziz- Neumani, 1911, *The Comparative Osteology of the Camel.* Cairo.

Afshar, A., 1978, 'Camels at Persepolis.' *Antiquity* 52: 228-231.

Aird, P., 1985, 'On Distinguishing Butchery from other Post-mortem Destruction: a Methodological Experiment Applied to a Faunal Sample from Roman Lincoln.' In: N. Fieller, D. Gilbertson & N. Ralph eds. *Palaeobiological Investigations: Research Design, Methods and Data Analysis,* pp.5-18. BAR, International Series 266, Oxford.

Albarella, U. & S. Davis, 1996, 'Mammals and birds from Launceston Castle, Cornwall: Decline in Status and the Rise of Agriculture.' *Circaea* 12(1): 1-156.

Alderton, D., 1988, *Turtles and Tortoises of the World.* Facts on File Publications, New York.

Alex, M., 1983a, *Vorderer Orient. Mittelere Januartemperaturen.* 1:8,000,000. Karte A IV 2. Dr. Ludwig Reichert Verlag, Wiesbaden.

1983b, *Vorderer Orient. Mittelere Julitemperaturen.* 1:8,000,000. Karte A IV 3. Dr. Ludwig Reichert Verlag, Wiesbaden.

1984, *Vorderer Orient. Mittelere Jahresniederschäge und Variabilität.* 1:8,000,000. Karte A IV 4. Dr. Ludwig Reichert Verlag, Wiesbaden.

1985a,*Vorderer Orient. Niederschlagsverläßigkeit.* 1:12,000,000. Karte A IV 5. Dr. Ludwig Reichert Verlag, Wiesbaden.

1985b, *Vorderer Orient. Jahresgangtypen des Niederschlags* 1:12,000,000. Karte A IV 6. Dr. Ludwig Reichert Verlag, Wiesbaden.

Allen, J. & J. Guy, 1984, 'Optimal Estimations of Individuals in Archaeological Faunal Assemblages: How Minimal is the MNI?' *Archaeology in Oceania* 19: 41-47.

Amir, D., A. Genizi & H. Schindler, 1980, 'Seasonal and other Changes in the Gestation Duration of Sheep.' *Journal of Agricultural Science, Cambridge* 95: 47-49.

Amorosi, T., 1989, *A Post-cranial Guide to Domestic Neo-Natal and Juvenile Mammals: The Identification and Aging of Old World Species.* BAR International Series, 533, Oxford.

Andrews, A., 1982, 'The Use of Dentition to Age Young Cattle'. In: B. Wilson, C. Grigson, & S. Payne, eds., *Aging and Sexing Animal Bones from Archaeological Sites,* pp.141-153. BAR British Series 109, Oxford.

Anthony, D., 1991, 'The Domestication of the Horse.' In: R. Meadow & H.-P. Uerpmann, eds., *Equids in the Ancient World, II,* pp.250-277. Dr. Ludwig Reichert Verlag, Wiesbaden.

Armitage, P., 1982, 'A System for Aging and Sexing the Horn Cores of Cattle from British Post-medieval Sites (with Special Reference to Unimproved British Longhorn Cattle).' In: B. Wilson, C. Grigson, & S. Payne, eds., *Aging and Sexing Animal Bones from Archaeological Sites,* pp.37-54. BAR British Series 109, Oxford.

Armitage, P. & J. Clutton-Brock, 1976, 'A System for the Classification and Description of the Horn Cores of Cattle from Archaeological Sites.' *Journal of Archaeological Science* 3: 329-348.

A.S.P., 1983, *Agriculture Structure and Production.* Prime Ministry State Institute of Statistics, Turkey.

Baker, J., 1978 'The Differential Diagnosis of Bone.' In: D. Brothwell, K. Thomas, & J. Clutton-Brock, eds., *Research Problems in Zooarchaeology,* pp. 107-112. Institute of Archaeology of the University of London, London.

1984, 'The Study of Animal Diseases with regard to Agricultural Practices and Man's Attitude to his Animals.' In: C. Grigson, & J. Clutton-Brock, eds., *Animals and Archaeology: 4. Husbandry in Europe*, pp.253-257. BAR International Series 227, Oxford.

Baker, J. & D. Brothwell, 1980, *Animal Diseases in Archaeology.* Academic Press, London.

Balikçi, A., 1990, 'Tenure and Transhumance: Stratification and Pastoralism among the Lakenkhel.' In J. Galaty, & D. Johnson, eds., *The World of Pastoralism: Herding Systems in Comparative Perspective,* pp. 301-322. The Guilford Press, New York.

Balkwill, D. & S. Cumbaa, 1992, *A Guide to the Identification of Postcranial Bones of Bos taurus and Bison bison.* Canadian Museum of Nature,Syllogeus, No. 71, Ottowa.

Barfield, T., 1993, *The Nomadic Alternative.* Prentice Hall, New Jersey.

Barth, F., 1965, *Nomads of South Persia: the Basseri Tribe of the Khamesh Confederacy.* Humanities Press, New York.

Bartos, L., 1990, ' Social Status and Antler Development in Red Deer' In: G. Bubenik, & A. Bubenik, eds., *Horns, Pronghorns and Antlers: Evolution, Morphology, Physiology and Social Significance*, pp. 442-459. Springer Verlag, New York.

Bartosiewicz, L., 1984, 'Reconstruction of Prehistoric Cattle Represented by Astragali in a Bronze Age "Sacrificial Pit"'. In: C. Grigson, & J. Clutton-Brock, eds., *Animals and Archaeology: 4. Husbandry in Europe*, pp. 67-80 BAR International Series 227, Oxford.

1985, 'Interrelationships in the Formation of Cattle Long Bones.' *Zoologischer Anzeiger* 215(1/2): 253-262.

1987, 'Cattle Metapodials Revisited: a Brief Review.' *Archaeozoologia* 1(1): 47-51.

1988, 'Camel Remains from Hungary.' In: H. Nuitenhuis, & H.-P. Uerpmann, eds., *Archaeozoology of the Near East, II: Proceedings of the Second Symposium on the Archaeozoology of Southwestern Asia and Adjacent Areas*, pp. 119-125. Backhuys Publishers, Leiden.

Bates, D., 1973, *Nomads and Farmers: A Study of the Yörük of South East Turkey.* University of Michigan, Ann Arbour.

Beasley, M., W. Brown & A. Legge, 1993, 'Metrical Discrimination between Mandibular First and Second Molars in Domestic Cattle.' *International Journal of Osteoarchaeology* 3: 303-314.

Benecke, N., 1987, 'Studies on Early Dog Remains from Northern Europe.' *Journal of Archaeological Science* 14: 31-49.

Binford, L., 1978, *Nunamiut Ethnoarchaeology.* Academic Press, New York.

1981, *Bones: Ancient Men and Modern Myths.* Academic Press, New York.

1984, *Faunal Remains from Klasies River Mouth.* Academic Press, New York.

Binford, L., & Bertram, 1977, 'Bone Frequencies- and Attritional Processes.' In: L. Binford, ed., *For Theory-Building in Archaeology*, pp. 77-153. Academic Press, New York.

Bingöl, E., 1985, *Türkei. Geologie (Ostteil)*, 1:8,000,000. Karte A II 4. Dr. Ludwig Reichert Verlag, Wiesbaden.

Bjärvall, A., & S. Ullström, 1986, *The Mammals of Britain and Europe.* Croom Helm, London.

Black-Michaud, J., 1974, 'An Ethnographic and Ecological Survey of Luristan, Western Persia: Modernisation in a Nomadic Pastoral Society.' *Middle East Studies* 10: 210-28.

1986, *Sheep and Land: the Economics of Power in a Tribal Society.* Cambridge University Press, Cambridge.

Bobek, H., 1951, 'Die Naturlichen Wälder und Gehölzfluren Irans'. *Bonner Geographische Abhandlungen.* 8.

Boessneck, J., 1969, 'Osteological differences between Sheep (*Ovis aries* Linne) and Goat (*Capra hircus* Linne).' In: D. Brothwell, & E. Higgs, eds., *Science in Archaeology*, pp. 331-358. Thames and Hudson, London.

1970, 'Ein altägyptisches Pferdeskelett.' *Mitteilungen des Deutschen Archäolgischen Instituts, Kairo* 26: 43-47.

1992, 'Besprechung der Tierknochen- und Molluskenreste von Hassek Höyük.' In: M. Behm-Blancke, ed. *Hassek Höyük: Naturwissenschaftliche Untersuchungen und Lithische Industrie*, pp. 58-74 Ernst Wasmuth Verlag, Tübingen.

Boessneck, J. & A. von den Driesch, 1975, Tierknochenfunde vom Korucutepe bei Elazig in Ostanatolien. In: M. van Loon, ed., *Korucutepe: Final Report on the Excavations of the Universities of Chicago, California (Los Angeles) and Amsterdam in the Keban Reservoir, Eastern Anatolia, 1968-1970*, pp. 1-191. Vol. 1. North Holland Publishing Company, Amsterdam.

1976a, 'Die Tierknochenfundeaus den Ausgrabungen von 1971 und 1972 auf dem Tültintepe.' *Türk Tarih Kurumu Basımevi, Ankara:* 173-174.

1976b, 'Die Wildfauna der Altinova in Vogeschichtlicher Zeit, wie die sie Knochenfunde vom Norşun-Tepe und anderen Siedlungshügeln Erschliessen.' *Türk Tarih Kurumu Basımevi, Ankara*: 91-100.

1978, 'Vorläufiger Bericht über die Untersuchungen an Knochenfunden vom Demircihüyük (Nordwestanatolien)'. *Istanbuler Mitteilungen* 27/28, 1977/78: 54-59.

1978a, 'The Significance of Measuring Animal Bones from Archaeological Sites'. In: R. Meadow, & M. Zeder, eds., *Approaches to Faunal Analysis in the Middle East*, pp. 25-39. Peabody Museum Bulletin 2, Cambridge, Massachuesetts.

1978b, 'Die Zoologische Dokumentation von Drei Pferdskeletten und anderen Tierknochenfunden aus einem Kammergrab auf dem Norşun-Tepe (Ostanatolien). *Istanbuler Metteilung* 27/28, 1977/78: 73-91.

1979a, 'Die Tierknochenfunde aus den Ausgrabungen 1970 bis 1973 auf dem Tepecik.' *Türk Tarih Kurumu Basımevi, Ankara*: 113-114.

1979b, *Die Tierknochenfunde aus der Neolithischen Siedlung auf dem Fikirtepe bei Kadiköy am Marmarameer.* München.

1981, 'Tierknochen vom Hassek-Höyük.' *Istanbuler Mitteilungen* 31: 88-90.

1983, 'Tierknochenfunde aus Didyma.' *Archaeologischer Anzeiger* 4: 611-651.

1987, 'Analyse der Vogel-, Reptilien-, Amphibien- und Fischknochen.' In: M. Korfmann ed., *Demircihüyük: Die Ergebnisse der Ausgrabungen 1975-1978*, Vol. 2, pp.43-52 Naturwissenschaftliche Untersuchungen, Mainz am Rhein.

Boessneck, J., H. Müller & M. Teichert, 1964, 'Osteologische Unterscheidungsmerkmale zwischen Schaf (*Ovis aries* LINNE) und Ziege (*Capra hircus* LINNE).' *Kühn-Archiv*, 78: 1-129.

Boessneck, J. & U. Schäffer, 1986, 'Tierknochenfunde aus Didyma II.' *Archaeologischer Anzeiger* 7: 251-301.

Boessneck J. & U. Wiedemann, 1977, 'Tierknochen aus Yarıkkaya bei Boğazköy, Anatolien.' *Archäologie und Naturwissenschaften* 1: 106-128Bogucki, P., 1993, 'Animal Traction and Household Economies in Neolithic Europe.' *Antiquity* 67: 492-503.

Bökönyi, S., 1972/1973, 'An Early Representation of Domesticated Horse in North Mesopotamia.' *Sumer* 28/29: 35-38.

1972, 'Zoological Evidence for Seasonal or Permanent Occupation of Prehistoric Settlements.' In: P. Ucko, R. Tringham & G. Dimbleby eds., *Man, Settlement, and Urbanism,* pp. 121-126. Duckworth, London.

1978, 'Environmental and Cultural Differences as Reflected in the Animal Bone Samples from Five Early Neolithic Sites in Southwest Asia.' In: R. Meadow, & M. Zeder, eds., *Approaches to Faunal Analysis in the Middle East*, Peabody Museum Bulletin 2, 57-62. Cambridge, Massachesetts.

1986, The Equids of Umm-Dabaghiyah, Iraq. In: R. Meadow & H.-P. Uerpmann, eds., *Equids in the Ancient World*, pp. 302-317. Dr. Ludwig Reichert Verlag, Wiesbaden.

1993, 'Hunting in Arslantepe, Anatolia' In: Fragipane, M., ed., *Between the Rivers and Over the Mountains: Archaeologica Anatolica at Mesopotamica Alba Palmeri Dedicata*, pp. 341-359. Università di Roma, Rome.

1991, 'Late Chalcolithic Horses in Anatolia.' In: R. Meadow & H.-P. Uerpmann, eds., *Equids in the Ancient World, II*, pp. 123-131. Dr. Ludwig Reichert Verlag, Wiesbaden.

Bökönyi, S. & L. Bartosiewicz, 1983, 'Testing the Utility of Quantitative Methods in Sex Determination of Hen (*Gallus domesticus* L.) Bones.' *Zoologischer Anzeiger* 210(3/4): 204-212.

1987, 'Domestication and Variation.' *Archaeozoology* 1 (1): 161-170.

Bonfield, W. & Li, C., 1966, 'Deformation and fracture of bone.' *Journal of Applied Physics* 37: 869-875.

Boyozoglu, J. & J.-C. Flamart, 1990, 'Meditteranean Systems of Animal Production.' In J. Galaty & D. Johnson, eds., *The World of Pastoralism: Herding Systems in Comparative Perspective,* pp. 353-393. The Guilford Press, New York.

Brain, C. ,1976, 'Some Principles in the Interpretation of Bone Accumulations Associated with Man.' In: G. Isaac & E. McCown, eds., *Human Origins: Louis Leakey and the East African Evidence,* pp. 97-116. W.A. Benjamin, New York.

Brewer, D., 1992, 'Zooarchaeology; Method, Theory, and Goals.' In: M., Schiffer, ed. *Archaeological Method and Theory,* Vol. 4, pp. 195-244 University of Arizona Press, Tuscon.

Breidermann, L., 1965, *Die Alterbestimmung erlegten Schwarzwildas,* Deutsche Akademie der Landwirtschaftswissenschaften zu Berlin. Arbeitsgemeinschaft für Jagd- und Wildforschung, Merkblat 22, Berlin.

Brown, B., P. Christofferson, M. Masser, & M. Weiss, 1960, 'Postnatal Tooth Development in Cattle.' *American Journal of Veterinary Research* 21(80): 7-34.

Bubenik, A., 1990a, 'Epigenetical, Morphological, Physiological and Behavioural Aspects of Evolution of Horns, Pronghorns, and Antlers' In: G. Bubenik & A. Bubenik, eds., *Horns, Pronghorns and Antlers: Evolution, Morphology, Physiology and Social Significance*, pp. 3-113. Springer-Verlag, New York.

1990b, 'The Antler as a Model in Biomedical Research' In: G. Bubenik & A. Bubenik, eds., *Horns, Pronghorns and Antlers: Evolution, Morphology, Physiology and Social Significance,* pp.474-487. Springer-Verlag, New York.

Buikstra, J. & M. Swegle, 1989, 'Bone Modification Due to Burning: Experimental Evidence.' In: R. Bonnichsen, & M. Song, eds., *Bone Modification,* pp. 247-258. Centre for Study of the First Americans, Orano, Maine.

Buitenhuis, H., 1984, 'Some Remarks on the Possible Development of *Bos taurus* Breeds in the Near East.' In: C. Grigson, & J. Clutton-Brock, eds., *Animals and Archaeology: 3. Early Herders and their Flocks,* pp. 247-258, BAR International Series 227, Oxford.

1985, 'Preliminary Report on the Faunal Remains of Hayaz Höyük from the 1979-1983 Seasons.' *Anatolica* 12: 61-73.

1991, 'Some Equid Remains from South Turkey, North Syria and Jordan.' In: R. Meadow & H.-P. Uerpmann, eds., *Equids in the Ancient World, II*, pp. 34-74. Dr. Ludwig Reichert Verlag, Wiesbaden.

Bull, G., & S. Payne, 1982, 'Tooth Eruption and Epiphyseal Fusion in Pigs and Wild Boar.' In: B. Wilson, C. Grigson, & S. Payne, eds., *Aging and Sexing Animal Bones from Archaeological Sites,* pp. 55-71. BAR British Series 109, Oxford.

Bullock, D. & J. Rackham, 1982, 'Epiphyseal Fusion and Tooth Eruption of Feral Goats from Moffatdale, Dumfries and Galloway, Scotland.' In: B. Wilson, C. Grigson, & S. Payne, eds., *Aging and Sexing Animal Bones from Archaeological Sites,* pp. 73-80. BAR British Series 109, Oxford.

Burleigh, R., 1986, 'Chronology of Some Early Domestic Equids in Egypt and Western Asia.' In: R. Meadow & H.-P. Uerpmann, eds., *Equids in the Ancient World*, pp. 230-236. Dr. Ludwig Reichert Verlag, Wiesbaden.

Burleigh, R., J. Clutton-Brock, P. Felder, & G. Sieveking, 1977, 'A Further Consideration of Neolithic Dogs with Special Reference to a Skeleton from Grime's Graves (Norfolk), England.' *Journal of Archaeological Science* 4: 353-366.

Caloi, L., 1978, 'The Bone Remains of Small Wild Carnivores from Shahr-i Sokhta' In: R. Meadow, & M.

Zeder, eds., *Approaches to Faunal Analysis in the Middle East*, pp. 129-132. Peabody Museum Bulletin 2, Cambridge Massachusetts.

Carruthers, D., 1997, 'Post-excavation Report: Zooarchaeological Research: Pinarbaşi' *Anatolian Archaeology: Reports on Research Conducted in Turkey* 3: 27.

Carter, H., 1977, 'Vertebrae of the Larger Mammals of Western Europe.' *Ossa* 3/4: 109-127.

Casteel, R., 1974, 'On the Number and Sizes of Animals in Archaeological Faunal Assemblages.' *Archaeometry* 16: 238-243.

1977, 'A Consideration of the Behaviour of the Minimum Number of Individuals Index: A Problem of Faunal Characterisation.' *Ossa* 3/4: 141-151.

1978, 'Faunal Assemblages and the "Wiegemethode" or Weight Method.' *Journal of Field Archaeology* 5: 71-77

Casteel, R., & D., Grayson, 1977, 'Terminological Problems in Quantitative Faunal Analysis.' *World Archaeology* 9(2): 235-242.

Chang, C., & P. Tourtellotte, 1993, 'Ethnoarchaeological Survey of Pastoral Transhumance Sites in the Grevena Region, Greece.' *Journal of Field Archaeology* 20: 249-264.

Chaplin, R., 1971, *The Study of Animal Bones from Archaeological Sites*. Seminar Press, London.

Chase, P., & R. Hagaman, 1987, 'Minimum Number of Individuals and its Alternative: a Probability Theory Prospective.' *Ossa* 13: 75-86.

Choyke, A., 1984, 'Patterns in the Use of Cattle and Sheep/Goat Metapodials in Bronze Age Hungary', In: C. Grigson, & J. Clutton-Brock, eds., *Animals and Archaeology: 4. Husbandry in Europe*, pp. 57-65. BAR International Series 227.

Clark, G., 1991, 'The Contribution of Faunal Analysis in the Study of Prehistoric and Historical Pastoralism in Italy.' *Rivista di Studi Liguri, A.* 57 (1-4): 73-80.

Clason, A. & W. Prummel, 1977, 'Collecting, Sieving and Archaeozoological Research.' *Journal of Archaeological Science* 4: 171-175.

Clayton Wilson, M., 1982, 'Cut Marks and Early Hominids: Evidence for Skinning.' *Nature* 298: 303.

Clutton-Brock, J., 1963, 'The Origins of the Dog.' In: D. Brothwell, & E. Higgs, eds. *Science in Archaeology: A Comprehensive Survey of Progress and Research,* pp. 269-274. Thames & Hudson, London.

1974, 'The Buhen Horse.' *Journal of Archaeological Science* 1: 89-100.

1984, 'Dog.' In: I. Mason, ed. *Evolution of Domesticated Animals,* pp. 198-211. Longman, London.

1986, 'Osteology of the Equids from Sumer.' In: R. Meadow & H.-P. Uerpmann, eds., *Equids in the Ancient World*, pp. 207-229. Dr. Ludwig Reichert Verlag, Wiesbaden.

Clutton-Brock, J., K. Dennis-Bryan, P. Armitage, & P. Jewell, 1990, 'Osteology of Soay Sheep.' *Bulletin of the British Museum of Natural History* 56 (1): 1-56.

Clutton-Brock, T. & S. Albon, 1989, *Red Deer in the Highlands.* BSP Professional Books, Boston.

Cohen, A. & D. Serjeantson, 1996, *A Manual for the Identification of Bird Bones from Archaeological Sites,* (revised edition). Archetype Publications, London.

Compagnoni, B., 1978, 'The Bone Remains of *Equus hemionus* from Shahr-i Sokhta.' In: R. Meadow, & M. Zeder, eds., *Approaches to Faunal Analysis in the Middle East*, pp.105-118. Peabody Museum Bulletins, Cambridge, Massachusetts.

Compagnoni, B., & M. Tosi, 1978, 'The Camel: its Distribution and State of Domestication in the Middle East during the Third Millennium B.C. in Light of the Finds from Shahr-i Sokhta' In: R. Meadow, & M. Zeder, eds., *Approaches to Faunal Analysis in the Middle East*, pp. 87-103. Peabody Museum Bulletins, Cambridge, Massachusetts.

Corbett, G. & J. Hill, 1991, *A World List of Mammalian Species,* (third edition), Oxford University Press, Oxford.

Crabtree, P., 1984, 'Historical Mammal Remains from Providence Cove Lands (RI-935), Rhode Island.' *MASCA* 3 (1): 13-16.

1993, 'Early Animal Domestication in the Middle East and Europe.' In: M. Schiffer, ed., *Archaeological Method and Theory* 5: 201-245.

Cramp, S., (chief ed.), 1978, *Handbook of the Birds of Europe, the Middle East and North Africa: The Birds of the Western Palearctic. Vol I, Ostrich to Ducks,* Oxford University Press, Oxford.

1980, *Handbook of the Birds of Europe, the Middle East and North Africa: The Birds of the Western Palearctic. Vol II, Hawks to Bustards,* Oxford University Press, Oxford.

1989, *Handbook of the Birds of Europe, the Middle East and North Africa: The Birds of the Western Palearctic. Vol. IV. Terns to Woodpeckers,* Oxford University Press, Oxford.

1994, *Handbook of the Birds of Europe, the Middle East and North Africa: The Birds of the Western Palearctic. Vol VIII, Crows to Finches,* Oxford University Press, Oxford.

Crawford, R., 1984, 'Domestic Fowl.' In: I. Mason, ed. *Evolution of Domesticated Animals,* pp. 298-310. Longman, London and New York.

Cribb, R., 1987, 'The Logic of the Herd: A Computer Simulation of Archaeological Herd Structure.' *Journal of Anthropological Archaeology* 6: 376-415.

1991, *Nomads in Archaeology.* Cambridge University Press, Cambridge.

Dahl, G., & A. Hjort, 1976, *Having Herds: Pastoral Herd Growth and Household Economy,* Studies in Social Anthropology 2. University of Stockholm, Stockholm.

Daly, P., 1969, 'Approaches to Faunal Analysis in Archaeology.' *American Antiquity* 34 (2): 146-153.

Davis, S., 1976, 'Mammal Bones from the Early Bronze Age City of Arad, Northern Negev, Israel: Some Implications Concerning Human Exploitation.' *Journal of Archaeological Science* 3: 153-164.

1980, 'Late Pleistocene and Holocene equid remains from Israel.' *Zoological Journal of the Linnean Society* 70: 289-312.

1996, 'Measurements of a Group of Adult Female Shetland Sheep Skeletons from a Single Flock: a Baseline for Zooarchaeologists.' *Journal of Archaeological Science* 23: 593-612.

Davis, S., N. Goring-Morris, & A. Gopher, 1982 'Sheep Bones from the Negev Epipalaeolithic.' *Paléorient* 8 (1): 87-93.

Davis, S. & F. Valla, 1978, Evidence for Domestication of the Dog 12,000 Years Ago in the Natufian of Israel.' *Nature* 276: 608- 610.

Dayan, T., 1994, 'Early Domestic Dogs in the Near East.' *Journal of Archaeological Science* 21: 633-640

Degerbøl, M., 1963, 'Prehistoric Cattle in Denmark and Adjacent Regions. In: A., Mourant, & F., Zeuner, eds., *Man and Cattle: Proceedings of a Symposium on Domestication at the Royal Anthropological Institute 24-26 May 1960,* pp. 69-79. Royal Anthropological Institute, London.

Degerbøl, M. & B. Fredskild, 1970, *The Urus (Bos primigenius Bojanus) and Neolithic Domesticated Cattle (Bos taurus domesticus Linne) in Denmark.* Biologiske Skrifter 17(1), København.

Deniz, E., 1975, 'Neolithic, Chalcolithic and Early Bronze Age Faunal Remains from Pulur Höyük (Keban Dam Region), Turkey.' In: A. Clason ed., *Archaeozoological Studies,* pp. 284-294. Amsterdam.

Deniz, E. & S. Payne, 1982, 'Eruption and Wear in the Mandibular Dentition as a Guide to Aging Turkish Angora Goats' In: B. Wilson, C. Grigson, & S. Payne, eds. *Aging and Sexing Animal Bones from Archaeological Sites.* pp. 155-214. BAR British Series 109.

1983, 'Eruption and Wear in the Mandibular Dentition of Turkish Angora Goats in Relation to Aging Sheep/goat Mandibles from Archaeological Sites.' In: M. Kubasiewicz, ed., *Archaeozoology, Vol. 3.* pp. 153-161. Agricultural Academy.

Diener, P. & E. Robkin, 1978, 'Ecology and Evolution and the Search for Cultural Origins: The Question of Islamic Pig Prohibition.' *Current Anthropology* 19: 493-540.

Dive, J. & V. Eisenmann, 1991, 'Identification and Discrimination of First Phalanges from Pleistocene and Modern *Equus*, Wild and Domestic.' In: R. Meadow & H.-P. Uerpmann, eds., *Equids in the Ancient World, II,* pp. 278-327. Dr. Ludwig Reichert Verlag, Wiesbaden.

Driesch, A. von den , 1976 *A Guide to the Measurement of Animal Bones from Archaeological Sites.* Peabody Museum Bulletin 1, Cambridge, Massachusetts.

Driesch, A. von den & J. Boessneck, 1987, 'Gesamtergebnis der Untersuchungen an den Tierknochenfunden vom Demircihüyük.' In: M. Korfmann ed., *Demircihüyük: Die Ergebnisse der Ausgrabungen 1975-1978.* pp. 52-66. Vol. 2. Naturwissenschaftliche Untersuchungen, Mainz am Rhein.

Drennan, R., 1996, *Statistics for Archaeologists: a Common sense Approach.* Plenum Press, New York.

Driver, J., 1985, 'Zooarchaeology of Six Prehistoric Sites in the Sierra Blanca Region, New Mexico.' *Research Papers in Archaeology* 12. University of Michigan, Ann Arbour.

Ducos, P., 1970, 'The Oriental Institute Excavations at Mureybit, Syria, Preliminary Report on the 1965 Campaign, Part 4: Les Restes d'Equides.' *Journal of Near Eastern Studies* 29: 273-289.

1975, 'A New Find of an Equid Metatarsal Bone from Tell Mureybit in Syria and its Relevance to the Identification of Equids from the Early Holocene of the Levant.' *Journal of Archaeological Science* 2: 71-7

1986, 'The Equid of Tell Muraibit, Syria.' In: R. Meadow & H.-P. Uerpmann, eds., *Equids in the Ancient World.* pp. 237-245. Dr. Ludwig Reichert Verlag, Wiesbaden.

Edmonds, C., 1957, *Kurds, Turks and Arabs: Politics, Travel and Research in North East Iraq, 1919-1925.* Oxford University Press. London.

Eisenmann, V., 1986, 'Comparative Osteology of Modern and Fossil Horses, Half-asses and Asses.' In: R. Meadow & H.-P. Uerpmann, eds., *Equids in the Ancient World.* pp. 67-116. Dr. Ludwig Reichert Verlag, Wiesbaden.

Eisenmann, V. & S. Beckouche, 1986, 'Identification and Discrimination of Metapodials from Pleistocene and Modern *Equus*, Wild and Domestic. In: R. Meadow & H.-P. Uerpmann, eds., *Equids in the Ancient World.* pp. 117-163. Dr. Ludwig Reichert Verlag, Wiesbaden.

Ellenberger, W. & H. Baum, 1915, *Handbuch der Vergleichenden Anatomie der Haustiere,* (fourteenth edition). Verlag August Hirschwald, Berlin.

Ellis, R. & M. Voigt, 1982, ' 1981 Excavations at

Gritille, Turkey.' *American Journal of Archaeology* 86: 319-332.

Epstein, H. & A. Herz, 1964, 'Fertility and Birth Weights of Goats in a Subtropical Environment.' *Journal of Agricultural Science* 62: 237-244.

Erinç, S. & N. Tunçdilek, 1952, 'The Agricultural Regions of Turkey.' *Geographical Review* 42 (2): 179-203.

Ernst, C. & R. Barbour, 1989, *Turtles of the World.* Smithsonian Institution Press, Washington.
Erol, O., 1982, *Türkei. Naturräumliche Gliederung (Ostteil),* 1:2,000,000. Karte A VII 2. Dr. Ludwig Reichert Verlag, Wiesbaden.

Ewbank, J., D Phillipson, R. Whitehouse & E. Higgs, 1964, 'Sheep in the Iron Age: a Method of Study.' *The Prehistoric Society* 17: 423-426.

Fieller, N. & A. Turner, 1982, 'Number Estimation in Vertebrate Samples.' *Journal of Archaeological Science* 9: 49-62.

Fisher, J., 1995, 'Bone Surface Modifications in Zooarchaeology.' *Journal of Archaeological Method and Theory* 2(1): 7-67.

Flannery, K., 1983, 'Early Pig Domestication in the Fertile Crescent: a Retrospective Look,' In: T. Cuyler Young, P. Smith, & P. Mortensen, eds., *The Hilly Flanks and Beyond: Essays on the prehistory of Southwestern Asia,* pp. 163-188. Oriental Institute of the University of Chicago, Chicago.

Fletcher, M. & G. Lock, 1994, *Digging Numbers: Elementary Statistics for Archaeologists.* Oxford University Committee for Archaeology, Oxford.

Fock, J., 1966, *Metrische Untersuchungen an Metapodien einiger Europäischer Rinderrassen.* Dissertation, Ludwig-Maxillians-Universitat, München.

Foley, R., D. Bath, F. Dickinson, & H. Tucker, 1973, *Dairy Cattle: Principles, Practices, Problems, Profits.* Lea & Febiger, Philadelphia.

Forbes, J., 1967, 'Factors affecting the Gestation Length in Sheep.' *Journal of Agricultural Science* 68: 191-194.

Galaty, J. & D. Johnson, 1990, 'Introduction: Pastoral Systems in Global Perspective.' In: J. Galaty, & D. Johnson, eds., *The World of Pastoralism: Herding Systems in Comparative Perspective,* pp. 1-32. The Guilford Press, New York.

Gamble, C., 1978, 'Optimising Information from Studies of Faunal Remains.' In: J. Cherry, C. Gamble & S. Shennan. eds., *Sampling Contemporary British Archaeology,* pp.321-353. BAR British Series 50, Oxford.

Garcia-Gonzalez, R., 1981, 'Estudio de la Ossification Postnatal en Ovinos de Raza Rasa Aragonesa.' *Munibs* 33: 259-279.

Gautier, A., 1984, 'How Do I Count You, Let Me Count the Ways? Problems of Archaeozoological Quantification.' In: C. Grigson, & J. Clutton-Brock, eds., *Animals and Archaeology: 4. Husbandry in Europe.* pp. 237-25. BAR International Series 227, Oxford.

1987, 'Taphonomic Groups: How and Why?' *Archaeozoologia* 1(2): 47-52.

Gauthier-Pilters, H. & A. Dagg, 1981, *The Camel: its Evolution, Ecology, Behaviour, and Relationship to Man.* Chicago University Press, Chicago.

Getty, R., 1975, *Sisson and Grossman's: The Anatomy of the Domestic Animals,* (fifth edition.). Vol. 1. W. B. Saunders, Philadelphia .

Gilbert, A., 1983, 'On the Origins of Specialised Nomadic Pastoralism in Western Iran.' *World Archaeology* 15(1): 105-116.

1991, 'Equid Remains from Godin Tepe, Western Iran: an Interim Summary and Interpretation, with Notes on the Introduction of the Horse into Southwest Asia.' In: R. Meadow & H.-P. Uerpmann, eds., *Equids in the Ancient World, II.* pp. 75-121. Dr. Ludwig Reichert Verlag, Wiesbaden.

Gilbert, A. & B. Singer, 1982, 'Reassessing Zooarchaeological Quantification.' *World Archaeology* 14 (1): 21-40.

Gilbert, A. & P. Steinfeld, 1977, 'Faunal Remains from Dinkha Tepe, Northwestern Iran.' *Journal of Field Archaeology* 4: 329-351.

Gogichaishvill, L., R. Kvachakidze, G. Kikava & R. Sharashidze, 1977, 'The History of Forest Vegetation in the Upper Reaches of the White Aragvi in the Holocene.' *Palynological Investigations in Georgia,* pp.114-123. IV International Congress of Palynology, Tbilisi.

Goss, R., 1983 *Deer Antlers: Regeneration, Function and Evolution.* Academic Press, New York.

Grant, A., 1978, 'Variation in Dental Attrition in Mammals and its relevance to Age Estimation.' In: D. Brothwell, K. Thomas, & J. Clutton-Brock, eds., *Research Problems in Zooarchaeology. pp.* 103-106. Institute of Archaeology of the University of London, Occasional Publication, No.3.

1982 'The Use of Tooth Wear as a Guide to the Age of Domestic Ungulates.' In B. Wilson, C. Grigson & S. Payne eds. *Aging and Sexing Animal Bones from Archaeological Sites.* pp. 91-108. BAR British Series 109, Oxford.

1991, 'Identifying and Understanding Pastoralism and Transhumance: an Archaeozoological Approach.' *Rivista di Studi Liguri,* A, 57 (1-4): 13-20.

Grayson, D., 1973, 'On the Methodology of Faunal Analysis.' *American Antiquity* 39 (4): 432-438.

1978, 'Minimum Numbers and Sample Size in Vertebrate Faunal Analysis.' *American Antiquity* 43 (1): 53-65.

1981, 'The Effects of Sample Size on some derived Measures in Vertebrate Faunal Analysis. *Journal of Archaeological Science* 8: 77-88.

1984, *Quantitative Zooarchaeology: Topics in the Analysis of Archaeological Fauna.* Academic Press, London.

Greenfield, H., 1991, 'Fauna from the Late Neolithic of the Central Balkans: Issues in Subsistence and Land Use.' *Journal of Field Archaeology* 18: 161-186.

Grigson, C., 1969, 'The Uses and Limitations of Differences in Absolute Size in the Distinction Between the Bones of Aurochs (*Bos primigenius*) and Domestic Cattle (*Bos taurus*)'. In: P. Ucko, & G. Dimbleby, eds., *The Domestication and Exploitation of Plants and Animals,* pp. 277-294. Duckworth.

1974 'The Craniology and Relationships of Four Species of Bos: 1. Basic Craniology: *Bos taurus* L. and its Absolute Size.' *Journal of Archaeological Science* 1: 353-379.

1975 'The Craniology and Relationships of Four Species of Bos: 2. Basic Craniology: *Bos taurus* L. Proportions and Angles.' *Journal of Archaeological Science* 2: 109-128.

1976, 'The Craniology and Relationships of Four Species of Bos: 3. Basic Craniology: *Bos taurus* L. Saggital Profiles and other Non-measureable Characters.' *Journal of Archaeological Science* 3: 115-136.

1978a, 'The Craniology and Relationships of Four Species of Bos: 4. The Relationship between *Bos primigenius* Boj. and *B. taurus* L. and its Implications for the Phylogeny of the Domestic Breeds.' *Journal of Archaeological Science* 5: 123-152.

1978b, 'Towards a Blueprint for Animal Bone Reports in Archaeology.' In: D. Brothwell, K. Thomas, & J. Clutton-Brock, eds., *Research Problems in Zooarchaeology,* pp. 121-128. Institute of Archaeology of the University of London, Occasional Publication, No.3.

1982a, 'Porridge and Pannage: Pig Husbandry in Neolithic England'. In: S., Limbrey & M. Bell, eds., *Archaeological Aspects of Woodland Ecology,* pp. 297-304. BAR International Series 146, Oxford.

1982b, 'Sex and Age Determination of Some Bones and Teeth of Domestic Cattle: a Review of the Literature.' In: B. Wilson, C. Grigson, & S. Payne, eds., *Aging and Sexing Animal Bones from Archaeological Sites,* pp. 7-24. BAR British Series, 109, Oxford.

1982c, 'Sexing Neolithic Domestic Cattle Skulls and Horn cores.' In: B. Wilson, C. Grigson, & S. Payne, eds. *Aging and Sexing Animal Bones from Archaeological Sites,* pp. 25-35. BAR British Series 109, Oxford.

1987, 'Different Herding Strategies for Sheep and Goats in the Chalcolithic of Beersheva.' *Archaeozoologia* 1 (2): 115-126.

1989, 'Size and Sex: Evidence for the Domestication of Cattle in the Near East.' In: A. Milles, D. Williams & N. Gardner eds. *The Beginning of Agriculture,* pp. 77-109 BAR, International Series 496, Oxford.

1993, 'The Earliest Domestic Horses in the Levant?-New Finds from the Fourth Millennium of the Negev.' *Journal of Archaeological Science* 20(6): 645-655.

Groves, C., 1986, 'The Taxonomy, Distribution, and Adaptations of Recent Equids.' In: R. Meadow & H.-P. Uerpmann, eds., *Equids in the Ancient World.* pp. 11-65. Dr. Ludwig Reichert Verlag, Wiesbaden.

Habermehl, K., 1975, *Die Altersbestimmung bei Haus- und Labortieren.* Paul Parey, Berlin.

Halstead, P., 1992 'Dimini and the 'DMP': Faunal Remains and Animal Exploitation in Late Neolithic Thessaly.' *British School at Athens* 87: 29-59.

1996, 'Pastoralism or Household Herding? Problems of Scale and Specialisation in Early Greek Animal Husbandry.' *World Archaeology* 28 (1): 20-42.

Halstead, P. & P. Collins, 1994, *The Taxonomic Identification of Limb Bones of European Farmyard Animals and Deer: a Multimedia Tutorial.* Teaching and Learning Technology Programme, Glasgow.

Harcourt, R., 1974, 'The Dog in Prehistoric Britain.' *Journal of Archaeological Science* 1: 151-175.

Harrison, D., 1991, *The Mammals of Arabia.* Harrison Zoological Museum, Kent.

Hatting, T., 1983, 'Osteological Investigations on *Ovis aries* L. Dansk.' *Naturhistorisk Forening* 144: 115-135.

Haynes, G., 1980, 'Evidence of Carnivore Gnawing on Pleistocene and Recent Mammalian Bones.' *Paleobiology* 6(3): 341-351.

Heinzel, H., R. Fitter & J. Parslow, 1995, *Birds of Britain and Europe.* Harper Collins, London.

Healy, W. & T. Ludwig, 1965, 'Wear of Sheep's Teeth I. The Role of Ingested Soil.' *New Zealand Journal of Agricultural Research* 8: 737-752.

Hesse, B., 1982, 'Slaughter Patterns and Domestication: The Beginnings of Pastoralism in Western Iran.' *Man* 17: 403-417.

1984, 'These are our Goats: The Origins of Herding in West Central Iran.' In: J. Clutton-Brock, & C. Grigson, eds., *Animals and Archaeology, Vol. 3: Early Herders and their Flocks.* pp. 243-264. BAR International Series, 202, Oxford.

Hesse, B., & D. Perkins, 1974, 'Faunal Remains from

Karataş-Semayük in Southwest Anatolia: An Interim Report.' *Journal of Field Archaeology* 1: 149-160.

Higgs, E., & J. White, 1963, 'Autumn Killing.' *Antiquity* 37: 282-289.

Higham, C., 1969a, 'Towards an Economic Prehistory of Europe.' *Current Anthropology* 10 (2-3): 139-150.

1969b, 'The Metrical Attributes of Two Samples of Bovine Limb Bones.' *Journal of Zoology, London* 157: 63-74.

Higham, C. & B. Leach, 1971 'An Early Centre of Bovine Husbandry in Southeast Asia.' *Science* 171: 54-56.

Higham, C. & M. Message, 1970, 'An Assessment of a Prehistoric Technique of Bovine Husbandry.' In: D. Brothwell, & E. Higgs, eds., *Science in Archaeology*, pp. 315-330.(revised & enlarged edition). Praeger, New York.
Hillson, S., 1986 *Teeth*. Cambridge University Press, Cambridge.

Hirsch, S., 1933, 'Sheep and Goats in Palestine.' *Bulletin of the Palestinian Economic Society* 6: 18-31.

Hoffman, R., 1993, 'Order Lagomorpha.' In: D. Wilson, & D. Reeder, eds., 1993, *Mammal Species of the World: A Taxonomic and Geographic Reference*, (second edition), Smithsonian Institution Press, Washington.

Hole, F., K. Flannery, & J. Neely, 1969, *Prehistory and Human Ecology of the Deh Luran Plain: An Early Village Sequence from Khuzistan, Iran,* Memoirs of the Museum of Anthropology, University of Michigan, No. 1, Ann Arbor.

Honacki, J., K. Kinman, & J. Koeppl, eds., 1982, *Mammal Species of the World: A Taxonomic and Geographic Reference*. Allen Press, America.

Horwitz, L., 1990, The Origin of Partially Digested Bones Recovered from Archaeological Contexts in Israel.' *Paléorient* 16(1): 97-106.

Irons, W., 1971, 'Variation in Political Stratification among the Yomut Turkmen.' *Anthropological Quarterly* 44 (3): 143-56.

IUCN, 1990, *IUCN Red List of Threatened Animals.* IUCN, Gland, Switzerland.

Jewell, P., 1963 'Cattle from British Archaeological Sites.' In: A. Mourant & F. Zeuner, eds., *Man and Cattle: Proceedings of a Symposium on Domestication at the Royal Anthropological Institute 24-26 May 1960*, pp. 80-101. Royal Anthropological Institute Occasional Paper No. 18.

Kent, S., 1993, 'Variability in Faunal Assemblages- The Influence of Hunting Kills, Sharing, Dogs, and Mode of Cooking on the Faunal Remains at a Sedentary Kalahari Community.' *Journal of Anthropological Archaeology* 12 (4): 323-385.

Khazanov, A., 1978, 'Characteristic Features of Nomadic Communities in the Eurasian Steppes.' In: W., Weissleder, ed., *The Nomadic Alternative: Modes and Models of Interaction in the African-Asian Deserts and Steppes.* pp. 119-126. Mouton Publishers, Paris.

1984, *Nomads and the Outside World.* Cambridge University Press, Cambridge.

King, W. & R., Burke, 1989, *Crocodilian, Tuatara, and Turtle Species of the World: A Taxonomic and Geographic Reference.* Association of Systematics Collections, Washington.

King, G. & W. Thatcher, 1993, 'Pregnancy.' In: G. King ed., *Reproduction in Domesticated Animals.* pp. 229-270. Elsevier Science Publishers B.V., Amsterdam.

Klein, R. & K. Cruz-Uribe, 1984, *The Analysis of Animal Bones from Archaeological Sites.* University of Chicago Press, Chicago.

Köhler, I., 1984, 'The Dromedary in Modern Pastoral Societies and Implications for its Process of Domestication.' In: J. Clutton-Brock, & C. Grigson, eds., *Animals and Archaeology, Vol. 3: Early Herders and their Flocks.* pp. 201-206. BAR International Series, 202, Oxford.

Köhler-Rollefson, I. & G. Rollefson, 1990, 'The Impact of Neolithic Subsistence Strategies on the Environment: the Case of 'Ain Ghazal, Jordan.' In: S. Bottema, G. Entjes-Nieborg, & W. van Zeist, eds., *Man's Role in Shaping the Eastern Mediterranean Landscape.* pp. 3-14. Balkema, Rotterdam.

Kramer, C., 1979, 'An Archaeological View of a Contemporary Kurdish Village; Domestic Architecture, Household Size, and Wealth.' In: C. Kramer, ed., *Ethnoarchaeology: Implications of Ethnography for Archaeology* pp. 139-163. Columbia University Press.

Krantz, G., 1968, 'A New Method of Counting Mammal Bones.' *American Journal of Archaeology* 72: 286-288.

Kussinger, S., 1988, *Tierknochenfunde vom Lidar Höyük in Südostanatolien (Grabungen 1979-86).* Dissertation Ludwig-Maximillians-Universität, München.

Lasota-Moskalewska, A. & Z. Sulgostowska, 1977, 'The Application of Contingency Table for Comparison of Archaeozoological Materials.' *Ossa* 3/4: 153-168.

Lauwerier, R., 1983 'Pigs, Piglets and Determining the Season of Slaughter.' *Journal of Archaeological Science* 10: 483-488.

Lawrence, B., 1967, 'Early Domestic Dogs.' *Zeutschrift für Saugetierkunde* 32: 44-59.

1978, 'Analysis of Unidentifiable Bone from Çayönü: an Early Village Farming Community'. In: R. Meadow, & M. Zeder, eds., *Approaches to Faunal Analysis in the Middle East.* pp. 11-13. Peabody Museum Bulletins, Cambridge, Massachusetts.

1980, 'Evidences of Animal Domestication at Çayönü.' In: H., Çambel, & R., Braidwood, eds., *Prehistoric Research in Southeastern Anatolia.* pp. 285-308. Edebiyat Fakültesi Basimevi, Istanbul.

Lawrence, B. & C. Reed, 1983, 'The Dogs of Jarmo.' In: L. Braidwood, R. Braidwood, B. Howe, C. Reed, & P.-J. Watson. eds., *Prehistoric Archaeology Along the Zagros Flanks.* pp. 485-489. Oriental Institute of the University of Chicago, Chicago.

Lees, S. & D. Bates, 1974, 'The Origins of Specialised Nomadic Populations: a Systemic Model.' *American Antiquity* 39: 187-193.

Legge, A., 1981, 'Aspects of Cattle Husbandry', In: R. Mercer, ed., *Farming Practice in British Prehistory*, pp. 169-181. Edinburgh University Press, Edinburgh.

Legge, A. & P. Rowly-Conwy, 1986, 'The Beaver (*Castor fiber* L.) in the Tigris-Euphrates Basin.' *Journal of Archaeological Science* 13: 469-476.

1988, *Star Carr Revisited: A Re-analysis of the Large Mammals.* University of London, London.

Levine, M., 1982, 'The Use of Crown Height Measurements and Eruption-wear Sequences to Age Horse Teeth.' In: B. Wilson, C. Grigson, S. Payne, eds., *Aging and Sexing Animal Bones from Archaeological Sites*, pp. 223-250. BAR British Series 109, Oxford.

Levitan, B., 1982 'Errors in Recording Tooth Wear in Ovicaprid Mandibles at Different Speeds.' In: B. Wilson, C. Grigson, & S. Payne, eds. *Aging and Sexing Animal Bones from Archaeological Sites.* pp. 207-222. BAR British Series, 109, Oxford.

1985, 'A Methodology for Recording the Pathology and other Anomalies of Ungulate Mandibles from Archaeological Sites.' In: N. Fieller, D. Gilbertson & N. Ralph, eds., *Palaeobiological Investigations: Research Design, Methods and Data Analysis.* pp. 41-54. BAR International Series, 266, Oxford.

Lieberman, D., 1994, 'The Biological Basis for Seasonal Increments in Dental Cementum and their Application to Archaeological Research.' *Journal of Archaeological Science* 21: 525-539.

Lister, A., 1996, 'The Morphological Distinction Between Bones and Teeth of Fallow Deer (*Dama dama*) and Red Deer (*Cervus elaphus*).'*International Journal of Osteoarchaeology* 6: 119-143.

Luff, R., 1984, *Animal Remains in Archaeology.* Shire Archaeology, England.

1994, 'The Conundrum of Castration in the Archaeological Record: an Interpretation of Roman Cattle Horn Cores from Chelmsford, Essex.' *International Journal of Osteoarchaeology* 4: 171-192.

Lyman, R., 1994a, 'Quantitative Units and Terminology in Zooarchaeology.' *American Antiquity* 59 (1): 36-71.

Lyman, R., 1994b, *Vertebrate Taphonomy.* Cambridge University Press. Cambridge.

MacDonald, K., 1992, 'The Domesticated Chicken (*Gallus gallus*) in Sub-Saharan Africa: A Background to its Introduction and its Osteological Differentiation from Indigenous Fowls (*Numidinae* and *Francolinus* sp.). *Journal of Archaeological Science* 19: 303-318.

MacDonald, D. & P. Barrett, P. 1993, *Mammals of Britain and Europe.* Harper Collins, London.

MacGregor, A. & J. Currey, 1985, 'Mechanical Properties as Conditioning Factors in the Bone and Antler Industry of the Third to the Thirteenth Centuries A.D.' *Journal of Archaeological Science* 12: 125-149.

MacKenzie, D., 1970 *Goat Husbandry.* Faber & Faber, London.

Maltby, J., 1982, 'The Variability of Faunal Samples and their Effects on Aging Data.' In: B. Wilson, C. Grigson, & S. Payne, eds., *Aging and Sexing Animal Bones from Archaeological Sites,* pp. 81-90. BAR British Series 109, Oxford.

Margalitadze, N., 1972, 'The History of Forests of the North-western Part of Trialeti Range in Holocene According to the Pollen Analysis.' *Journal of Palynology* 7: 69-75.

Markhov, G., 1978, 'Problems of Social Change Among Asiatic Nomads'. In: W., Weissleder, ed., *The Nomadic Alternative: Modes and Models of Interaction in the African-Asian Deserts and Steppes,*. pp. 305-311. Mouton Publishers, Paris.

Mason, I., 1984, *Evolution of Domesticated Animals.* Longman, London.

Matschke, G., 1967, 'Aging European Wild Hogs by Dentition.' *Journal of Wildlife Management* 31: 109-113.

Mayer, J. & I. Lehr Brisbin, 1988 'Sex Identification of *Sus scrofa* based on Canine Morphology.' *Journal of Mammalogy* 69(2): 408-412.

McCormick, F., 1983, 'Dairying and Beef Production in Early Christian Ireland: The Faunal Evidence' In: T. Reeves-Smyth, & F. Hammond, eds., *Landscape Archaeology in Ireland.* pp. 253-267. BAR British Series 116, Oxford.

McDonald, I., G. Wenham & J. Robinson, 1977, 'Studies on Reproduction in Prolific Ewes 3: The Development of Size and Shape of the Foetal Skeleton.' *Journal of Agricultural Science* 89: 373-391.

McGovern, T., 1984, 'From Zooarchaeology to Palaeoeconomy: A Case from Norse Greenland.' *MASCA.* 3(2): 36-40.

McRoberts, M., R. Hill, & A. Dalgarno, 1965, 'The Effects of Diets Deficient in Phosphorous and Vitamin D or Calcium on the Skeleton and Teeth of Growing Sheep.' *Journal of Agricultural Science* 65: 1-14.

Meadow, R., 1975 'Mammal Remains from Hajji Firuz: a Study in Methodology.' In: A. Clason, ed., *Archaeo-*

zoological Studies, pp. 265-283. North Holland, American Elsevier.

1978 'Effects of Context on the Interpretation of Faunal Remains: A Case Study.' In: R. Meadow, & M. Zeder, eds., *Approaches to Faunal Analysis in the Middle East*. pp. 15-21. Peabody Museum Bulletin 2, Cambridge Massachusetts.

1980, 'Animal Bones: Problems for the Archaeologist Together with Some Possible Solutions.' *Paléorient* 6: 65-77.

1981, 'Early Animal Domestication in South Asia: A First Report on the Faunal Remains from Mehrgarh, Pakistan.' *South Asian Archaeology, 1979,* pp. 143-179. Dietrich Reaner Verlag, Berlin.

1983 'The vertebrate faunal remains from Hasanlu Period X at Hajji Firuz.' In: M. Voigt, ed., *Hajji Firuz Tepe, Iran: The Neolithic Settlement*, pp. 369-422. University of Pennsylvania, Philadelphia.

1986a, Some Equid Remains from Çayonü, Southern Turkey.' In: R. Meadow & H.-P. Uerpmann, eds., *Equids in the Ancient World*. pp. 266-301. Dr. Ludwig Reichert Verlag, Wiesbaden.

1986b, 'The Geographical and Environmental Setting of Tepe Yahya.' In: T. Beale, ed., *Excavations at Tepe Yahya, Iran 1967-1975: The Early Periods.* pp. 21-38. Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge, Massachusetts.

1991, 'Faunal Remains and Urbanism at Harappa.' In: R. Meadow, ed., *Harappa Excavations 1986-1990: A Multidisciplinary Approach to Third Millennium Urbanism*, pp. 89-106. Prehistory Press, Madison, Wisconsin.

Monks, G., 1981, 'Seasonality Studies.' In: M. Schiffer, ed., *Advances in Archaeological Method and Theory* 4: 177-240.

(ed.) 1993, Incremental Growth Structures in Zooarchaeological Seasonality. *Archaeozoologia* 5(2).

Moran, N. & T. O'Connor, 1994, 'Age Attribution in Domestic Sheep by Skeletal and Dental Study of Available Sources.' *International Journal of Osteoarchaeology* 4(4): 267-285.

Moreno-Garcia, M., C. Orton, & J. Rackham, 1996, 'A New Statistical Tool for Comparing Animal Bone Assemblages.' *Journal of Archaeological Science* 23: 437-453.

Morey, D., 1992, 'Size, Shape and Development in the Evolution of the Domestic Dog.' *Journal of Archaeological Science* 19: 181-204.

Mortensen, I., 1993, *Nomads of Luristan: History, Material Culture and Pastoralism in Western Iran.* Thames and Hudson, London.

Musser, G. & M. Carleton, 1993, 'Family Muridae.' In: D., Wilson, & D., Reeder, eds., *Mammal Species of the World: A Taxonomic and Geographic Reference* (second edition), pp. 501-755. Smithsonian Institution Press, Washington.

Nichol, R. & G. Creak, 1979, 'Matching Paired Elements among Archaeological Bone Remains: a Computer Procedure and Some Practical Limitations.' *Newsletter of Computer Archaeology* 14: 6-16.

N.I.D. (Naval Intelligence Division) 1943, *Turkey*. Geographical Handbook Series, Vol. 2. HMSO.

Niethammer, J. & F. Krapp, eds., 1978, *Handbuch der Säugetiere Europas: Vol. 1 Rodentia. Part 1 Sciuridae, Castoridae, Gliridae, Muridae.* Akademische Verlagsgesellschaft, Wiesbaden.

1990, *Handbuch der Säugetiere Europas: Vol. 3 Insectivora, Primates.* AULA, Wiesbaden.

1993a, *Handbuch der Säugetiere Europas: Vol. 5 Carnivora. Part 1 Canidae, Ursidae, Procyonidae, Mustelidae.* AULA, Wiesbaden.

1993b, *Handbuch der Säugetiere Europas: Vol. 5 Carnivora. Part 2: Mustelidae, Viverridae, Herpestidae, Felidae.* AULA, Wiesbaden.

Noddle, B., 1974, 'Ages of Epiphyseal Closure in Feral and Domestic Goats and Ages of Dental Eruption.' *Journal of Archaeological Science* 1: 195-204.

1978, 'Some Minor Skeletal Differences in Sheep.' In: D. Brothwell, K. Thomas, & J. Clutton-Brock, eds., *Research Problems in Zooarchaeology,* pp. 133-141 Institute of Archaeology of the University of London, Occasional Publication, No.3, London.

1984 'A Comparison of the Bones of Cattle, Sheep, and Pigs from Ten Iron Age and Romano-British Sites'. In: C. Grigson, & J. Clutton-Brock, eds., *Animals and Archaeology: 4. Husbandry in Europe*. pp. 105-123. BAR International Series 227, Oxford.

1989, 'Flesh on the Bones: Some Notes on Animal Husbandry of the Past.' *Archaeozoologia* 3(1-2): 25-50.

Nowak, R., 1991, *Walker's Mammals of the World.* (fifth edition), Vol. 2., The John Hopkins University Press, Baltimore.

Nyerges, N., 1977, *Traditional Pastoralism in the Near East: the Ecology of Domesticated Sheep and Goats in the Turan Biosphere Reserve, Iran.* University of Pennsylvania, Philadelphia.

O'Connor, 1985, 'On Quantifying Vertebrates: some Sceptical Observations.' *Circaea* 3: 27-30.
Olsen, S., 1985, *Origins of the Domestic Dog.* University of Arizona Press, Tucson,

Orme, B., 1981, *Anthropology for Archaeologists.* Duckworth, London.

Ovadia, E., 1992, 'Domestication of the Ass and Pack Transport by Animals: A Case of Technological Change.' In: O. Bar-Yosef, & A. Khazanov, eds., *Pastoralism in the Levant: Archaeological Materials in Anthropological Perspectives.* pp. 19-28. Monographs in World Archaeology, Ann Arbor.

Parker, S., (ed.) 1990, *Grzimeks' Encyclopaedia of Mammals.* Vol. 3. McGraw Hill Publishing Company, New York.

Patterson, B., 1937, 'Animal Remains.' In: H. von der Osten, *The Alişar Höyük Seasons of 1930-32, part III.* pp. 294-309. Oriental Institute of the University of Chicago, Chicago.

Payne, S., 1972, 'Partial Recovery and Sample Bias: the Results of Some Sieving Experiments.' In: E. Higgs, ed., *Papers in Economic Prehistory,* pp. 49-64. Cambridge University Press, Cambridge.

1973, 'Kill-off patterns in sheep and goats; the mandibles from Aşvan Kale' *Anatolian Studies* 23: 281-303.

1975, 'Partial Recovery and Sample Bias.', In: A. Clason, ed., *Archaeozoological Studies.* pp. 7-17. North Holland Publishing Company, Amsterdam.

1985a, 'Animal Bones from Aşıklı Höyük.' *Anatolian Studies* 35: 109-122.

1985b, 'Morphological Distinctions Between the Mandibular Teeth of Young Sheep *Ovis* and Goats *Capra.*' *Journal of Archaeological Science* 12: 139-47.

1987, 'Reference Codes for Wear States in the Mandibular Cheek Teeth of Sheep and Goats.' *Journal of Archaeological Science* 14: 609-614.

1990, 'Field Report on the Dendra Horses.' In: R. Hägg, & N. Gullög, eds., *Celebrations of Death and Divinity in the Bronze Age Argolid.* pp.103-106. Skrifter Utgivna av Svenska Institutet I Athen, Stockholm.

1991, 'Early Holocene Equids from Tall-i-Mushki (Iran) and Can Hasan III (Turkey).' In: R. Meadow & H.-P. Uerpmann, eds., *Equids in the Ancient World, II.* pp. 132-177. Dr. Ludwig Reichert Verlag, Wiesbaden.

Payne, S. & G. Bull, 1988, 'Components of Variation in Measurements of Pig Bones and Teeth, and the Uses of Measurements to Distinguish Wild from Domestic Pig Remains.' *Archaeozoologia* 2(1,2): 27-66.

Perkins, D., 1969, 'Fauna of Çatal Höyük: Evidence for Early Cattle Domestication in Anatolia.' *Science* 164: 177-179.

Perkins, D. & P. Daly, 1968, 'A Hunter's Village in Neolithic Turkey. *Scientific American* 219: 97-106.

Petter, F., 1961, 'Eléments d'une Révision des Lievres Européens et Asiatiques du sous-genre *Lepus.*' *Zeitschrift für Saugetierkunde* 26: 30-40.

Pilgram, T., & F. Pilgrim 1995, 'Bone Counts and Statistics: a Reply to Ringrose.' *Journal of Archaeological Science* 22: 93-97.

Postgate, N., 1986, 'The Equids of Sumer, Again.' In: R. Meadow & H.-P. Uerpmann, eds., *Equids in the Ancient World,* pp. 194-206. Dr. Ludwig Reichert Verlag, Wiesbaden.

Pritchard, P., 1979, *Encyclopaedia of Turtles.* T.F.H. Publications, New Jersey.

Prummel, W., 1987a, 'Atlas for the Identification of Foetal Skeletal Elements of Cattle, Horse, Sheep and Pig, Part 1.' *Archaeozoologia.* 1(1), 23-30.

1987b, 'Atlas for the Identification of Foetal Skeletal Elements of Cattle, Horse, Sheep and Pig, Part 2.' *Archaeozoologia* 1(2): 11-42.

1988, 'Atlas for the Identification of Foetal Skeletal Elements of Cattle, Horse, Sheep and Pig, Part 3.' *Archaeozoologia* 2(1-2): 13-26.

Putman, R., 1988, *The Natural History of the Deer.* Christopher Helm, London.

Rackham, J., 1983, 'Faunal Sample to Subsistence Economy: Some Problems in Reconstruction.' In: M. Jones, ed., *Integrating the Subsistence Economy.* pp. 251-277. BAR International Series 181, Oxford.

Redding, R., 1981, *Decision Making in Subsistence Herding of Sheep and Goats in the Middle East.* Ph.D. Dissertation, University of Michigan, Ann Arbor.

1982, 'The Faunal Remains .' In: H. Wright, ed., *An Early Town on the Deh Luran Plain: Excavations at Tepe Farukhabad.* pp. 231-261. Museum of Anthropology, University of Michigian, Ann Arbor.

1984, 'Theoretical Determinants of a Herder's Decisions; Modelling Variation in the Sheep/goat Ratio.' In: J. Clutton-Brock, & C. Grigson, eds., *Animals and Archaeology, Vol. 3: Early Herders and their Flocks.* pp. 223-241. BAR International Series, 202. Oxford.

1985, 'The Role of Faunal Remains in the Explanation of the Development of Complex Societies in South-west Iran: Potential, Problems and the Future.' *Paléorient* 11(2): 121-124.

1991, 'The Role of Pigs in the Subsistence Systems of Ancient Egypt: A Parable on the Potential of Faunal Data' In: P. Crabtree. & K. Ryan, eds., *Animal Use and Culture Change.* pp. 20-30. MASCA Research Papers in Science and Archaeology. University Mueseum, University of Pennsylvania, Philadelphia.

Richardson, C., C. Herbert, & S. Terlecki, 1976, 'Estimation of the Developmental Age of the Ovine Fœtus and Lamb.' *The Veterinary Record* 90: 22-26.

Richardson, C., M. Richards, S. Terlecki & W. Miller, 1979, Jaws of Adult Culled Ewes'. *Journal of Agricultural*

Science 93: 521-529.

Ringrose, T., 1993, 'Bone Counts and Statistics: A Critique.' *Journal of Archaeological Science* 20: 121-157.

1995, 'Response to Pilgram and Marshall "Bone Counts and Statisticians: a Reply to Ringrose."' *Journal of Archaeological Science* 22: 99-102.

Ripinsky, M., 1975, "The Camel in Arabia.' *Antiquity* 49: 295-298.

Rissman, P., 1986, 'Seasonal Aspects of Man/cattle Interaction in Bronze Age Western India.' *Journal of Ethnobiology* 6(2): 257-277.

Roberts, N., 1982, 'Forest Re-advance and the Anatolian Neolithic.' In: S. Limbrey, & M. Bell, eds., *Archaeological Aspects of Woodland Ecology*. pp. 231-246. BAR International Series 146, Oxford.

Rollefson, G., A. Simmon, M. Donaldson, W. Gillespie, Z. Kafafi, I. Köhler-Rollefson, E. McAdam, S. Rolston & M. Tubb, 1985, 'Excavations at the Pre-Pottery Neolithic B Village of 'Ain Ghazal (Jordan), 1983. *Mitteilungen der Deutschen Orient-gesellschaft zu Berlin* 117: 69-470.

Rolett, B. & M. Chiu, 1994, 'Age Estimation of Prehistoric Pigs (*Sus scrofa*) by Molar Eruption and Attrition.' *Journal of Archaeological Science* 21: 377-386.

Rottensten, K. & F. Ampy, 1971, 'Studies on Awassi Sheep in Lebanon. I. Production Traits of a Flock.' *Journal of Agricultural Science* 77: 371-373.

Rowly-Conwy, P., 1995, 'Wild or Domestic? On the Evidence for the Earliest Domestic Cattle and Pigs in South Scandinavia and Iberia.' *International Journal of Osteoarchaeology* 5: 115-126.

Russell, K., 1988, *After Eden: The Behavioural Ecology of Early Food Production in the Near East and North Africa*. BAR International Series 391, Oxford.

Ryder, M., 1969. *Animal Bones in Archaeology: a Book of Notes and Drawings for Beginners,* (second edition). Blackwell Scientific, Oxford.

Sagona, A., M. Erkmen, C. Sagona, I. McNiven, & S. Howells, 1998, 'Excavations at Sos Höyük, 1996: Third Preliminary Report.' *Anatolica* 23: 181-226.

Sagona, A., M. Erkmen, C. Sagona, I. Thomas & S. Howells, 1996, 'Excavations at Sos Höyük, 1995: Second Preliminary Report.' *Anatolian Studies* 46: 27-52.

Sagona, A., E. Pemberton & I. McPhee, 1991, 'Excavations at Büyüktepe Höyük, 1990: First Preliminary Report.' *Anatolian Studies* 41: 145-58.

1992, 'Excavations at Büyüktepe Höyük, 1991: Second Preliminary Report.' *Anatolian Studies* 42: 29-46.

1993, 'Excavations at Büyüktepe Höyük, 1992: Third Preliminary Report.' *Anatolian Studies* 43: 69-83.

Sagona, A., C. Sagona & H. Özkorucuklu, 1995, 'Excavations at Sos Höyük: First Preliminary Report 1994.' *Anatolian Studies* 45: 193-218.

Schäffer, J. & J. Boessneck, 1988, 'Bericht über die Tierreste aus der halafzeitlichen Siedlung Çavi Tarlası (Nisibin/Osttürkei). *Istanbuler Mitteilungen* 38: 37-54.

Shipman, P., G. Foster & M. Schoeninger, 1984, 'Burnt Bones and Teeth: an Experimental Study of Color, Morphology, Crystal Structure and Shrinkage.' *Journal of Archaeological Science* 11: 307-325.

Schmid, E., 1972, *Atlas for the Identification of Animal Bones.* Elsevier, Amsterdam.

Siegel, J., 1976, 'Animal Palaeopathology; Possibilities and Problems.' *Journal of Archaeological Science* 3: 349-384.

Silver, I., 1969, 'The Aging of Domestic Animals.' In: D. Brothwell, & E. Higgs, eds., *Science in Archaeology* (revised edition), pp. 283-302. Thames and Hudson, London,

Smit, C., & A. van Wijngaarden, 1981, *Threatened Mammals in Europe.* Akademische Verlag, Wiesbaden.

Solecki, R., 1979, 'Contemporary Kurdish Winter Time Inhabitants of Shanidar Cave, Iraq.' *World Archaeology* 15: 79-89.

Spennemann, D. & Colley, S., 1990, 'Fire in a Pit: The Effects of Burning on Faunal Remains.' *Archaeozoologia* 3(1-2): 45-63.

Spooner, B., 1973, *The Cultural Ecology of Pastoral Nomads.* Module in Anthropology 45, Addison-Wesley.

Stahl, U., 1989, *Tierknochenfunde vom Hassek Höyük (Südostanatolien).* Dissertation, Ludwig-Maximillians-Universität, München.

Stallibrass, S., 1982, 'The Use of Cement Layers for Absolute Aging of Mammalian Teeth: a Selective Review of the Literature, with Suggestions for Further Studies and Alternative Applications.' In: B. Wilson, C. Grigson & S. Payne eds., *Aging and Sexing Animal Bones from Archaeological Sites,* pp. 109 - 126. BAR British Series 109, Oxford.

Stampfli, H., 1983, 'The Fauna of Jarmo with Notes on Animal Bones from Matarrah, the Amuq and Karim Shahir.' In: L. Braidwood, R. Braidwood, B. Howe, C. Reed, & P.-J. Watson. eds., *Prehistoric Archaeology Along the Zagros Flanks,* pp. 431-483. Oriental Institute of the University of Chicago, Chicago.

Stauffer, T., 1965, 'The Economics of Nomadism in Iran.' *Middle East Journal* 19: 284-302.

Stein, G., 1986, 'Herding Strategies at Neolithic Gritille: The Use of Animal Bone Remains to Reconstruct Ancient Economic Systems.' *Expedition* 28 (2): 35-42.

1988, *Pastoral Production in Complex Societies: Mid-late Third Millennium B.C. and Medieval Faunal Remains from Gritille Höyük in the Karababa Basin.* Ph.D. Dissertation, University of Pennsylvania, Philadelphia, Ann Arbor.

1989, 'Strategies of Risk Reduction in Herding and Hunting Systems of Neolithic Southeast Anatolia.' In: P. Crabtree, & K. Ryan, eds., *Early Animal Domestication and its Cultural Context.* pp. 87-97. MASCA Special Supplement.

Tapper, R., 1974, 'The Organisation of Nomadic Communities in Pastoral Societies of the Middle East.' In: *Pastoral Production and Society.* pp. 43-65. Cambridge University Press, Cambridge.

Tchernov, E. & F. Valla, 1997, ' Two New Dogs, and Other Naturfian Dogs, from the Southern Levant.' *Journal of Archaeological Science* 24: 65-95.

Teichert, M., 1975, 'Osteometrische Untersuchungen zur Berechnung der Widerristhöhe bei Schafen.' In: A. Clason, ed., *Archaeozoological Studies*, pp. 51-69. North Holland Publishing Company, Amsterdam.

1984, 'Size Variation in Cattle from Germania Romana and Germania Libera.' In: C. Grigson, & J. Clutton-Brock, eds., *Animals and Archaeology: 4. Husbandry in Europe*, pp. 93-103. BAR International Series 227, Oxford.

Tekkaya, I. & S. Payne, 1988, 'The Mammalian Fauna of Ikiztepe.' In: U. Alkım, H. Alkım, & Ö. Bilgi, eds., *Ikiztepe I: The First and Second Seasons' Excavation (1974-1975).* pp. 227-243. Türk Tarih Kurumu Basımevi, Ankara.

Thomas, R., 1988, 'A Statistical Evaluation of Criteria used in Sexing Cattle Metapodial Bones.' *Archaeozoologia* 2/1 (2): 83-92.

Turnbull, P., 1986, 'Measurements of *Equus hemionus* from Palegawra Cave (Zarzian, Iraq).' In: R. Meadow & H.-P. Uerpmann, eds., *Equids in the Ancient World*, pp.366-365. Dr. Ludwig Reichert Verlag, Wiesbaden.

Turnbull, P. & C. Reed, 1974, 'The Fauna from the Terminal Pleistocene of Palegawra Cave, a Zarzian Occupation Site in Northeastern Iraq.' *Fieldiana Anthropology* 63: 81-146.

Turner, A., 1980, 'Minimum Number Estimations Offers Minimal Insight in Faunal Analysis.' *Ossa* 7: 199-201.

Uerpmann, H.-P., 1973, 'Animal Bone Finds and Economic Archaeology: A Critical Study of 'Osteo-archaeological' Method.' *World Archaeology* 4: 307-322.

1978, 'Metrical Analysis of Faunal Remains from the Middle East.' In: R. Meadow, & M. Zeder, eds., *Approaches to Faunal Analysis in the Middle East*, pp. 41-45. Peabody Museum Bulletin 2, Cambridge,Massachusetts.

1979, *Problems der Neolithisienung des Mittelmeeraums.* Dr. Ludwig Reichert, Wiesbaden.

1986, 'Halafian Equid Remains from Shams ed-Din Tannira in Northern Syria.' In: R. Meadow & H.-P. Uerpmann, eds., *Equids in the Ancient World.* pp. 246-265. Dr. Ludwig Reichert Verlag, Wiesbaden.

1987, *The Ancient Distribution of Ungulate Mammals in the Middle East*; Dr. Ludwig Reichert Verlag, Wiesbaden.

1991, '*Equus africanus* in Arabia.' In: R. Meadow & H.-P. Uerpmann, eds., *Equids in the Ancient World, II*, pp. 12-33. Dr. Ludwig Reichert Verlag, Wiesbaden.

Uerpmann, H.-P., K. Köhler & E. Stephen, 1992, 'Tierreste aus den Neuen Grabungen in Troia: Erster Bericht.' *Studia Troica.* pp. 106-121. Vol. 2. Philipp von Zabern.

Uerpmann, M. & H.-P. Uerpmann, 1994, 'Animal Bones.' In: F. Hojlund & H. Andersen, eds., *Qala'at al-Bahrain, Vol. 1, The Northern City Wall and the Islamic Fortress*, pp.417-444. Jutlund Archaeological Society, Moesgaard.

Vigne, J.-D., 1991, 'The Meat and Offal Weight (MOW) Method and the Relative Proportion of Ovicaprines in Some Ancient Meat Diets of the North-western Mediterranean.' *Rivista di Studi Liguri, A* 57(1-4): 21-47.

Vinogradov, B. & A. Argiropulo, 1968 *Fauna of the U.S.S.R., Mammals: Key to Rodents.* Isreal Program for Scientific Translations, Jerusalem.

Vogel, R., 1952, 'Reste von Jagd- und Haustieren. In: K. Bittel & R. Naumann eds., *Boğazköy-Hattusa I.* pp. 128-153. Stuttgart.

Walter, H., 1956, 'Vegetationsgliederung Anatoliens.' *Flora* 143: 295-326.

Wapnish, P., 1984, 'The Dromedary and Bactrian Camel in Levantine Historical Settings: the Evidence from Tell Jemmeh.' In: J. Clutton-Brock, & C. Grigson, eds., *Animals and Archaeology, Vol. 3: Early Herders and their Flocks.* pp.171-200. BAR International Series 202, Oxford.

Watson, J., 1978, 'The interpretation of Epiphyseal Union data.' In: D. Brothwell, K. Thomas, & J. Clutton-Brock, eds., *Research Problems in Zooarchaeology*, pp. 97-101. Institute of Archaeology of the University of London, London.

Watson, P., 1979, *Archaeological Ethnography in Western Iran.* University of Arizona Press, Tucson.

Weinstock, J., 1993, 'Two Complete Pig (*Sus*) Skeletons from Southern Germany: Considerations of Limb Proportions and Aging Criteria.' *Archaeozoologia* 6(11): 71-92.

West, B. & B. Zhou, 1988, 'Did Chickens Go North? New evidence for Domestication' *Journal of Archaeological Science* 15: 515-533.

White, T., 1953, 'A Method for Calculating the Dietary

Percentage of Various Food Animals Utilised by Aboriginal Peoples.' *American Antiquity* 18: 396-398.

Whitehead, G., 1993, *The Whitehead Encyclopaedia of Deer.* Swan Hill, England.

Wijngaarden-Bakker, L., van, & P. Bergstrom, 1988, 'Estimation of the Shoulder Height of Cattle.' *Archaeozoologia* 2/1(2): 67-82.

Wild, C., & R. Nichol, 1983, 'Estimation of the Original Number of Individuals from Paired Bone Counts using Estimators of the Krantz Type.' *Journal of Field Archaeology* 10: 337-344.

Wilson, D. & D. Reeder, eds., 1993, *Mammal Species of the World: A Taxonomic and Geographic Reference* (second edition). Smithsonian Institution Press, Washington.

Wilson, M., 1982, 'Cut Marks and Early Hominids: Evidence for Skinning.' *Nature* 298: 303.

Yakar, J., 1985, *The Later Prehistory of Anatolia: The Late Chalcolithic and Early Bronze Age.* BAR International Series 268, Oxford.

Zarins, J., 1986, 'Equids Associated with Human Burials in Third Millennium B.C. Mesopotamia: Two Complementary Facets.' In: R. Meadow & H.-P. Uerpmann, eds., *Equids in the Ancient World*, pp. 164-193. Dr. Ludwig Reichert Verlag, Wiesbaden.

Zeder, M., 1986, 'The Equid Remains from Tel-e Malyan, Southern Iran.' In: R. Meadow & H.-P. Uerpmann, eds., *Equids in the Ancient World*, pp. 366-412. Dr. Ludwig Reichert Verlag, Wiesbaden.

1996, ' The Role of Pigs in the Near East.' In: J., Seger, ed., *Retrieving the Past : Essays on Archaeological Research and Methodology in Honour of Gus W. van Beek*, pp. 297-312. Mississippi State University.

Zeist, W. van & S. Bottema, 1991, *Late Quaternary Vegetation of the Near East. Beihefte zum Tübinger Atlas.* Luwig Reichert Verlag, Tübingen.

Zeist, W. van & H. Woldring, 1978, 'A Postglacial Pollen Diagram from Lake Van in East Anatolia.' *Review of Palaobotany and Palynology* 26: 249-276.

Zeuner, F., 1963, *A History of Domesticated Animals.* Hutchinson of London. London.

Zohary, M., 1973, *Geobotanical Foundations of the Middle East.* 2 Vols. Gustav Fischer Verlag, Stuttgart.

TABLES

Table 1a. Early Bronze Age Sos Höyük Bonelist

SPECIES	COMMON NAME	NISP	MNI	WEIGHT (g)
Domesticates				
Equus caballus	horse	8	2	425.1
Equus asinus/E. hemionus	ass/hemione	2	1	36.1
Bos taurus	cow	1006	26	44194.3
Ovis/Capra	sheep/goat	1347	85	12235.2
including:				
Ovis aries	sheep	244	36	3704.3
Capra hircus	goat	93	14	1420.8
Sus scrofa domesticus	pig	9	2	111.8
Canis familiaris	dog	28	3	237.0
SUB TOTAL		**2400**	**119**	**57239.5**
Wild Species				
Bos primigenius	aurochs	7	2	883.6
Bison bison?	bison	5	1	193.4
Ovis orientalis	wild sheep	2	2	75.8
Capra aegagrus?	wild goat	1	1	22.5
O.orientalis/C.aegagrus	wild sheep/goat	3	2	24.4
Sus scrofa	wild pig	4	1	132.2
Cervus elaphus	red deer	9	2	873.6
Canis lupus	wolf	1	1	7.4
Ursus arctos	brown bear	6	1	197.3
Vulpes vulpes	red fox	6	3	31.4
Lepus europaeus	brown hare	10	2	5.9
Pisces	unidentified	6	2	1.5
Aves				
Ardaidae	unidentified	1	1	12.9
Anatidae	unidentified	1	1	1.8
Ciconia ciconia	white stork	1	1	2.9
Anser albifrons	whitefront goose	1	1	4.9
Anas platyrhynchos	mallard	1	1	0.4
Circus aeruginosus	marsh harrier	1	1	0.9
Aquila chrysaetos	golden eagle	1	1	6.9
Alectoris chukar	chukar	1	1	0.8
Grus grus	common crane	4	1	18.3
Otis tarda	great bustard	4	2	13.0
Athene noctua	little owl	1	1	0.1
SUB TOTAL		**77**	**32**	**2511.9**
TOTAL IDENTIFIED		**2477**	**151**	**59751.4**
Intrusive				
Crocidura leucodon	bi-coloured white-toothed shrew	1	1	0.5
Nannospalax nehringi	mountain mole rat	10	8	17.0
Mesocricetus brandti	Turkish hamster	13	12	3.4
Rodent		368	-	53.6
SUB TOTAL		**392**		**74.5**
Unidentified				
Small		83		76.3
Medium		1150		3757.2
Large		1070		13652.2
Indeterminate		92		146.8
SUB TOTAL		**2395**		**17632.5**
TOTAL		**5264**		**77458.3**

Table 1bi. Relative Representation of Identified to Unidentified Specimens in terms of NISP.

	Identified		Unidentified	
	NISP	%	NISP	%
EBA Sos	2477	50.8	2395	49.2
EBA Büyüktepe	34	42	47	58.8
IA Sos	2217	44.5	2761	55.5
IA Büyüktepe	848	49.5	865	50.5

Table 1bii. Relative Representation of Identified to Unidentified Specimens in terms of Weight.

	Identified		Unidentified	
	NISP	%	NISP	%
EBA Sos	59751.4	77.2	17632.5	22.8
EBA Büyüktepe	1141.2	84.6	207.0	15.4
IA Sos	31356.8	65.6	16409.6	34.4
IA Büyüktepe	17523.6	83.3	3509.0	16.7

TABLES

Table 2. Early Bronze Age Büyüktepe Höyük Bonelist

SPECIES	COMMON NAME	NISP	MNI	WEIGHT (g)
Domesticates				
Equus caballus	horse	2	1	288.5
Equus asinus/hemionus	ass/hemione	1	1	45.0
Bos taurus	cow	12	2	632.6
Ovis/Capra	sheep/goat	15	3	172.3
including:				
Ovis aries	sheep	2	1	6.6
Sus scrofa domesticus	pig	2	1	9.1
Canis familiaris	dog	1	1	1.8
SUBTOTAL		**33**	**8**	**1140.2**
Wild Species				
Equus hemionus	hemione	1	1	96.4
SUBTOTAL		**1**	**1**	**1.0**
TOTAL IDENTIFIED		**34**	**9**	**1141.2**
Unidentified				
Small		4		1.4
Medium		19		32.9
Large		20		171.7
Indeterminate		4		1.0
SUB TOTAL		**47**		**207.0**
TOTAL		81		**2488.4**

Table 3. Iron Age Sos Höyük Bonelist

SPECIES	COMMON NAME	NISP	MNI	WEIGHT (g)
Domesticates				
Equus caballus	horse	5	1	309.4
Equus asinus	ass	1	1	23.3
Equus asinus/E.hemionus	ass/hemione	1	1	32.3
Equus sp.		3	1	28.6
Bos taurus	cow	474	14	13676.3
Ovis/Capra	sheep/goat	1682	40	16846.3
including:				
Ovis aries	sheep	341	25	3775.0
Capra hircus	goat	41	8	436.2
Sus scrofa domesticus	pig	4	3	99.8
Canis familiaris	dog	18	2	182.0
Gallus gallus domesticus	chicken	1	1	10.0
SUB TOTAL		**2189**	**64**	**31208.0**
Wild Species				
E. hemionus/E. hydruntinus/E.caballus	hemione/hydruntine/horse	2	1	42.2
Dama dama	fallow deer	2	1	26.3
Vulpes vulpes	red fox	4	1	10.8
Meles meles	Eurasian badger	1	1	4.3
Castor fiber	beaver	2	1	14.5
Mustela nivalis	common weasal	7	1	3.6
Lepus europaeus	brown hare	2	1	6.9
Aves				
Anas platyrhynchos	mallard	1	1	1.1
Coturnix coturnix	quail	2	1	0.2
Grus grus	common crane	1	1	10.0
Reptilia				
Mauremys caspica caspica	Caspian turtle	4	1	28.9
SUB TOTAL		**28**	**11**	**148.8**
TOTAL IDENTIFIED		**2217**	**75**	**31356.8**
Intrusive				
Nannospalax nehringi	mountain mole rat	2	1	0.7
Mesocricetus brandti	Turkish hamster	1	1	0.3
Apodemus sylvaticus	wood mouse	1	1	0.1
SUB TOTAL		**4**	**3**	**31356.8**
Unidentified				
Small		15		5.4
Medium		1450		3870.4
Large		1279		12504.8
Inndeterminate		17		29.0
SUB TOTAL		2761		**16409.6**
TOTAL		4982		79123.1

Table 4. Iron Age Büyüktepe Höyük Bonelist

SPECIES	COMMON NAME	NISP	MNI	WEIGHT (g)
Domesticates				
Equus caballus	horse	28	2	2179.2
Equus asinus/E.hemionus	ass/hemione	2	1	68.0
Equus sp.		24	-	750.9
Bos taurus	cow	221	9	9362.6
Ovis/Capra	sheep/goat	491	19	3606.6
including:				
Ovis aries	sheep	82	7	1173.7
Capra hircus	goat	11	2	119.4
Sus scrofa domesticus	pig	54	10	790.5
Canis familiaris	dog	2	1	26.1
Camelus sp.	camel	1	1	258.5
Gallus gallus domesticus	chicken	4	1	6.2
SUB TOTAL		**827**	**44**	**17048.5**
Wild Species				
Bos primigenius	aurochs	1	1	40.3
Bison bison?	bison	1	1	133.1
Equus hemionus	hemione	2	1	40.3
Cervus elaphus	red deer	7	4	215.5
Meles meles	Eurasian badger	3	2	24.2
Vormela peregusna	marbled polecat	1	1	10.7
Aves				
Anas platyrhynchos	mallard	2	2	3.9
Aquila chrysaetos	golden eagle	1	1	5.9
Perdix perdix	grey partridge	2	1	1.0
Corvus corone	carrion crow	1	1	0.3
SUB TOTAL		**21**	**15**	**475.1**
TOTAL IDENTIFIED		**848**	**59**	**17523.6**
Intrusive				
Nannospalax nehringi	mountain mole rat	6	4	7.6
Mesocricetus brandti	Turkish hamster	3	2	1.3
Citellus xanthoprymnus	Asia Minor suslik	2	2	8.1
SUB TOTAL		**11**	**8**	**17.0**
Unidentified				
Small		76		52.9
Medium		352		697.5
Large		340		2686.7
Indeterminate		97		71.8
SUB TOTAL		**865**		**3509.0**
TOTAL		**1724**	**67**	**21049.6**

Table 5a. Preservation of the Early Bronze Age Sos Höyük Assemblage

Table 5ai) Unidentified Remains

	AB	%	AB/RB	%	RB	%	COMPL	%	TOTAL
Small	80	96.4	2	2.4	1	1.2	0	0.0	**83**
Medium	932	81.0	201	17.5	17	1.5	0	0.0	**1150**
Large	831	77.7	220	20.6	18	1.7	1	0.1	**1070**
Indeterminate	78	84.8	14	15.2	0	0.0	0	0.0	**92**
TOTAL	**1921**	**80.2**	**437**	**18.2**	**36**	**1.5**	**1**	**0.0**	**2395**

Table 5aii) Identified Remains

	AB	%	AB/RB	%	RB	%	COMPL	%	TOTAL
Equus caballus	7	87.5	0	0.0	0	0.0	1	12.5	**8**
E.asinus/E.hemionus	1	50.0	0	0.0	0	0.0	1	50.0	**2**
Bos taurus	675	67.1	110	10.9	35	3.5	186	18.5	**1006**
Ovis aries/Capra hircus	940	69.8	177	13.1	46	3.4	184	13.7	**1347**
Sus scrofa domesticus	6	66.7	1	11.1	0	0.0	2	22.2	**9**
Canis familiaris	16	57.1	2	7.1	2	7.1	8	28.6	**28**
Wild Mammal	17	31.5	17	31.5	3	5.6	17	31.5	**54**
Wild Bird	15	88.2	1	5.9	0	0.0	1	5.9	**17**
Wild Fish	0	0.0	0	0.0	0	0.0	6	100.0	**6**
TOTAL	**1677**	**67.7**	**308**	**12.4**	**86**	**3.5**	**406**	**16.4**	**2477**

Table 5b. Preservation of the Early Bronze Age Büyüktepe Höyük Assemblage

Table 5bi) Unidentified Remains

	AB	%	AB/RB	%	RB	%	COMPL	%	TOTAL
Small	3	75.0	1	25.0	0	0.0	0	0.0	4
Medium	18	94.7	1	5.3	0	0.0	0	0.0	**19**
Large	18	90.0	2	10.0	0	0.0	0	0.0	**20**
Indeterminate	0	0.0	4	100.0	0	0.0	0	0.0	4
TOTAL	**39**	**83.0**	**8**	**17.0**	**0**	**0.0**	**0**	**0.0**	**47**

Table 5bii) Identified Remains

	AB	%	AB/RB	%	RB	%	COMPL	%	TOTAL
Equus caballus	2	100.0	0	0.0	0	0.0	0	0.0	2
E.asinus/E.hemionus	1	100.0	0	0.0	0	0.0	0	0.0	1
Bos taurus	9	75.0	2	16.7	0	0.0	1	8.3	**12**
Ovis aries/Capra hircus	12	80.0	1	6.7	0	0.0	2	13.3	**15**
Sus scrofa domesticus	2	100.0	0	0.0	0	0.0	0	0.0	2
Canis familiaris	1	100.0	0	0.0	0	0.0	0	0.0	1
Wild Mammal	1	100.0	0	0.0	0	0.0	0	0.0	1
TOTAL	**28**	**82.4**	**3**	**8.8**	**0**	**0.0**	**3**	**8.8**	34

Table 5c. Preservation of the Iron Age Sos Höyük Assemblage.

Table 5ci) Unidentified Remains

	AB	%	AB/RB	%	RB	%	COMPL	%	TOTAL
Small	13	86.7	1	6.7	0	0.0	1	6.7	**15**
Medium	1223	84.3	216	14.9	10	0.7	1	0.1	**1450**
Large	1091	85.3	186	14.5	2	0.2	0	0.0	**1279**
Indeterminate	11	64.7	6	35.3	0	0.0	0	0.0	**17**
TOTAL	2338	**84.7**	**409**	**14.8**	**12**	**0.4**	**2**	**0.1**	**2761**

Table 5cii) Identified Remains

	AB	%	AB/RB	%	RB	%	COMPL	%	TOTAL
Equus caballus	4	80.0	0	0.0	1	20.0	0	0.0	**5**
E.asinus/E.hemionus	1	100.0	0	0.0	0	0.0	0	0.0	**1**
E.asinus	1	100.0	0	0.0	0	0.0	0	0.0	**1**
Equus sp.	3	100.0	0	0.0	0	0.0	0	0.0	**3**
Bos taurus	344	72.6	41	8.6	8	1.7	81	17.1	**474**
Ovis aries/Capra hircus	566	33.7	112	6.7	510	30.3	494	29.4	**1682**
Sus scrofa domesticus	4	100.0	0	0.0	0	0.0	0	0.0	**4**
Canis familiaris	5	27.8	3	16.7	2	11.1	8	44.4	**18**
Gallus gallus domesticus	0	0.0	1	100.0	0	0.0	0	0.0	**1**
Wild Mammal	7	35.0	0	0.0	3	15.0	10	50.0	**20**
Wild Bird	1	25.0	0	0.0	0	0.0	3	75.0	**4**
Wild Reptile	1	25.0	1	25.0	1	25.0	1	25.0	**4**
TOTAL	**937**	**42.3**	**158**	**7.1**	**525**	**23.7**	**597**	**26.9**	**2217**

Table 5d. Preservation of the Iron Age Büyüktepe Höyük Assemblage.

Table 5di) Unidentified Remains

	AB	%	AB/RB	%	RB	%	COMPL	%	TOTAL
Small	48	63.2	27	35.5	1	1.3	0	0.0	**76**
Medium	298	84.7	49	13.9	5	1.4	0	0.0	**352**
Large	264	77.6	65	19.1	11	3.2	0	0.0	**340**
Indeterminate	55	56.7	31	32.0	11	11.3	0	0.0	**97**
TOTAL	**665**	**76.9**	**172**	**19.9**	**28**	**3.2**	**0**	**0.0**	**865**

Table 5dii) Identified Remains

	AB	%	AB/RB	%	RB	%	COMPL	%	TOTAL
E.caballus	10	35.7	2	7.1	0	0.0	16	57.1	**28**
E.asinus/E.hemionus	2	100.0	0	0.0	0	0.0	0	0.0	**2**
Equus sp.	20	83.3	4	16.7	0	0.0	0	0.0	**24**
Bos taurus	144	65.2	51	23.1	6	2.7	20	9.0	**221**
Ovis aries/Capra hircus	330	67.2	72	14.7	21	4.3	68	13.8	**491**
Sus Scrofa domesticus	33	61.1	10	18.5	2	0.0	9	16.7	**54**
Canis familiaris	0	0.0	2	100.0	0	0.0	0	0.0	**2**
Camelus sp.	1	100.0	0	0.0	0	0.0	0	0.0	**1**
Gallus gallus domesticus	3	75.0	0	0.0	0	0.0	1	25.0	**4**
Wild Mammal	8	53.3	7	46.7	0	0.0	0	0.0	**15**
Wild Bird	6	100.0	0	0.0	0	0.0	0	0.0	**6**
TOTAL	**557**	**65.7**	**148**	**17.5**	**29**	**3.4**	**114**	**13.4**	**848**

Table 6. Frequency of Gnawing in the Assemblages

Table 6a) Early Bronze Age Sos Höyük

SPECIES	No.	%		UNIDS	No.	%
Bos	19	1.9		Medium	4	0.4
Ovis/Capra	24	1.8		Large	8	0.8

Table 6b) Early Bronze Age Büyüktepe Höyük

SPECIES	No.	%		UNIDS	No.	%
Bos	1	8.3		Large	1	5.0
Ovis/Capra	1	6.7				

Table 6c) Iron Age Sos Höyük

SPECIES	No.	%		UNIDS	No.	%
Bos	6	1.3		Large	13	1.0
Ovis/Capra	16	1.0		Medium	12	0.8
				Indeterminate	1	5.9

Table 6d) Iron Age Büyüktepe Höyük

SPECIES	No.	%		UNIDS	No.	%
Equus caballus	2	7.1		Medium	1	0.3
Equus sp.	1	4.2		Large	2	0.6
Bos	6	2.7				
Ovis/Capra	6	1.2				

Table 7. Frequency of Burning in the Assemblages

Table 7a) Early Bronze Age Sos Höyük

SPECIES	No.	%		UNIDS	No.	%
Bos	5	0.5		Medium	7	0.6
Ovis/Capra	20	1.5		Large	8	0.8
Cervus	1	11.1				
Sus scrofa	1	25.0				

Table 7b) Iron Age Sos Höyük

SPECIES	No.	%		UNIDS	No.	%
Equus sp.	2	15.4		Medium	29	2.0
Bos	26	5.5		Large	43	3.4
Ovis/Capra	26	1.6		Indeterminate	1	5.9

Table 7c) Iron Age Büyüktepe Höyük

SPECIES	No.	%		UNIDS	No.	%
Bos	1	0.5		Medium	5	1.4
Ovis/Capra	2	0.4		Large	2	0.6

Table 8. Frequency of Butchery in the Assemblages

Table 8a) Early Bronze Age Sos Höyük

SPECIES	No.	%		UNIDS	No.	%
Bos	24	2.4		Medium	2	0.2
Ovis/Capra	23	1.7		Large	2	0.2
O.orientalis	1	50.0				
O.orientalis/ C.aegagrus	1	33.3				

Table 8b) Early Bronze Age Büyüktepe Höyük

SPECIES	No.	%
Bos	1	8.3
Equus caballus	1	50.0

Table 9. Frequency of Tools in the Assemblages

Table 9a) Early Bronze Age Sos Höyük

SPECIES	No.	%		UNIDS	No.	%
Bos	18	1.8		Small	1	1.2
Ovis/Capra	12	0.9		Medium	6	0.5
Cervus	6	66.7		Large	14	1.3

Table 9c) Iron Age Büyüktepe Höyük

SPECIES	No.	%		UNIDS	No.	%
Bos	1	0.5		Medium	3	0.9
Ovis/Capra	8	1.6		Large	1	0.3
Cervus	4	57.1				

Table 9b) Iron Age Sos Höyük

SPECIES	No.	%		UNIDS	No.	%
Bos	9	1.9		Medium	5	0.3
Ovis/Capra	8	0.5		Large	7	0.6
Lepus	1	50.0				

Table 8c) Iron Age Sos Höyük

SPECIES	No.	%		UNIDS	No.	%
Bos	12	2.5		Large	1	0.1
Ovis/Capra	7	0.4				

Table 8d) Iron Age Büyüktepe Höyük

SPECIES	No.	%		UNIDS	No.	%
Equus sp.	2	8.3		Medium	2	0.6
Bos	11	5.0		Large	2	0.6
Ovis/Capra	7	1.4				

Table 10a.

ELEMENT	*E.caballus*	*E.asinus/ E.hemionus*
Cranium	-	-
Mandible	3	1
Vertebra	-	-
Rib	-	-
Scapula	1	-
Humerus	1	-
Radius	1	-
Ulna	-	-
Carpus	-	1
Metacarpal	-	-
Pelvis	-	-
Femur	1	-
Patella	-	-
Tibia	-	-
Fibula	-	-
Calcaneus	-	-
Talus	-	-
Tarsus	-	-
Metatarsal	-	-
Metapodial	-	-
Phalanx 1	-	-
Phalanx 2	-	-
Phalanx 3	-	-
Sesamoid	1	-
TOTAL	**8**	**2**

Table 10b.

ELEMENT	*E.caballus*	*E.asinus*	*E.asinus/ E.hemionus*	*E.caballus/ E.hemionus/ E.hydruntinus*	*E .sp.*
Cranium	-	-	-	-	1
Mandible	1	-	1	-	-
Vertebra	-	-	-	-	-
Rib	-	-	-	-	-
Scapula	-	-	-	-	-
Humerus	1	-	-	-	-
Radius	-	-	-	-	-
Ulna	-	-	-	-	-
Carpus	-	-	-	-	-
Metacarpal	1	-	-	-	1
Pelvis	-	-	-	-	-
Femur	1	-	-	-	-
Patella	-	-	-	-	-
Tibia	-	-	-	-	-
Fibula	-	-	-	-	-
Calcaneus	-	-	-	-	-
Talus	-	-	-	-	-
Tarsus	-	-	-	-	-
Metatarsal	-	-	-	-	1
Metapodial	-	1	-	-	-
Phalanx 1	1	-	-	-	-
Phalanx 2	-	-	-	1	-
Phalanx 3	-	-	-	1	-
Sesamoid	-	-	-	-	-
TOTAL	**5**	**1**	**1**	**2**	**3**

Table 10a. Frequency of *Equus* Skeletal Elements from Early Bronze Age Sos Höyük.
Table 10b. Frequency of *Equus* Skeletal Elements from Iron Age Sos Höyük.

Table 10c.

ELEMENT	E.caballus	E.asinus/ E.hemionus	E.hemionus	E .sp.
Cranium	-	-	-	-
Mandible	-	1	1	1
Vertebra	1	-	-	2
Rib	-	-	-	9
Scapula	3	-	-	-
Humerus	-	-	-	1
Radius	2	-	-	2
Ulna	-	1	-	-
Carpus	4	-	-	1
Metacarpal	-	-	-	-
Pelvis	2	-	-	1
Femur	1	-	-	2
Patella	-	-	-	-
Tibia	1	-	-	2
Fibula	-	-	-	-
Calcaneus	-	-	-	1
Talus	1	-	-	-
Tarsus	-	-	-	-
Metatarsal	-	-	-	-
Metapodial	1	-	-	2
Phalanx 1	3	-	-	-
Phalanx 2	4	-	-	-
Phalanx 3	3	-	1	-
Sesamoid	2	-	-	-
TOTAL	**28**	**2**	**2**	**24**

Table 11a.

ELEMENT	*Bos taurus*	*B. primigenius*
Horn core	12	-
Cranium	134	-
Mandible	211	-
Atlas	7	-
Axis	8	-
Cerv. Vert.	5	1
Thor. Vert.	1	-
Lumb. Vert.	1	-
Sacr. Vert.	1	-
Caudal Vert.	8	-
Rib	4	-
Scapula	68	-
Humerus	54	2
Radius	50	2
Ulna	21	1
Carpus	27	-
Metacarpal	40	-
Pelvis	30	-
Femur	27	-
Patella	2	-
Tibia	32	-
Fibula	-	-
Calcaneus	14	-
Talus	36	-
Tarsus	21	-
Metatarsal	45	-
Metapodial	12	-
Phalanx 1	63	1
Phalanx 2	45	-
Phalanx 3	20	-
Sesamoid	7	-
TOTAL	**1006**	**7**

Table 11b.

ELEMENT	*Bos taurus*
Horn core	1
Cranium	-
Mandible	2
Atlas	-
Axis	-
Cerv. Vert.	-
Thor. Vert.	-
Lumb. Vert.	-
Sacr. Vert.	-
Caudal Vert.	-
Rib	-
Scapula	2
Humerus	1
Radius	-
Ulna	-
Carpus	1
Metacarpal	-
Pelvis	1
Femur	-
Patella	-
Tibia	1
Fibula	-
Calcaneus	2
Talus	-
Tarsus	-
Metatarsal	1
Metapodial	-
Phalanx 1	-
Phalanx 2	-
Phalanx 3	-
Sesamoid	-
TOTAL	**12**

Table 11c.

ELEMENT	*Bos taurus*
Horn core	7
Cranium	74
Mandible	97
Atlas	5
Axis	3
Cerv. Vert.	-
Thor. Vert.	-
Lumb. Vert.	-
Sacr. Vert.	2
Caudal Vert.	3
Rib	10
Scapula	27
Humerus	20
Radius	24
Ulna	9
Carpus	10
Metacarpal	20
Pelvis	19
Femur	4
Patella	1
Tibia	13
Fibula	-
Calcaneus	8
Talus	14
Tarsus	9
Metatarsal	29
Metapodial	12
Phalanx 1	22
Phalanx 2	23
Phalanx 3	5
Sesamoid	4
TOTAL	**474**

Table 10c. Frequency of *Equus* Skeletal Elements from Iron Age Büyüktepe Höyük.

Table 11a. Frequency of *Bos* Skeletal Elements from Early Bronze Age Sos Höyük.

Table 11b. Frequency of *Bos* Skeletal Elements from Early Bronze Age Büyüktepe Höyük.

Table 11c. Frequency of *Bos* Skeletal Elements from Iron Age Sos Höyük.

Table 11d.

ELEMENT	*Bos taurus*	*B. primigenius*
Horn core	9	-
Cranium	21	-
Mandible	40	-
Atlas	2	-
Axis	-	-
Cerv. Vert.	3	-
Thor. Vert.	4	-
Lumb. Vert.	2	-
Sacr. Vert.	-	-
Caudal Vert.	-	-
Rib	7	-
Scapula	8	-
Humerus	12	-
Radius	10	-
Ulna	4	-
Carpus	2	-
Metacarpal	16	-
Pelvis	6	-
Femur	6	-
Patella	1	-
Tibia	22	-
Fibula	-	-
Calcaneus	4	-
Talus	7	-
Tarsus	3	-
Metatarsal	14	-
Metapodial	5	-
Phalanx 1	5	1
Phalanx 2	5	-
Phalanx 3	2	-
Sesamoid	1	-
TOTAL	**221**	**1**

Table 12a.

ELEMENT	*Ovis/ Capra*	including:		*O.orientalis/ C.aegagrus*	*O.orientalis*	*C.aegagrus*
		O. aries	*C. hircus*			
Horn core	28	4	13	-	-	-
Cranium	200	5	-	-	-	-
Mandible	268	46	18	-	-	-
Atlas	11	4	1	-	-	-
Axis	10	-	2	-	-	-
Cerv. Vert.	9	-	-	-	-	-
Thor. Vert.	3	-	-	-	-	-
Lumb. Vert.	7	-	-	-	-	-
Sacr. Vert.	4	-	-	-	-	-
Caudal Vert.	2	-	-	-	-	-
Rib	5	-	-	-	-	-
Scapula	78	8	-	-	-	-
Humerus	74	17	5	-	2	-
Radius	97	15	7	1	-	-
Ulna	44	13	3	-	-	-
Carpus	11	-	-	-	-	-
Metacarpal	78	16	3	-	-	1
Pelvis	49	6	10	-	-	-
Femur	47	8	3	-	-	-
Patella	7	-	-	-	-	-
Tibia	73	-	-	2	-	-
Fibula	-	-	-	-	-	-
Calcaneus	19	15	1	-	-	-
Talus	48	26	9	-	-	-
Tarsus	4	-	-	-	-	-
Metatarsal	70	7	1	-	-	-
Metapodial	21	8	-	-	-	-
Phalanx 1	50	31	6	-	-	-
Phalanx 2	21	10	3	-	-	-
Phalanx 3	8	5	1	-	-	-
Sesamoid	1	-	-	-	-	-
TOTAL	**1347**	**244**	**93**	**3**	**2**	**1**

Table 12b.

ELEMENT	*Ovis/ Capra*	including: *O. aries*
Horn core	-	-
Cranium	1	-
Mandible	4	2
Atlas	-	-
Axis	-	-
Cerv. Vert.	-	-
Thor. Vert.	-	-
Lumb. Vert.	-	-
Sacr. Vert.	-	-
Caudal Vert.	-	-
Rib	1	-
Scapula	1	-
Humerus	-	-
Radius	2	-
Ulna	-	-
Carpus	-	-
Metacarpal	2	-
Pelvis	1	-
Femur	-	-
Patella	-	-
Tibia	3	-
Fibula	-	-
Calcaneus	-	-
Talus	-	-
Tarsus	-	-
Metatarsal	-	-
Metapodial	-	-
Phalanx 1	-	-
Phalanx 2	-	-
Phalanx 3	-	-
Sesamoid	-	-
TOTAL	**15**	**2**

Table 11d. Frequency of *Bos* Skeletal Elements from Iron Age Büyüktepe Höyük.

Table 12a. Frequency of *Ovis/Capra* Skeletal Elements from Early Bronze Age Sos Höyük.

Table 12b. Frequency of *Ovis/Capra* Skeletal Elements from Early Bronze Age Büyüktepe Höyük.

Table 12c.

ELEMENT	*Ovis/* *Capra*	including: *O. aries*	*C. hircus*
Horn core	19	13	2
Cranium	213	17	-
Mandible	174	31	3
Atlas	18	9	-
Axis	15	5	1
Cerv. Vert.	52	-	-
Thor. Vert.	64	-	-
Lumb. Vert.	60	-	-
Sacr. Vert.	14	-	-
Caudal Vert.	6	-	-
Vertebra	6	-	-
Sternum	10	-	-
Rib	191	-	-
Scapula	63	20	-
Humerus	89	30	1
Radius	72	12	8
Ulna	27	7	2
Carpus	19	-	-
Metacarpal	49	8	2
Pelvis	63	16	3
Femur	66	13	-
Patella	14	12	-
Tibia	62	-	-
Fibula	-	-	-
Calcaneus	23	9	-
Talus	25	9	1
Tarsus	23	-	-
Metatarsal	57	14	-
Metapodial	26	2	-
Phalanx 1	94	69	4
Phalanx 2	47	33	12
Phalanx 3	19	12	2
Sesamoid	2	-	-
TOTAL	**1682**	**341**	**41**

Table 12d.

ELEMENT	*Ovis/* *Capra*	including: *O. aries*	*C. hircus*
Horn core	3	-	1
Cranium	58	-	1
Mandible	62	12	2
Atlas	2	-	1
Axis	3	-	-
Cerv. Vert.	7	-	-
Thor. Vert.	12	-	-
Lumb. Vert.	13	-	-
Sacr. Vert.	5	-	-
Caudal Vert.	-	-	-
Vertebra	5	-	-
Rib	53	-	-
Scapula	15	1	-
Humerus	36	11	-
Radius	28	5	-
Ulna	6	1	-
Carpus	4	-	-
Metacarpal	30	5	-
Pelvis	17	9	-
Femur	19	3	-
Patella	-	-	-
Tibia	29	-	-
Fibula	-	-	-
Calcaneus	3	2	-
Talus	5	3	2
Tarsus	2	1	-
Metatarsal	32	10	-
Metapodial	4	2	-
Phalanx 1	28	13	2
Phalanx 2	7	3	1
Phalanx 3	3	1	1
Sesamoid	-	-	-
TOTAL	**491**	**82**	**11**

Table 13a.

ELEMENT	*Sus scrofa* domesticus	*Sus scrofa*
Cranium	1	-
Mandible	2	-
Vertebra	-	-
Rib	-	-
Scapula	1	-
Humerus	2	-
Radius	-	-
Ulna	-	-
Carpus	-	-
Metacarpal	-	-
Pelvis	1	-
Femur	-	-
Patella	-	-
Tibia	-	-
Fibula	-	-
Calcaneus	-	1
Talus	1	-
Tarsus	-	-
Metatarsal	-	2
Metapodial	-	-
Phalanx 1	1	1
Phalanx 2	-	-
Phalanx 3	-	-
Sesamoid	-	-
TOTAL	**9**	**4**

Table 13b.

ELEMENT	*Sus scrofa* domesticus
Cranium	15
Mandible	33
Vertebra	-
Rib	-
Scapula	-
Humerus	-
Radius	-
Ulna	1
Carpus	-
Metacarpal	-
Pelvis	-
Femur	-
Patella	-
Tibia	-
Fibula	-
Calcaneus	-
Talus	-
Tarsus	-
Metatarsal	3
Metapodial	-
Phalanx 1	2
Phalanx 2	-
Phalanx 3	-
Sesamoid	-
TOTAL	**54**

Table 12c. Frequency of *Ovis/Capra* Skeletal Elements from Iron Age Sos Höyük.
Table 12d. Frequency of *Ovis/Capra* Skeletal Elements from Iron Age Büyüktepe Höyük.
Table 13a. Frequency of *Sus* Skeletal Elements from Early Bronze Age Sos Höyük.
Table 13b. Frequency of *Sus* Skeletal Elements from Iron Age Büyüktepe Höyük.

Table 14a.

ELEMENT	*C. familiaris*	*C. lupus*
Cranium	5	-
Mandible	5	-
Atlas	3	-
Axis	-	-
Cerv. Vert.	1	-
Thor. Vert.		
Lumb. Vert.	-	-
Sacr. Vert.	-	-
Caudal Vert.		-
Rib		
Scapula	3	
Humerus	1	-
Radius	2	
Ulna	1	
Carpus	1	-
Metacarpal	2	
Pelvis	2	-
Femur	-	-
Patella	-	-
Tibia	1	-
Fibula	-	
Calcaneus	1	
Talus	-	-
Tarsus	-	
Metatarsal	-	
Metapodial	-	1
Phalanx 1	-	
Phalanx 2		-
Phalanx 3	-	-
Sesamoid	-	-
TOTAL	**28**	**1**

Table 14b.

ELEMENT	*C. familiaris*
Cranium	1
Mandible	4
Atlas	-
Axis	1
Cerv. Vert.	-
Thor. Vert.	
Lumb. Vert.	-
Sacr. Vert.	
Caudal Vert.	1
Rib	
Scapula	-
Humerus	2
Radius	2
Ulna	1
Carpus	1
Metacarpal	1
Pelvis	1
Femur	
Patella	
Tibia	-
Fibula	-
Calcaneus	-
Talus	1
Tarsus	-
Metatarsal	-
Metapodial	-
Phalanx 1	1
Phalanx 2	1
Phalanx 3	
Sesamoid	-
TOTAL	**18**

Table 14a. Frequency of *Canis* Skeletal Elements from Early Bronze Age Sos Höyük.
Table 14b. Frequency of *Canis* Skeletal Elements from Iron Age Sos Höyük.

Table 15. *Equus caballus, E. asinus, E. hemionus* Measurements.

Table 15a)

MANDIBULAR TEETH				A*	B*	C*	D*	E*	F*	G*	H*	I*	J*	K*	L*	M*
6.0362	EBA	SOS	CAB	-	13.8			-	-	11.2	11.4	2.4	11.9	6.7	5.8	-
6.1491	EBA	SOS	ASS/HEM	-	12.8	10.3	12.9	7.0	5.7	10.5	11.5	3.5	9.9	8.4	5.8	5.0
7.0422	IA	SOS	ASS/HEM	[29.6]	15.3	-	[16.4]	8.8	[7.1]	7.2	16.6	4.9	11.5	9.9	6.2	
7.1078	IA	SOS	CAB	30.3	17.3	17.3	18.3	9.3	9.4	12.8	15.8	3.1	14.4	10.0	7.4	7.9
4.0434	IA	BTH	ASS/HEM	[24.6]	-	13.8	[12.5]	[6.6]	4.9		13.2	3.4	-	11.0	-	6.0
5.0008	IA	BTH	HEM	-	-	10.9	[11.9]	[6.9]	5.8	-	-	0.9	-	8.1	-	4.7

A Tooth length
B Anterior width
C Posterior Width
D Length metaconid-metastylid
E Length metaconid
F Length metastylid
G Length protoconid

H Length hypoconid
I Width between valleys
J Length paralophid
K Length metaflexid
L Width metaconid
M Width metastylid
* Taken from Turnbull 1986 342

Table 15b)

SCAPULA				SLC	GLP	LG	BG
4.0156	IA	BTH	CAB	56.0	-	53.0	44.5
4.0225A-F	IA	BTH	CAB	62.0	90.0	57.8	-
4.0226A-B	IA	BTH	CAB	[60]	90.5	57.5	49.5

Table 15c)

HUMERUS				BT	Bd
4.0782	EBA	BTH	CAB	76	78.5

Table 15d)

RADIUS				GL	PL	Ll	Bp	BFp	SD	CD	Bd	BFd
4.0362A-D	IA	BTH	CAB	-	-	-	-	-	-	-	[74]	64.0
5.1234	IA	BTH	CAB	340.0	332.0	327.0	82.5	[73.7]	38.7	115.0	77.0	65.1

Table 15e)

RADIAL CARPAL				GL	GB	GH
6.0246	EBA	SOS	ASS/HEM	36.3	25.3	24.0
4.0719	IA	BTH	CAB	41.1	28.8	25.9
5.0045	IA	BTH	CAB	38.0	29.5	24.0

Table 15f)

THIRD CARPAL				GL*	GB	GH*
4.0937	IA	BTH	CAB	39.0	44.0	21.0

* Taken from Meadow 1986, 283

Table 15g)

INTERMEDIATE				GL	GH
4.0746	IA	BTH	CAB	36.8	28.2

Table 15h)

PELVIS				LA	LAR	SH	SB	SC	LFo
4.0784	EBA	BTH	HEM	56.0	50.0	23.5	15.0	91.0	55.5
4.0176A-B	IA	BTH	CAB	66.0	59.0	39.0	23.0	101.5	65.0
4.0228A-C	IA	BTH	CAB	68.7	63.0	38.0	23.0	103.0	65.1

Table 15i)

FEMUR				DC
5.2291	EBA	SOS	CAB	56.0

Table 15j)

TIBIA				Bd	Dd
5.1241	IA	BTH	CAB	74.7	43.5

Table 15k)

TALUS				GH	GB	BFd	LmT
4.1530.	IA	BTH	CAB	[61.4]	65.4	53.8	56.9

Table 15l)

METAPODIAL				Bd	A*	B*	C*	D*	E*	
7.1106A-B	IA	SOS	CAB	50.2	45.5	-	35.6	27.5	29.8	MTC
7.0740.	IA	SOS	ASS	34.1	33.4	-	-	19.7	21.4	MTC
4.0585	IA	BTH	CAB	[48]	-	50.0	-	[23]	28.0	MTC

A Distal supra-articular breadth (transverse diameter)

B Breadth of the distal articulation

C Depth of saggital crest

D Least depth of the medial (internal) condyle

E Greatest depth of the medial (internal) condyle

* Taken from Eisenmann & Beckouche 1986 130

Table 15m)

DISTAL SESAMOID				GB
6.1648	EBA	SOS	CAB	49
4.0154	IA	BTH	CAB	43
4.023	IA	BTH	CAB	48

Table 15n)

PHALANX 1				GL	Bp	BFp	Dp	SD	Bd	BFd	A*	
4.0785	EBA	BTH	CAB	94.0	53.5	48.5	37.0	35.0	47.0	44.5	37.2	F/L
4.0157	IA	BTH	CAB	[92.5]	[59]	[53]	[41]	[34]	[46]		36.8	
4.0178	IA	BTH	CAB	88.5	57.0	52.5	38.0	33.5	45.0	44.0	37.9	H/L
4.0733	IA	BTH	CAB	82.0	≈52	48.0	38.0	31.0	[41]	-	37.8	F/L

A Index of robustness

* Taken from Compagnoni 1975, p.111

Table 15o)

PHALANX 2				GL	Bp	BFp	Dp	SD	Bd		
7.1337	IA	SOS	CAB/HEM/HYD	[44.6]	45.2	40.1	25.9	[35.2]	[39.8]		burnt
4.0179	IA	BTH	CAB	51.0	57.0	48.0	32.5	46.0	49.5	F/L	
4.0229	IA	BTH	CAB	51.5	52.5	47.0	32.5	42.5	48.0	H/L	
4.0363A-B	IA	BTH	CAB	48.0	-	-	30.0	39.5	42.0	H/L	
5.0070.	IA	BTH	CAB	49.0	-	-	32.0	48.0	52.8	F/L	

Table 15p)

PHALANX 3				GL	GB	LF	BF	Ld	HP	
7.1338A-B	IA	SOS	CAB/HEM/HYD	[52]	[63]	18.2	37.2	[42.4]	27.8	burnt
4.0180.	IA	BTH	CAB	55.5	70.0	25.5	47.5	52.5	41.0	
4.0129	IA	BTH	HEM	[52]	[57]	24.5	42.0	48.0	35.5	
4.0709A-B	IA	BTH	CAB	61.5	74.0	32.0	54.0	58.0	44.0	
5.0003	IA	BTH	CAB	69.0	82.0	28.0	52.0	[45]	50.5	

Table 16. *Bos taurus/B. primigenius* Measurements

Table 16a)

HORN CORE			A	B	C	D	SEX
6.0182	EBA	SOS	161.5	54.4	46.9	[235]	CAS
6.1040.	EBA	SOS	151.5	52.7	40.9	-	M
6.2296	EBA	SOS	145.0	51.4	38.0	[260]	M
4.0167	EBA	BTH	216.0	74.0	64.0		CAS
7.0674	IA	SOS	118.5	39.8	33.5	-	F
7.0974	IA	SOS	[142]	48.0	[45]		CAS

A Horncore basal circumference

B Greatest (oro-aboral) diameter of horncore base

C Least (dorso-basal) diameter of the horncore base

D Length of the outer curvature of the horn core

Table 16b)

CRANIAL			A	B	C	D	E
5.1060.	EBA	SOS		-	-	55.5	60.2
6.0083	EBA	SOS	54.0	29.7	129.5	-	-

A Greatest length of the inner orbit:Ectorbitale-Entorbitale

B Least inner height of the temporal groove

C Lateral length of the premaxilla:Nasointermaxillare-Prosthion

D Greatest inner length of the orbit

E Greatest inner height of the orbit

Table 16c)

MAXILLARY TEETH			L P4	W P4	L M1	W M1	L M2	W M2	L M3	W M3	A
5.1975A-B	EBA	SOS	-	-	25.2	16.2			-	-	-
5.2500A-E	EBA	SOS	17.0	-	22.8	19.0	26.8	19.2	-		-
5.2676	EBA	SOS	-	-	25.3		25.3	20.0	-	-	-
5.2677	EBA	SOS	-	-	25.7	23.3	-				-
5.2678	EBA	SOS	16.3			-	-	-	-	-	-
5.2774	EBA	SOS	-	-	-	-	-		28.8	24.0	-
5.3491	EBA	SOS	-	-	[25.1]	[21.6]	-	-	-		-
6.0213	EBA	SOS	-	-	[27]		-		-	-	-
6.0344	EBA	SOS	-	-	21.0	20.9	-	-		-	-
6.0420.	EBA	SOS	-	-			28.3	22.3	-	-	-
6.0439	EBA	SOS	-	-	18.0	19.6			-		
6.0756	EBA	SOS			24.3	17.0	-	-		-	
6.0945	EBA	SOS	18.4	19.5	23.4	20.1	-		-	-	-
6.1066	EBA	SOS	-	-	-	-	27.7	15.5		-	
6.1112	EBA	SOS	-			-		-	-	-	-
6.1204	EBA	SOS	-	-	-	-			27.8	17.3	-
6.1266A-B	EBA	SOS	16.3	19.1	23.4	23.9	26.4	23.3	28.4	21.7	79.5
6.1449	EBA	SOS	-	-	-	-			20.6	24.4	
6.1528	EBA	SOS			23.0	17.4	-	-	-		-
6.1838	EBA	SOS	-	-	23.1	20.5	28.0	20.6	30.2	20.7	-
6.1952	EBA	SOS	-	-	27.8	21.6	-	-	-		
6.2237	EBA	SOS			23.4	22.0	27.3	21.9	29.4	20.8	83.0
6.2238	EBA	SOS				-	27.3	19.0	26.9	17.8	-
6.2239	EBA	SOS	-	-	-	-	27.7	18.0	29.6	23.0	
6.2240.	EBA	SOS			24.8	19.7	-	-	-	-	-
6.2241	EBA	SOS		-			28.2	20.9	-		
6.2273	EBA	SOS	-	-	-	-	28.5	-	-	-	-
6.2340.	EBA	SOS			-		24.8	19.7	25.5	19.8	-
6.2341	EBA	SOS	15.3	15.6	-	-	-	-	-	-	-
6.2360.	EBA	SOS	16.7	19.1			-			-	-
6.2413A-B	EBA	SOS				27.4	17.3	-	-		-

A Length of molar row

Table 16c) cont.

MAXILLARY TEETH			L P4	W P4	L M1	W M1	L M2	W M2	L M3	W M3	A
6.2444A-D	EBA	SOS	-	-	24.8	17.3		-	-	-	-
7.0005	IA	SOS	-		22.2	-	-		-		-
7.0424	IA	SOS	-	-	21.4	-	24.1	[21.6]	21.8	-	73.5
7.0446	IA	SOS	-	-	-	-	-	-	27.1	20.4	-
7.0486	IA	SOS	-	-	26.5	17.6	25.8	16.5		-	-
7.0788	IA	SOS	16.5	16.2	-		-		-		-
4.0023	IA	BTH	-	-	23.0	[17.2]	-	-	-	-	-
4.0642A-C	IA	BTH	-	-		-		-	26.0	20.0	
4.0802A-S	IA	BTH		-	-	-	30.0	15.5	29.0	12.5	-
4.0812	IA	BTH	-	-	-	-	26.5	[17]	-	-	-
4.0977	IA	BTH		-	-	-	-	-	31.0	[21]	-
5.0086	IA	BTH	-	-		-	27.5	18.5	-	-	-
5.1345A	IA	BTH		-	-	-	29.5	-		-	-
5.1646	IA	BTH	-	-		-	28.0	22.9	-	-	-

A Length of molar row

Table 16d)

MANDIBLE			A	B	C	D	E	F	G	H	I	J
5.1993A-B	EBA	SOS	-		-	52.0			40.5			-
5.2627A-C	EBA	SOS	-	-		[47]	-	-	-	-	-	-
6.0176	EBA	SOS		-	-	58.0		-	28.7			
6.0520.	EBA	SOS	-	-			-	-	29.0	-	-	-
6.0824	EBA	SOS		-	-	56.3	-	40.0	30.0	-	-	-
6.0852	EBA	SOS	-	139.0	89.0	48.2						
6.0921	EBA	SOS		-		-	67.5	-	-	-	-	-
6.0947	EBA	SOS	-	-	-	49.6	-	48.3		-	-	-
6.0962	EBA	SOS	-			56.1		37.8	26.2	-	-	
6.1029	EBA	SOS				47.3		-	-	-	-	
6.1695	EBA	SOS	-	-	-	51.8	-	-	-	-	-	-
6.1839	EBA	SOS				53.3						-
6.1840.	EBA	SOS	-	-	-	-	-	-	31.4	-		-
6.2022A-B	EBA	SOS	-						-	109.2	116.7	155.0
6.2371	EBA	SOS	-	-	-	54.3			36.2			-
4.0780A-G	EBA	BTH	-		-	55.0	-	38.0	-	-		
4.0330A-H	IA	BTH	-	-	71.5				-	-	-	-
4.0378A-AM	IA	BTH	[224]	148.0	97.0	52.5		[51]	39.5	-		-
4.0743A-S	IA	BTH	-	135.0	82.5	55.0	-	48.0	37.0	-		
4.0780A-G	IA	BTH	-	-	55.0	-		38.0	-	-	-	-
4.0811A-C	IA	BTH	-		-	-	67.0	-		-	-	-
4.1535	IA	BTH	-			48.0	-	39.0	28.0	-		-
4.1536	IA	BTH		-		59.0	-	32.0	19.5	-	-	-
5.0018A-T	IA	BTH			97.0	-	-	49.5	-	-	-	-
5.1257	IA	BTH		-	-	-	-	-	34.6			
5.1285A-F	IA	BTH	-		-	-			-	119.0	-	-
5.1404	IA	BTH		-	-	-	-		37.0	-	-	-
5.1545A-B	IA	BTH	-	-	-	52.0	-	[48.5]	33.3	-	-	-

A Length of horizontal ramus: aboral border of alveolus of M3-Infradentale

B Length of cheektooth row M3-P2 along alveoli

C Length of molar row along alveoli

D Length of premolar row P4-P2 measured along alveoli

E Height of mandible behind M3 from most aboral point of alveolus

G Height of mandible in front of P2

H Middle Height of vertical ramus: Gonion ventrale-Coronion

I Aboral height of the vertical ramus: Gonion ventrale-highest point of condyle process

J Oral height of the vertical ramus: Gonion ventrale-Coronion

Table 16e)

MANDIBULAR TEETH			L P4	W P4	L M1	W M1	L M2	W M2	L M3	W M3
5.0376	EBA	SOS		-	25.4	16.4	-	-	-	-
5.1993A-B	EBA	SOS	22.5	12.0	21.0	15.5	25.6	15.5	-	-
5.2063	EBA	SOS	-		-	-	-	-	35.0	14.0
5.2227A-G	EBA	SOS	-	-	-	-	-	-	39.0	13.6
5.2436A-B	EBA	SOS	-	-			26.2	12.5	-	-
5.2441	EBA	SOS	-	-	25.3	-	-		-	-
5.2443	EBA	SOS	19.3	12.1	-	-	-	-	-	-
5.2733	EBA	SOS	22.2	12.2			-		-	-
5.3635	EBA	SOS			22.4	15.8	-	-	-	-
6.0145A-B	EBA	SOS	17.7	16.4	22.2	-	-			-
6.0168	EBA	SOS	-	-	-		26.3	11.5		-
6.0373	EBA	SOS	19.0	12.3			-	-	-	-
6.0441	EBA	SOS	-			-	28.0	13.5		-
6.0857	EBA	SOS		-	-	-		-	36.8	14.1
6.0858	EBA	SOS	-	-	-	-	25.3	15.4	-	-
6.0879	EBA	SOS		-		-	29.2	-	-	-
6.0947	EBA	SOS	20.4	11.5	23.2	13.9	-	-	-	-
6.0963A-C	EBA	SOS		-	25.0	13.0				-
6.1067	EBA	SOS	-			-	27.0	15.9	-	-
6.1176A-D	EBA	SOS		-	-	-	27.3	11.4	30.6	11.2
6.1426	EBA	SOS	-	-	-	-	-	-	37.6	12.9
6.1434	EBA	SOS	-				-	-	35.3	12.5
6.1441	EBA	SOS	-	-	-	-	-		37.2	14.7
6.1695	EBA	SOS	21.7	12.8	21.1	15.1	24.5	14.3	-	
6.1778	EBA	SOS	-			-	-	-	36.8	16.1
6.1839	EBA	SOS	22.0	12.3	22.6	14.6		-	-	-
6.1908A-C	EBA	SOS	-		27.8	14.4	-	-	-	-
6.2052	EBA	SOS	-	-	24.3	15.8	-	-	-	-
6.2094	EBA	SOS				-	-	-	37.6	15.6
6.2294	EBA	SOS	-	-		-	-	-	36.0	12.8
6.2371	EBA	SOS	21.1	12.8	-	-	-			
6.2422	EBA	SOS						-	32.0	12.6
6.2482	EBA	SOS	-	-	-	-	-	-	36.5	11.8
6.2567	EBA	SOS	-			-	25.3	13.1		-
4.0780A-G	EBA	BTH	-	-	28.0	9.5	-	-	-	-
7.0004	IA	SOS		-	26.0	14.0	-	-	-	-
7.0071	IA	SOS	-	-	-	-	-	-	34.0	12.0
7.0285	IA	SOS	19.9	11.1	21.4	13.7	23.2	13.7		-
7.0307	IA	SOS		-		-	-	-	35.5	12.7
7.0591	IA	SOS	-	-	22.1	15.2	25.3	16.4	-	
7.0612	IA	SOS	-			-		-	30.4	11.9
7.1187	IA	SOS		-		-		-	32.3	-
7.1410.	IA	SOS	-	-			-	-	33.5	
4.0081	IA	BTH		-			28.0	12.0	-	-
4.0378A-AM	IA	BTH	21.0	[8]	23.0	14.0	29.0	13.0	39.0	13.0
4.0743A-S	IA	BTH	22.0	10.0	24.0	12.5	27.5	11.5	34.0	11.0
4.0780A-G	IA	BTH	-	-	28.0	9.5	-	-	-	
4.0811A-C	IA	BTH	-	-	-	-	27.0	11.5	31.5	11.0
4.0976	IA	BTH		-	18.0	13.0	23.5	12.5	-	-
4.01012	IA	BTH	[19.5]	-	-	-	-	-		-
4.1536	IA	BTH		-	28.0	-			-	-
5.0018A-T	IA	BTH	21.8	10.5	[22.5]		25.4	[13]	35.0	12.0
5.1257	IA	BTH	-	-	-	-			-	-
5.1285A-F	IA	BTH					26.1	11.0	-	-
5.1404	IA	BTH	20.0	-	-	-	-	-	-	-
5.1493	IA	BTH	-	-	-		32.5		-	-
5.1644	IA	BTH	19.1	-	-	-	-	-	-	-

Table 16f)

ATLAS			BFcr	BFcd	GLF	H
6.2035	EBA	SOS	88.0	91.0	79.7	73.1
6.2405	EBA	SOS	-	-	82.0	-

Table 16g)

AXIS			BFcr
6.1696	EBA	SOS	87.1

Table 16h)

CERVICAL VERT			GLPa	BPacr	BFcd	HFcd	H	
5.2261	EBA	SOS	[60.5]	-	-		-	
6.2287	EBA	SOS	108.7	71.6	42.0	48.7	90.5	WILD
6.2034	EBA	SOS	[72.6]		-	-	-	
4.0356A-D	IA	BTH	66.5		-	-	-	
5.1452	IA	BTH	[80]	[80]	[78.2]	-	-	

Table 16i)

LUMBAR VERT			PL
5.2666	EBA	SOS	54.5

Table 16j)

SACRAL VERT			BFcr	HFcr
6.1780.	EBA	SOS	65.4	[26.5]

Table 16k)

SCAPULA			SLC	GLP	LG	BG
5.2354	EBA	SOS	57.0	69.0	58.0	49.6
6.0350.	EBA	SOS	47.8		-	-
6.0603	EBA	SOS	47.9	69.0	55.3	53.7
6.0758	EBA	SOS	53.5	-	-	-
6.0823	EBA	SOS	-	-	-	51.1
6.0906A-B	EBA	SOS	59.8			46.3
6.1163	EBA	SOS	-	-	-	49.6
6.1559	EBA	SOS		72.0	57.9	51.0
5.2074A-B	EBA	SOS	51.5	71.5	53.0	52.0
6.2316	EBA	SOS		-	53.3	47.4
4.1020.	IA	BTH	-	-	48.0	47.0

Table 16l)

HUMERUS			SD	Bd	BT	
5.1973	EBA	SOS	-	78.5	70.4	
5.2226A-P	EBA	SOS	45.0	105.0	93.0	WILD
5.2241	EBA	SOS	-	-	69.0	
5.2885A-B	EBA	SOS	29.2	81.1	72.5	
6.0205	EBA	SOS		74.1	67.6	
6.0318	EBA	SOS	-	72.9	67.1	
6.1716	EBA	SOS	-	78.5	68.9	
6.2096	EBA	SOS		70.6	62.1	
4.0162A-C	IA	BTH	[34]	-	-	
4.0425	IA	BTH	28.5	-	-	
5.0001	IA	BTH	[29.5]			
5.1281	IA	BTH	-	[70]	-	

Table 16m)

RADIUS			Bp	BFp	SD	Bd	BFd
5.2140.	EBA	SOS	71.3	65.4	-	-	-
5.2497A-B	EBA	SOS	93.3	84.7			
5.2135A-B	EBA	SOS	-	-	[38]	-	-
6.0164	EBA	SOS		-	-	72.1	63.2
6.0178	EBA	SOS	-	-	-	62.4	61.3
6.0747	EBA	SOS		-	-	88.7	82.0
6.1642	EBA	SOS	[57]	[52.5]	23.8		
6.2198A-B	EBA	SOS		-	-	85.5	76.5
6.2199A-C	EBA	SOS	-		-	-	76.7
6.2299	EBA	SOS	-	-	-	71.0	69.6
6.2372	EBA	SOS	-	-	-	68.0	65.6
7.1310A-B	IA	SOS	-	70.3	-	-	-
7.1524	IA	SOS	-		-	58.6	55.4
7.0151A-B	IA	SOS	-	-	-	59.9	56.0
7.0452	IA	SOS			-	64.6	60.0
7.1104A-G	IA	SOS	-			66.5	63.6
7.1217	IA	SOS	-	-	-	61.7	56.3
4.0163A-B	IA	BTH	-		41.0	-	
4.0843	IA	BTH	-	-	-	73.5	63.0

Table 16n)

ULNA			DPA	SDO	BPC	
6.1060.	EBA	SOS		61.2	36.0	
6.1165	EBA	SOS	-		52.7	WILD
6.2198A-B	EBA	SOS	-	-	48.7	
7.0310.	IA	SOS	62.5	-	45.6	
7.1032	IA	SOS	52.9	48.2	41.4	
7.1310A-B	IA	SOS	-		43.9	
4.0735	IA	BTH	59.0	-	-	
4.0571A-B	IA	BTH	-	-	[51.5]	

Table 16o)

2ND&3RD CARPAL			GB
6.0358	EBA	SOS	38.0
6.0745	EBA	SOS	42.7
6.0774	EBA	SOS	36.4
6.2254	EBA	SOS	42.2
4.1526	EBA	BTH	31.5
7.0247	IA	SOS	26.9
7.0762	IA	SOS	30.9
7.1047	IA	SOS	27.2
7.2030.	IA	SOS	30.0
5.1355	IA	BTH	36.0

Table 16p)

PELVIS			LA	LAR
5.2957	EBA	SOS	58.5	51.4
6.1643	EBA	SOS	84.4	64.3
6.2295	EBA	SOS	75.9	59.6
6.2373	EBA	SOS	62.4	51.0
7.0572	IA	SOS	63.9	54.5
7.1241	IA	SOS	51.9	41.5
7.1296	IA	SOS	60.3	48.7
7.1603	IA	SOS	57.8	45.3
4.0614	IA	BTH	60.5	49.0
4.0755	IA	BTH	73.0	65.0

Table 16q)

FEMUR			Bp	DC
5.2681	EBA	SOS	-	[42]
5.3481	EBA	SOS	-	47.8
6.0244	EBA	SOS		50.2
6.2288	EBA	SOS	-	49.6
6.2308	EBA	SOS	111.5	44.6
6.2365	EBA	SOS	-	55.0

Table16r)

PATELLA			GL	GB
6.2039	EBA	SOS	-	50.0
7.0796	IA	SOS	56.5	
4.0117	IA	BTH	65.0	52.3

Table 16s)

TIBIA			Bp	SD	Bd
5.0282	EBA	SOS	-	-	63.5
5.0493	EBA	SOS	-	-	62.4
5.2723	EBA	SOS	-		74.4
6.0279	EBA	SOS	-		65.9
6.0349	EBA	SOS			50.4
6.0799	EBA	SOS	-	-	68.3
6.0845	EBA	SOS			69.0
6.0846	EBA	SOS	-		76.9
6.0876	EBA	SOS	-	-	61.4
6.0968	EBA	SOS			63.6
6.1096	EBA	SOS	-	-	58.8
6.1646	EBA	SOS			66.3
6.2139	EBA	SOS	-	-	51.9
6.2277	EBA	SOS			72.3
7.0010.	IA	SOS	-		59.3
7.0453	IA	SOS			53.9
7.0675	IA	SOS	-		56.9
7.0998	IA	SOS	-	-	49.4
7.1152	IA	SOS	78.2	-	
7.1234	IA	SOS	-	-	66.6
4.0322A-E	IA	BTH	-		61.0
4.0328	IA	BTH	-		50.0
4.0718A-B	IA	BTH	[95]	-	-
4.0813	IA	BTH			54.0
5.0013	IA	BTH	-	[30.5]	-
5.1237	IA	BTH		31.0	52.0
5.1406	IA	BTH	-		49.7
5.1580.	IA	BTH		-	56.6
5.1701	IA	BTH	-	-	[54]

Table 16t)

CALCANEUS			GL	GB
5.2061	EBA	SOS	-	42.2
5.3589	EBA	SOS	125.0	42.8
6.0931	EBA	SOS		51.6
6.1169	EBA	SOS		42.0
6.1328	EBA	SOS	154.5	46.3
6.1945	EBA	SOS	126.3	43.8
6.2255	EBA	SOS	-	56.5
4.1504A-D	EBA	BTH		[41]
5.1255	EBA	BTH	-	45.0
7.0454	IA	SOS	116.4	40.4
7.0598	IA	SOS	[113.9]	39.5
4.0590.	IA	BTH	-	52.0

Table 16u)

TALUS			GLl	GLm	Dl	Dm	Bd
5.1769	EBA	SOS	65.4	-	37.0	38.0	43.3
5.1974	EBA	SOS	66.8	60.0	36.4	38.0	43.5
5.2233	EBA	SOS	61.0	[57.2]	34.0	-	37.1
5.2234	EBA	SOS	53.5	51.0	28.2	29.5	33.7
5.2724	EBA	SOS	75.4	69.9	42.5	43.1	49.2
5.2775	EBA	SOS	64.5	59.6	36.0	38.1	42.8
5.3542	EBA	SOS	64.2	57.8	38.4	36.4	42.2
6.0120.	EBA	SOS	67.3	63.4	37.9	36.3	42.4
6.0242	EBA	SOS	60.3	56.0	34.0	33.7	37.9
6.0280.	EBA	SOS	63.5	61.0	38.0	37.7	41.9
6.0295	EBA	SOS	64.7	60.3	-	38.9	42.4
6.0585	EBA	SOS	65.2	61.1	37.6	38.3	43.2
6.0602	EBA	SOS	62.1	58.7	33.7	36.3	41.4
6.0757	EBA	SOS	79.0	71.7	46.6	46.2	53.3
6.0930.	EBA	SOS	58.5	56.2	32.9	33.2	37.0
6.0967	EBA	SOS	68.5	61.9	36.0	39.1	42.7
6.1061	EBA	SOS	61.2	58.0	35.3	35.2	38.5
6.1145	EBA	SOS	60.6	-	33.3	-	
6.1168	EBA	SOS	74.6	68.3	41.0	41.8	48.7
6.1331	EBA	SOS	74.0	70.4	41.3	42.4	52.1
6.1560.	EBA	SOS	63.5	58.9	35.0	36.1	40.4
6.1585	EBA	SOS	66.1	59.5	38.5	39.4	44.6
6.1614	EBA	SOS	64.7		36.0	36.1	
6.1685	EBA	SOS	[59]	56.0	34.2	-	[37.3]
6.1700.	EBA	SOS	58.9	54.6	33.7	34.0	40.5
6.1701	EBA	SOS	66.4	61.3	37.5	39.3	43.5
6.1803	EBA	SOS	74.3	69.4	41.0	42.1	50.0
6.1862	EBA	SOS	65.9		37.9		44.0
6.1863	EBA	SOS	-	-	-	-	41.2
6.1864	EBA	SOS	[65.7]	61.2		37.6	[44.3]
6.1953	EBA	SOS	64.7	60.2	38.0	38.1	43.1
7.0158	IA	SOS	63.5	57.9	35.1	35.1	41.6
7.0159	IA	SOS	-		-	-	43.2
7.0175	IA	SOS	59.2	54.6	33.4	33.9	41.9
7.0345	IA	SOS	74.2	66.6	[37.8]		
7.0346	IA	SOS	61.1	56.4	33.8	34.4	38.3
7.0646	IA	SOS	62.8	55.9	34.4	36.4	41.4
7.0824	IA	SOS	68.3	63.0	38.6	37.0	44.3
7.0906	IA	SOS	68.4	63.7	39.4	-	44.8
7.0908	IA	SOS	62.7	58.0	33.2	38.2	41.8
7.0979	IA	SOS	-	53.5	-	-	36.5
7.1462	IA	SOS	64.6	58.2	35.3	35.6	43.5
7.1504	IA	SOS	-	56.3		34.3	40.2
4.0025	IA	BTH	70.0	-	39.5	-	47.5
4.0393	IA	BTH	67.5	62.0	38.0		[41]
4.0469	IA	BTH	75.0	67.4	37.0	39.0	49.0
4.0631	IA	BTH	60.5	57.0	35.0	33.0	39.0
4.0847	IA	BTH	67.0	61.0	39.0	38.0	46.5
4.1509	IA	BTH	66.5	60.0	36.0	-	41.5
5.1500.	IA	BTH	-	59.0	-	-	42.0

Table 16v)

CENTROQUARTAL			GB
5.2099	EBA	SOS	48.7
5.2356	EBA	SOS	61.2
6.0180.	EBA	SOS	56.4
6.0208	EBA	SOS	58.7
6.0226	EBA	SOS	59.2
6.0447	EBA	SOS	48.7
6.1554	EBA	SOS	47.9

Table 16v) cont.

CENTROQUARTAL			GB
6.1968	EBA	SOS	50.4
6.2555	EBA	SOS	58.7
7.0166	IA	SOS	44.0
7.0494	IA	SOS	52.1
7.0573	IA	SOS	45.6
7.0825	IA	SOS	45.9
7.1411	IA	SOS	47.6

Table 16w)

LAT. MALLEOLUS			GB
6.2725	EBA	SOS	40.2
6.0136	EBA	SOS	27.8
6.0284	EBA	SOS	35.0
6.1149	EBA	SOS	31.5
4.0072	IA	BTH	31.5

Table 16x)

METAPODIAL			GL	Bp	SD	CD	DD	Bd	
5.2144A-D	EBA	SOS	-	61.0	-	-	-	-	MTC
5.2726	EBA	SOS	-	67.6	-	-	-	-	MTC
6.0319	EBA	SOS	-	51.7	28.6	-	-	-	MTC
6.0395	EBA	SOS	-	52.2	-	-	-	-	MTC
6.0545	EBA	SOS	-	60.4	-	-	-	-	MTC
6.0720.	EBA	SOS	-	60.8	-	-	-	-	MTC
6.0705	EBA	SOS	-	-	-	-	23.8	69.9	MTC
6.0841	EBA	SOS	-	-	-	-	24.8	66.8	MTC
6.0847	EBA	SOS	[213]	-	-	-	-	-	MTC
6.0877	EBA	SOS	-	-	-	-	27.6	63.1	MTC
6.1002	EBA	SOS	-	-	-	-	31.8	65.3	MTC
6.1160.	EBA	SOS	-	-	-	-	29.0	64.8	MTC
6.1164A-D	EBA	SOS	189.5	55.8	31.4	[87]	21.4	55.4	MTC
6.1166	EBA	SOS	-	-	-	-	24.6	71.4	MTC
6.1666	EBA	SOS	-	65.4	-	-	-	-	MTC
6.1944	EBA	SOS	-	62.5	-	-	-	-	MTC
6.2038	EBA	SOS	-	56.4	-	-	-	-	MTC
6.2169	EBA	SOS	-	68.0	-	-	-	-	MTC
6.2171	EBA	SOS	-	-	-	-	28.0	62.6	MTC
6.2300.	EBA	SOS	-	60.9	-	-	-	-	MTC
5.1765	EBA	SOS	-	-	-	-	27.0	63.1	MTT
5.2139	EBA	SOS	-	47.7	[25]	-	-	-	MTT
5.2141	EBA	SOS	-	51.0	-	-	-	-	MTT
5.2229	EBA	SOS	-	53.0	-	-	-	-	MTT
5.2462A-B	EBA	SOS	-	-	-	-	24.2	54.5	MTT
5.2807	EBA	SOS	-	47.3	-	-	-	-	MTT
6.0202	EBA	SOS	-	50.2	29.0	96.5	-	-	MTT
6.0204A-B	EBA	SOS	212.2	45.6	25.8	84.3	24.7	53.9	MTT
6.0301	EBA	SOS	-	-	-	-	24.9	59.6	MTT
6.1345A-E	EBA	SOS	-	-	-	-	-	64.1	MTT
6.1584	EBA	SOS	-	-	-	-	22.3	52.9	MTT
6.1728	EBA	SOS	-	48.0	25.4	-	-	-	MTT
6.1783	EBA	SOS	-	-	-	-	24.4	53.0	MTT
6.1904	EBA	SOS	-	-	-	-	-	57.6	MTT
6.2256	EBA	SOS	-	[52.1]	-	-	-	-	MTT
6.2374	EBA	SOS	-	45.6	-	-	-	-	MTT
4.0836	EBA	BTH	-	-	19.0	70.0	19.5	[47]	MTT
7.0571	IA	SOS	-	49.0	-	-	-	-	MTC
7.0823	IA	SOS	-	-	-	-	-	53.9	MTC
7.1009	IA	SOS	-	61.8	31.3	90.5	22.0	-	MTC

Table 16x) cont.

METAPODIAL			GL	Bp	SD	CD	DD	Bd	
7.1250.	IA	SOS	-	47.9	25.0	-	-	-	MTC
7.1363	IA	SOS	-	52.4	-	-	-	-	MTC
7.1390.	IA	SOS	-	-	-	-	-	57.1	MTC
7.1602	IA	SOS	-	62.0	-	-	-	-	MTC
7.0009	IA	SOS	-	-	-	-	24.1	58.1	MTT
7.0455	IA	SOS	-	-	-	-	-	45.2	MTT
7.0513	IA	SOS	-	41.9	-	-	-	-	MTT
7.0574	IA	SOS	-	36.6	-	-	-	-	MTT
7.0827	IA	SOS	-	43.5	-	-	-	-	MTT
7.0828	IA	SOS	-	39.5	-	-	-	-	MTT
7.1531A-B	IA	SOS	-	44.0	-	-	-	-	MTT
4.0024	IA	BTH	-	-	-	-	21.5	66.5	MTC
4.0592	IA	BTH	-	52.0	-	-	-	-	MTC
4.0601	IA	BTH	-	-	35.5	101.0	23.5	-	MTC
4.0660.	IA	BTH	-	54.0	27.5	83.0	20.5	-	MTC
4.0806A-B	IA	BTH	-	58.0	36.0	98.0	22.0	-	MTC
5.0017	IA	BTH	-	65.0	-	-	-	-	MTC
5.1246	IA	BTH	-	-	[37]	-	-	[64]	MTC
5.1294	IA	BTH	-	33.8	18.0	50.0	11.9	[30]	MTC
5.1377	IA	BTH	-	-	27.2	83.0	[21]	-	MTC
5.1648	IA	BTH	-	-	28.8	85.0	18.7	-	MTC
4.0190.	IA	BTH	-	44.0	[23]	-	-	-	MTT
4.0327	IA	BTH	-	-	-	[74]	19.5	47.0	MTT
4.0379A-B	IA	BTH	-	40.5	23.0	77.0	-	-	MTT
4.0579	IA	BTH	-	[43]	-	-	-	-	MTT
4.0635	IA	BTH	-	-	-	-	18.0	-	MTT
4.1010A-C	IA	BTH	-	-	23.0	-	-	-	MTT

Table 16y)

PHALANX 1			GLpe	Bp	SD	Bd		
5.1828	EBA	SOS	63.0	[28.3]	23.5	-	F/L	
5.1952	EBA	SOS	64.6	32.0	24.3	31.3	F/L	
5.2065	EBA	SOS	-	[30.7]	26.3	[26.5]	F/L	
5.2076A-B	EBA	SOS	60.7	30.0	25.9	[28]	F/L	
5.2137	EBA	SOS	52.0	31.4	24.9	27.7	F/L	
6.0206	EBA	SOS	52.5	31.0	25.2	28.0	F/L	
6.0220.	EBA	SOS	-	[35.2]	29.8	-	F/L	
6.0296	EBA	SOS	-	34.4	-	-	F/L	
6.0957	EBA	SOS	59.0	37.4	32.9	32.8	F/L	
6.0959	EBA	SOS	57.0	30.6	25.2	28.4	F/L	

Table 16y)

PHALANX 1			GLpe	Bp	SD	Bd		
6.2502	EBA	SOS	-	-	19.7	22.5		
7.0079	IA	SOS	49.9	[28.5]	23.7	25.0	F/L	
7.0203	IA	SOS	56.5	29.5	25.1	30.9	F/L	
7.0931	IA	SOS	56.4	32.6	25.9	32.8	F/L	
7.1481	IA	SOS	56.9	31.4	27.2	35.6	F/L	
7.1482	IA	SOS	54.1	33.0	28.2	36.2	F/L	
7.0013	IA	SOS	46.8	23.6	20.0	24.3	H/L	
7.0080.	IA	SOS	53.2	25.9	21.6	25.9	H/L	
7.0312	IA	SOS	53.6	28.3	23.3	28.6	H/L	
7.0617	IA	SOS	62.8	32.7	28.0	32.4	H/L	
7.0430.	IA	SOS	-	-	20.2	22.8	H/L	
7.0980.	IA	SOS	57.3	33.4	28.6	29.2	H/L	
7.1068	IA	SOS	49.0	23.0	19.7	22.2	H/L	
7.1335	IA	SOS	58.0	[31]	27.8	-	H/L	
7.1336	IA	SOS	46.8	23.3	17.3	21.5	H/L	
7.0800.	IA	SOS	-	-	-	28.9		
7.1364	IA	SOS	-	-	-	22.8		
4.0450.	IA	BTH	67.0	34.5	30.4	32.0	F/L?	WILD
4.0652	IA	BTH	-	-	-	35.0	F/L?	
4.0745	IA	BTH	54.0	-	20.5	-	H/L	
4.0986	IA	BTH	53.0	30.0	27.0	29.0	H/L	
5.0027	IA	BTH	59.0	31.5	27.0	32.0	F/L	

Table 16z)

PHALANX 2			GL	Bp	SD	Bd	
5.1767	EBA	SOS	36.2	28.4	20.3	22.1	F/L
5.1844	EBA	SOS	38.0	28.0	22.1	22.5	F/L
5.1960.	EBA	SOS	43.0	33.0	26.0	29.5	F/L
5.2064	EBA	SOS	40.0	32.0	25.3	26.5	F/L
5.2662	EBA	SOS	39.7	33.3	28.0	30.2	F/L
5.3558	EBA	SOS	37.1	27.1	23.5	24.9	F/L
5.3582	EBA	SOS	34.0	28.7	22.7	25.3	F/L
5.2101	EBA	SOS	38.2	31.0	24.8	26.8	F/L
6.0022	EBA	SOS	-	-	27.4	27.2	F/L
6.0179	EBA	SOS	44.0	35.5	29.3	29.9	F/L
6.0207	EBA	SOS	36.8	33.0	27.3	29.3	F/L
6.0490.	EBA	SOS	35.6	31.4	25.0	26.9	F/L
6.1868	EBA	SOS	38.5	33.9	28.7	27.5	F/L
6.1905A-B	EBA	SOS	-	-	30.0	30.9	F/L
6.1969	EBA	SOS	-	30.2	[25]	-	F/L

Table 16y) cont.

PHALANX 1			GLpe	Bp	SD	Bd		
6.1170.	EBA	SOS	68.5	41.2	-	-	F/L	WILD
6.1172	EBA	SOS	60.7	28.4	27.5	29.5	F/L	
6.1320.	EBA	SOS	65.5	34.5	27.0	30.5	F/L	
6.1562	EBA	SOS	63.2	29.3	24.4	27.6	F/L	
6.1668	EBA	SOS	64.7	34.9	30.3	32.9	F/L	
6.1847	EBA	SOS	60.0	33.4	27.0	31.6	F/L	
6.1941	EBA	SOS	64.7	34.9	27.5	32.6	F/L	
6.2043	EBA	SOS	[60]	-	24.4	29.6	F/L	
5.1708	EBA	SOS	-	[29]	24.9	-	H/L	
5.2185A-B	EBA	SOS	53.5	25.7	21.4	25.5	H/L	
5.2232	EBA	SOS	-	[27.8]	24.5	27.0	H/L	
5.3620.	EBA	SOS	66.4	29.8	26.4	30.4	H/L	
6.0217	EBA	SOS	58.4	27.5	25.0	28.2	H/L	
6.0218	EBA	SOS	60.1	28.5	26.1	28.7	H/L	
6.0219	EBA	SOS	55.3	29.7	27.0	26.0	H/L	
6.0303	EBA	SOS	55.6	27.3	22.6	26.2	H/L	
6.0958	EBA	SOS	61.5	33.7	27.9	29.4	H/L	
6.1171	EBA	SOS	53.4	29.4	23.9	26.1	H/L	
6.1321	EBA	SOS	57.7	29.6	26.3	26.8	H/L	
6.1464	EBA	SOS	65.7	33.0	30.2	33.1	H/L	
6.1561	EBA	SOS	59.0	26.9	22.8	35.8	H/L	
6.1667	EBA	SOS	63.4	34.2	29.9	32.1	H/L	
6.1784	EBA	SOS	-	-	20.9	24.7	H/L	
6.2044	EBA	SOS	56.6	-	24.2	26.5	H/L	
6.2058	EBA	SOS	57.4	-	23.7	27.3	H/L	
6.2142	EBA	SOS	51.2	26.4	22.3	24.9	H/L	
6.2204	EBA	SOS	58.5	34.0	28.7	33.4	H/L	
6.2367	EBA	SOS	66.0	32.3	27.5	32.4	H/L	
6.2550.	EBA	SOS	56.2	30.6	26.0	27.7	H/L	
6.1702	EBA	SOS	49.0	26.8	21.6	24.8	H/L	
5.1709A-D	EBA	SOS	[65]	31.0	-	29.0	H/L	
6.1272	EBA	SOS	[63.2]	-	25.9	29.6	H/L	
5.2057	EBA	SOS	66.9	50.0	45.0	46.0		PATH
5.2643	EBA	SOS	-	32.8	-	-		
6.0456	EBA	SOS	-	-	20.3	26.6		
6.0482	EBA	SOS	-	-	-	27.1		
6.0531A-B	EBA	SOS	-	-	22.5	25.6		
6.0547	EBA	SOS	-	-	-	26.6		
6.0932	EBA	SOS	-	-	21.5	25.0		
6.2091	EBA	SOS	-	-	20.1	23.5		

Table 16z) cont.

PHALANX 2			GL	Bp	SD	Bd	
6.1998	EBA	SOS	40.9	36.0	28.0	31.0	F/L
6.2059	EBA	SOS	43.0	35.2	27.3	31.3	F/L
6.2060.	EBA	SOS	43.1	36.0	30.7	32.9	F/L
6.2185	EBA	SOS	38.3	30.1	23.8	25.9	F/L
6.2258	EBA	SOS	41.0	35.3	28.0	30.3	F/L
6.2320.	EBA	SOS	36.9	29.6	24.3	25.7	F/L
6.2601	EBA	SOS	[38.7]	31.5	26.0	26.6	F/L
6.1703	EBA	SOS	[40.3]	31.6	25.0	[27.5]	F/L
5.2098	EBA	SOS	46.1	36.4	30.0	29.2	H/L
5.2184	EBA	SOS	42.0	32.1	25.8	26.3	H/L
5.3559	EBA	SOS	40.2	30.3	26.5	24.5	H/L
6.0082	EBA	SOS	35.3	27.1	22.8	22.1	H/L
6.0245	EBA	SOS	-	27.2	-		H/L
6.0359	EBA	SOS	37.3	28.3	22.6	24.3	H/L
6.0378	EBA	SOS	41.7	31.3	26.9	26.6	H/L
6.0396	EBA	SOS	37.1	27.3	21.3	22.0	H/L
6.0532	EBA	SOS	43.1	42.5	26.6	28.4	H/L
6.0606	EBA	SOS	39.7	27.7	22.4	22.8	H/L
6.1173	EBA	SOS	-	33.2	26.4		H/L
6.1174	EBA	SOS	40.0	29.8	23.6	24.9	H/L
6.1481	EBA	SOS	43.2	30.8	26.4	26.0	H/L
6.2375A-B	EBA	SOS	40.4	32.6	27.2		H/L
6.2376	EBA	SOS	43.3	35.0	28.0	27.8	H/L
6.2416	EBA	SOS	38.7	27.4	21.9	22.8	H/L
6.2515	EBA	SOS	40.0	-	-	24.9	H/L
6.2563	EBA	SOS	36.6	27.0	22.9	24.4	H/L
6.1452	EBA	SOS	[43.7]	32.8	27.1	[26.2]	H/L
6.1891	EBA	SOS	[37.5]	25.7	20.7	21.1	H/L
6.2278	EBA	SOS	[41.7]	28.5	23.3	26.3	H/L
7.0167	IA	SOS	[42.1]	37.6	31.2	[31.8]	F/L
7.0192	IA	SOS	41.6	30.4	25.2	25.5	F/L
7.0313	IA	SOS	35.8	31.5	24.5	26.2	F/L
7.0347	IA	SOS	35.2	29.4	23.3	26.4	F/L
7.0801	IA	SOS	-	26.9			F/L
7.1155	IA	SOS	30.9	26.3	21.5	23.1	F/L
7.1365	IA	SOS	37.6	32.4	24.2	24.9	F/L
7.1510.	IA	SOS	37.0	35.8	27.7	27.5	F/L
7.0204	IA	SOS	34.6			-	H/L
7.0907	IA	SOS	37.3	30.7	26.2	[24.7]	H/L
7.1298	IA	SOS	37.4	31.3	24.6	24.8	H/L
7.1552	IA	SOS	35.6	27.5	22.7	23.8	H/L
7.0575	IA	SOS			-	26.4	
4.0804	IA	BTH	36.0	32.0	25.0	26.5	F/L
4.0829	IA	BTH	43.0	32.0	23.5	23.0	H/L
4.0845	IA	BTH	42.0	32.0	26.0	27.0	F/L
5.0025	IA	BTH	35.5	25.5	19.5	19.8	H/L

Table 16aa)

PHALANX 3			DLS	Ld	MBS	
5.2576	EBA	SOS	[72.5]	-	24.0	F/L
6.0024	EBA	SOS	78.1	55.6	26.7	F/L
6.1617	EBA	SOS	56.4	42.7	18.7	F/L
6.2321	EBA	SOS	68.5	54.4	24.6	F/L
6.2346	EBA	SOS	58.7	50.7	17.6	F/L
6.2561	EBA	SOS	-		27.7	F/L
5.2293	EBA	SOS	60.9	46.0	20.3	H/L
6.1175	EBA	SOS	-		21.5	H/L
6.1444	EBA	SOS			23.9	H/L
6.2061	EBA	SOS	86.4	61.7	29.0	H/L
6.2062	EBA	SOS	101.2	73.5	31.7	H/L
6.2063	EBA	SOS	93.4	66.1	29.5	H/L
6.2172	EBA	SOS	69.0		21.3	H/L
6.2556	EBA	SOS	-	-	22.3	H/L
5.2138	EBA	SOS	[55.2]	-	22.5	
5.2294	EBA	SOS	-	-	21.5	
5.3522	EBA	SOS	73.2	56.4	25.0	
5.3590.	EBA	SOS	82.2	63.4	30.2	
7.0495	IA	SOS	93.1	69.2	29.2	F/L
7.0576	IA	SOS	88.2		31.7	F/L
7.0082	IA	SOS	56.3		17.9	H/L
7.0602	IA	SOS	64.0	54.1	22.8	H/L
7.0618	IA	SOS	70.8	53.5	25.9	H/L
5.1276	IA	BTH	66.0	50.0	22.0	

Table 17. *Ovis aries/O.orientalis, Capra hircus/C.aegagrus* Measurements.

Table 17a)

HORN CORE				A	B	C	D	E	SEX
6.0027	EBA	SOS	O	49.4	-	-	-	-	M
6.0282	EBA	SOS	O	75.9	39.4	152.5	-	-	M
6.0514A-B	EBA	SOS	O	39.9	25.5	107.0	92.5	-	F
6.2291	EBA	SOS	O	51.5	36.9	140.0		-	M
5.3598	EBA	SOS	C	41.0	26.8	107.0	-	-	M
6.0045	EBA	SOS	C	46.9	32.9	[121]	-		M
7.0085	IA	SOS	O	[38]	[24.4]	-		-	F
7.0361	IA	SOS	O	[35.6]	[25]	-	-		F
7.1720A-B	IA	SOS	O	42.3	27.2	112.5		[128]	M
7.1721A-I	IA	SOS	O	48.9	29.5	125.5	-	-	M
4.0285	IA	BTH	C	24.0	17.0	68.0	-	[46.5]	

A	Greatest diameter of horn core base
B	Least diameter of horn core base
C	Horncore basal circumference
D	Greatest breadth between the lateral borders of the horn core bases
E	Length of horn core along outer curvature

Table 17b)

CRANIAL				A	B	C	D	E	F
5.1882	EBA	SOS	O	57.2	-	23.0	20.2	-	-
6.2024A-N	EBA	SOS	O	50.6	[68.8]	21.0	-	40.8	-
7.0808	IA	SOS	O/C	47.8	-	23.6	19.7	-	-
7.2034	IA	SOS	O/C	-	-	-	-	27.0	31.2
7.1722	IA	SOS	O	7.8	57.3	23.5	17.3		
7.1732A-B	IA	SOS	O	39.5		17.6	17.3	-	-
7.1721A-I	IA	SOS	C	48.3	81.0	17.7	17.0	-	-
4.0284	IA	BTH	C	47.0	63.5	20.0	20.5	-	-

A Greatest breadth of the occipital condyles

B Greatest breadth at the bases of the paraoccipital processes

C Greatest breadth of the foramen magnum

D Height of the foramen magnum

E Greatest length of the inner orbit

F Greatest inner height of the orbit

Table 17c)

MAXILLARY TEETH				L P4	W P4	L M1	W M1	L M2	W M2	L M3	W M3	A	B	C
5.0602	EBA	SOS	O/C	-	-	-	-	15.0	12.0	-	-	-	-	-
5.0603	EBA	SOS	O/C	-	-	12.2	8.0	-	-	-		-		-
5.0802	EBA	SOS	O/C	-	-	-	-	14.5	8.5	-	-	-	-	-
5.1082A-C	EBA	SOS	O/C			14.3	7.2			-	-	-	-	-
5.1773	EBA	SOS	O/C	-		14.8	10.0	-	-	-	-	-	-	-
5.2186	EBA	SOS	O/C		-		-	-	-	17.7	10.5		-	
5.2577	EBA	SOS	O/C	10.7	10.0	15.8	12.5		-	-	-	-	-	-
5.2580.	EBA	SOS	O/C	9.8	8.2	15.2	11.5	18.6	12.7	-	-	28.0	46.0	68.0
5.2648	EBA	SOS	O/C	-		-			-	19.8	11.8	-	-	
5.2667	EBA	SOS	O/C	9.5	7.5	15.5	11.7	19.0	11.0	-	-	-	-	-
5.2683	EBA	SOS	O/C					18.3						-
5.2729	EBA	SOS	O/C	8.9	9.3	12.7	11.0	17.0	12.3	17.3	10.5	24.5	48.8	-
5.2818	EBA	SOS	O/C	10.1	9.4	14.9	12.2	17.9	12.8	-	-	26.4	-	-
5.2962A-B	EBA	SOS	O/C	-		-		17.3	11.9	18.9	10.9			
5.2963	EBA	SOS	O/C	-	-	-	-	-	-	18.5	10.5	-	-	-
5.3495A-F	EBA	SOS	O/C			-		16.9	12.0	15.8	10.3			-
5.3503	EBA	SOS	O/C	10.0	8.3	14.6	10.4		-				25.5	-
5.3519	EBA	SOS	O/C	-	-	-	-	16.9	10.3	-	-	-	-	-
5.3566	EBA	SOS	O/C	-	-	-	-			19.5	11.0		-	-
5.3567	EBA	SOS	O/C	-	-	15.6	12.4	-	-	-	-	-		-
5.3596	EBA	SOS	O/C	-				16.6	-	-	-	-		
5.3633	EBA	SOS	O/C	-	-	14.1	10.5		-			-	-	-
6.0010.	EBA	SOS	O/C	-		15.6	10.8	16.8	-	-	-	-	-	
6.0042	EBA	SOS	O/C	-	-	-		17.4	12.1			-	-	-
6.0043	EBA	SOS	O/C	-				16.7	10.3	-	-	-	-	-
6.0125	EBA	SOS	O/C	-		-	-	17.5	10.5			-	-	-
6.0128	EBA	SOS	O/C	-	-	-	-	-	-	17.2	11.2	-	-	
6.0147	EBA	SOS	O/C	-	-	15.6	11.4						-	-
6.0150.	EBA	SOS	O/C		-	14.4	8.5					-		-
6.0162	EBA	SOS	O/C	-	-	-	-	16.4	10.7	-	-	-	-	-
6.0214	EBA	SOS	O/C	10.2	8.9	16.2	11.5	19.2	11.4			-	-	-
6.0254	EBA	SOS	O/C	-	-	-	-	17.5	10.2	-	-	-	-	-
6.0266	EBA	SOS	O/C	-		-		-	-	20.5	12.9	-	-	-
6.0312	EBA	SOS	O/C	-	-	14.3	9.3	-	-	-	-	-	-	-
6.0331	EBA	SOS	O/C	-	-	-	-	-	-	18.0	-	-		-
6.0346	EBA	SOS	O/C	10.9	9.3	16.2	12.1	18.9	12.1	-		29.3		-
6.0375	EBA	SOS	O/C	-	-	-	-	16.0	10.8	-	-	-		-
6.0403	EBA	SOS	O/C			16.0	11.4	18.8	11.4		-	-	-	-
6.0432	EBA	SOS	O/C		-	12.6	[10.6]			-	-	-	-	-
6.0494	EBA	SOS	O/C	-		14.9	11.5		-	-	-	-		-
6.0540.	EBA	SOS	O/C	9.0	8.8	-	-	-	-	-	-	-	-	-
6.0555A-C	EBA	SOS	O/C	-		14.1	11.8	16.7	11.4	17.4	11.2	-	47.8	-
6.0566	EBA	SOS	O/C	-		15.9	9.4	-	-	-	-		-	-
6.0580.	EBA	SOS	O/C	10.0	9.2				-	-	-	-	-	
6.0596	EBA	SOS	O/C			15.8	11.3		-	-	-	-	-	-
6.0609	EBA	SOS	O/C	-	-	14.0	11.0			-	-	-	-	-
6.0610.	EBA	SOS	O/C			-		16.7	11.3	-	-	-	-	-

Table 17c) cont.

MAXILLARY TEETH				L P4	W P4	L M1	W M1	L M2	W M2	L M3	W M3	A	B	C
6.0718	EBA	SOS	O/C	-	-	-		-		17.9	10.9			-
6.0727	EBA	SOS	O/C	-	-	-	-		-	[21]	12.4	-	-	-
6.0819	EBA	SOS	O/C	-	-	13.2	12.4		-	-			-	
6.0828	EBA	SOS	O/C	-	-	12.6	11.7	-	-	-	-	-	-	-
6.0834	EBA	SOS	O/C	-	-	-		16.0	10.5	-	-		-	-
6.0881	EBA	SOS	O/C	-		16.4	10.2	-		-	-	31.7		-
6.0885	EBA	SOS	O/C	-	-	15.6	-	-	-	-	-	-	-	-
6.0914	EBA	SOS	O/C	-	-	15.0	11.5	-		-	-	-	-	-
6.0974	EBA	SOS	O/C	-	-	-		16.7	11.3	-	-		-	-
6.0991	EBA	SOS	O/C	-	-	-	-	16.2	10.4	-	-	-	-	-
6.1153	EBA	SOS	O/C	-	-	15.0	12.6	-	-	-				
6.1154	EBA	SOS	O/C	-	-	-	-	15.5	12.2		-	-	-	-
6.1275	EBA	SOS	O/C	-	-		-	-	-	19.0	12.3			-
6.1276	EBA	SOS	O/C	-	-	-	-			18.5	11.4		-	-
6.1495	EBA	SOS	O/C	-				18.7	10.9	-	-	-	-	-
6.1497	EBA	SOS	O/C	9.6	9.8	-	-							-
6.1565A-B	EBA	SOS	O/C	10.9	8.2	16.0	11.3	17.8	10.8	-	-	27.0	-	-
6.1567	EBA	SOS	O/C		-	-	-	16.9	10.3	-	-		-	
6.1568	EBA	SOS	O/C	-		15.1	10.7			-	-	-	-	-
6.1587	EBA	SOS	O/C		-	-	-	-	-		-	-	-	-
6.1558	EBA	SOS	O/C	-	-			17.7	10.2	-	-	-		
6.1617	EBA	SOS	O/C	-			-	16.5	11.0	-	-	-	-	
6.1689	EBA	SOS	O/C	-	-	-	-		-	16.5	10.0	-	-	-
6.1806A-E	EBA	SOS	O/C		-	17.4	11.9					30.6		-
6.1807A-D	EBA	SOS	O/C	-	-	15.7	-	-	-	-	-	-	-	
6.1808	EBA	SOS	O/C	-	-		-	-	-	18.1	11.0	-	-	-
6.1809	EBA	SOS	O/C	-	-	-	-	16.6	-	-	-			-
6.1809	EBA	SOS	O/C	-	-	-		16.6	12.1	-	-	-	-	-
6.1848	EBA	SOS	O/C	-	-	-	-			17.0	10.8		-	-
6.1849	EBA	SOS	O/C			-	-	-	-	17.3	10.3			
6.1869	EBA	SOS	O/C	-	-		-	16.4	11.4	-	-	-	-	-
6.1917A-B	EBA	SOS	O/C	-	-	14.6	8.4				-	-	-	-
6.1935	EBA	SOS	O/C		-		-	16.9	9.9	-		-	-	-
6.1955	EBA	SOS	O/C	-	-	-		-	-	17.9	12.0	-	-	
6.2014	EBA	SOS	O/C		-	-	-		-	17.4	10.6	-	-	-
6.2025	EBA	SOS	O/C	-			-	16.2	11.1					-
6.2066A-B	EBA	SOS	O/C		17.3	10.7			-	-	-		-	-
6.2176	EBA	SOS	O/C		-	-	-	17.3	12.0		-	-	-	-
6.2186	EBA	SOS	O/C	9.3	-		-	16.2	12.4					-
6.2187	EBA	SOS	O/C		-	14.8	9.9	16.8	9.3	-	-		-	-
6.2193A-B	EBA	SOS	O/C	-	-	15.7	-	-			-	-	-	-
6.2266	EBA	SOS	O/C	-	-	-	-	-	-	16.8	9.9			-
6.2267	EBA	SOS	O/C	-		-	-	-		17.2	11.0			
6.2281	EBA	SOS	O/C		-		-	-		17.5		-	-	-
6.2292	EBA	SOS	O/C	-		-		18.8	11.3		-			-
6.2301	EBA	SOS	O/C		-	14.6	11.6		-	-	-			
6.2324	EBA	SOS	O/C	8.8	8.1	-	-	-			-	-	-	-
6.2325	EBA	SOS	O/C	-	-	16.2	8.7	-	-	-	-	-	-	-
6.2347	EBA	SOS	O/C	-	-	16.3	10.5	-		-	-	-	-	-
6.2366	EBA	SOS	O/C	-		-	-	17.6	11.4			-		-
6.2407	EBA	SOS	O/C	-	-		-		-	18.2	11.6		-	
6.2418A-B	EBA	SOS	O/C	-	-	14.5	9.3	-			-	-	-	-
6.2448	EBA	SOS	O/C	-		15.3	12.0		-	-				-
6.2487	EBA	SOS	O/C			-		16.6	11.0	-	-	-	-	-
6.2516	EBA	SOS	O/C	-	-	14.8	11.2	-	-	-	-	-	-	-
6.2530.	EBA	SOS	O/C	-	-	-	-		-	17.9	12.1			
6.2551	EBA	SOS	O/C		-	-		-	-	16.9	10.3	-	-	-
6.2599	EBA	SOS	O/C	10.2	8.6	-	-		-	-		-	-	-
4.0372	EBA	BTH	O/C		-	-	-		-	18.5	11.5			-
7.0035	IA	SOS	O/C					15.0	11.9		-	-	-	-
7.0036	IA	SOS	O/C	-	-	15.7	9.4		-	-			-	

Table 17c) cont.

MAXILLARY TEETH				L P4	W P4	L M1	W M1	L M2	W M2	L M3	W M3	A	B	C
7.0039	IA	SOS	O/C		-	-	-	16.7	11.4	-	-	-	-	-
7.0139	IA	SOS	O/C	9.6	8.0	15.0	10.7	17.8	10.8	-	-	-	-	-
7.0196	IA	SOS	O/C	-	-	-		16.1	12.1	-	-	-	-	-
7.0210.	IA	SOS	O/C	-	-	-	-	-	-	15.7	10.0	-	-	-
7.0214	IA	SOS	O/C			14.3	9.1	-	-			-	-	-
7.0432	IA	SOS	O/C					-	-	18.0	-	-	-	-
7.0433A-B	IA	SOS	O/C	-	-	-	-	-	-	-	-	-	-	-
7.0499	IA	SOS	O/C		-	14.2	10.8	-	-	-	-	-	-	
7.0578	IA	SOS	O/C		-	-		-		17.2	11.5	-	-	-
7.0744	IA	SOS	O/C					18.0	13.4	-	-	-	-	-
7.0804	IA	SOS	O/C	-	-	16.4	9.5	-		-	-	-	-	-
7.0966A-G	IA	SOS	O/C	8.3	8.8	12.6	11.1	15.0	10.9	16.2	10.8		-	-
7.0983	IA	SOS	O/C	-	-	14.9	10.2		-	-			-	-
7.1079	IA	SOS	O/C		-	-	-	-		19.1	13.4		-	-
7.1251	IA	SOS	O/C		-	13.9	10.2	-	-	-	-		-	-
7.1275	IA	SOS	O/C	-	-	-	-	-	-	17.7	11.4			-
7.1392	IA	SOS	O/C	-	-	-	-	-	-	18.0	10.9	-	-	-
7.1723	IA	SOS	O/C		-	16.4	8.9	-	-	-	-	-	-	-
7.1724	IA	SOS	O/C	-	-	13.8	8.6	-	-					-
7.1725	IA	SOS	O/C	6.4	8.7	10.0	10.9	12.9	11.4	17.8	10.3	17.9	41.8	62.0
7.1730A-B	IA	SOS	O/C	6.7	8.9	9.5	10.7	12.7	11.5	16.8	10.5	-	40.2	
7.1731	IA	SOS	O/C	-	-	16.4	9.0	-	-	-	-			-
7.2037	IA	SOS	O/C					14.3	11.9	17.4	11.6	29.8	48.5	68.7
7.2039	IA	SOS	O/C	-	-	-		-	-	18.0	10.8	-	-	-
7.2041	IA	SOS	O/C	-	-	-	-	-		18.4	11.7			-
4.0618	IA	BTH	O/C			-			-			23.0		-
4.0109	IA	BTH	O/C	-	-	-	-	16.0	10.5	-		-	-	-
4.0394	IA	BTH	O/C		-			18.0	12.0		-			-
4.0436	IA	BTH	O/C	-	-	-	-	18.0	12.0	-	-	-	-	-
4.0451	IA	BTH	O/C	-	-	-			-	-	-	-	-	-
4.0616	IA	BTH	O/C		-	14.3	9.6	17.0	10.0				-	-
4.0618	IA	BTH	O/C	7.4	8.9	-	-	-	-	-	-	-	-	-
4.0619	IA	BTH	O/C		-	-	-	17.5	11.0	-			-	
4.0713	IA	BTH	O/C	-	-	-	-	-	-	18.5	12.5	-	-	-
4.0889	IA	BTH	O/C	10.4	7.6	-			-		-	-		-
4.0953	IA	BTH	O/C	-	-	14.5	11.0		-		-	-	-	-
4.0991	IA	BTH	O/C	-	-	-	-	-	-		-	-		-
4.1043	IA	BTH	O/C	-	-	-	-	-	-	21.0	12.0	-	-	-
5.0015	IA	BTH	O/C		-	-	-	16.6	11.0	-	-	-	-	-
5.1260.	IA	BTH	O/C	-	-	-	-	-	-	18.9	-		-	-
5.1261	IA	BTH	O/C		-	-	-	16.9	10.0	-	-	-	-	-
5.1286	IA	BTH	O/C	-			-	17.8	9.6					-
5.1287	IA	BTH	O/C	11.0	-	-	-	-	-		-	-	-	
5.1320.	IA	BTH	O/C		-		-	-	-	-	-	-		-
5.1344	IA	BTH	O/C	-	-	-		17.8	11.5		-		-	-
5.1362	IA	BTH	O/C	-	-	-	-	-	-	16.7	9.2	-	-	-
5.1363	IA	BTH	O/C	-	-	-		17.9	10.5			-		-
5.1366	IA	BTH	O/C	-	-	-	-	-	-	17.2	11.2	-	-	-
5.1403	IA	BTH	O/C		-	13.5	11.0	-	-	-	-	-		-
5.1439	IA	BTH	O/C	-				17.2	11.0		-		-	-
5.1450.	IA	BTH	O/C	-	-	-	-	-	-	17.0	10.0	-		-
4.1508	IA	BTH	O/C		-	-		17.5	12.0	-		-	-	-
4.1532	IA	BTH	O/C		-	-	-	-	-	-	-	-	-	-
5.1534	IA	BTH	O/C	-	-	-	-	15.0	9.0		-	-	-	-
5.1548	IA	BTH	O/C	-	-	-	-	16.9	10.7	-	-	-	-	-
5.1560.	IA	BTH	O/C		-	14.3	12.0		-	-	-	-		-
5.1565	IA	BTH	O/C	9.0	7.0	-	-	-	-		-		-	-
5.1575	IA	BTH	O/C			-			-	18.0	12.0	-	-	-
5.1597	IA	BTH	O/C	-		-		-		17.5	12.0	-	-	-
5.1601	IA	BTH	O/C	-	-	-	-	16.9	9.0	-	-	-	-	-

A Length of the premolar row B Length of the molar row C Length cheektooth row

Table 17d)

MANDIBLE				A	B	C	D	E	F	G	H	I	J	K	L	M
5.1724A-E	EBA	SOS	O/C				-	30.5		-		-		-	-	-
5.1976A-B	EBA	SOS	O/C	-	24.0	16.2			-	-	-	-	-	66.0	60.3	-
5.2075	EBA	SOS	O/C		24.0	15.0			-	-	-			-		-
5.2136A-J	EBA	SOS	O/C	-	[24]	20.0	-	27.3	-	-	-	-	-	-	-	-
5.2296A-C	EBA	SOS	O/C		-			23.0			-	-	-	-		-
5.2647A-G	EBA	SOS	O/C		[23.9]	18.0		[27.7]	-	-	-	-			-	-
5.3290.	EBA	SOS	O/C	-	25.3	-	-	30.2	-	-	-	-	-	-	-	-
5.3525	EBA	SOS	O/C			18.7	-	21.5	-	-	-	-		-		
6.0047	EBA	SOS	O/C	-		20.4	-	19.6	-	-	-	-	-	-	-	-
6.0079	EBA	SOS	O/C	-		-	-	21.6	-		-	-	-			
6.1414	EBA	SOS	O/C	-	-		-	26.9	-	-	-			-	-	-
6.1533	EBA	SOS	O/C	-	-	21.6		25.2	-	-		-	-	-	-	-
6.1570.	EBA	SOS	O/C	-	21.9	-	-	31.3	-	-	-	-		-		
6.1589A-E	EBA	SOS	O/C		22.2			32.0	-	-	-		-	-	-	-
6.1618	EBA	SOS	O/C	-	-	15.7	-	22.9	-	-	-				-	-
6.1619A-E	EBA	SOS	O/C	-	-	20.0			-		-		-	-	-	-
6.1670A-H	EBA	SOS	O/C	-	26.0	17.4	41.1	30.0	-	-	-	-	-	-	-	-
6.1732	EBA	SOS	O/C	38.4	25.2	17.3	[35]	22.4	51.1	74.0				-	-	-
6.1906A-F	EBA	SOS	O/C	-	24.9	16.9	-	31.1			-	-	-	-	-	-
6.1911A-G	EBA	SOS	O/C	-	-	-			57.2	-	-		-	-	-	-
6.2072A-C	EBA	SOS	O/C			18.1	39.6	29.2		-		-	-	-	-	-
6.2073A-D	EBA	SOS	O/C	-	25.8	18.7	44.2	27.5		-	-	-	-	62.5	-	-
6.2208	EBA	SOS	O/C		21.9	17.0	-	22.4	-	-	-			-		-
6.2260A-B	EBA	SOS	O/C	-	-	19.1	-	23.6		-			-	-	-	-
5.2811A-D	EBA	SOS	O	-		18.9	42.2	32.7	-	-	-	-	-	-	-	-
5.3565	EBA	SOS	O	-	22.4	16.2	-	31.6	-					-		
5.3571	EBA	SOS	O	-	22.8	15.2		30.8				-	-	-	-	-
5.3606	EBA	SOS	O	-	23.3	[15]	-	-	-	-	-	-	-	-	-	-
6.0028	EBA	SOS	O	-	24.8	19.6	40.8	28.7				-	132.0	-	-	175.0
6.0126	EBA	SOS	O		23.9	17.9	37.9	30.3		-	-	-	-	-	-	-
6.0174A-B	EBA	SOS	O	-	21.9	16.1	-	20.8	35.5	67.3	-	-	-	-	-	-
6.0235	EBA	SOS	O	-	24.4	-	-			-	-	-	-	-	-	-
6.0256	EBA	SOS	O	-	23.3	18.1	38.2	23.9	-	-	-	130.5	145.5	63.2	64.3	-
6.0260.	EBA	SOS	O		23.5	-	-	-	-	-	-	-	-	-	-	-
6.0334	EBA	SOS	O	[39.6]	22.2	17.0	36.0	22.1	46.1	68.6		-			-	-
6.0335A-B	EBA	SOS	O	-	-	-	-	21.4	49.7	70.4		-				
6.0442	EBA	SOS	O		22.9	13.0		32.8	-	-	-	-	-	-	-	-
6.0578A-D	EBA	SOS	O	-	-					76.5		-	-	-	-	-
6.0608	EBA	SOS	O		26.6	-	-	-	-	-					-	
6.0882	EBA	SOS	O	-	24.9	17.9	-	31.4	-	-	-	-	-	-	-	-
6.1446	EBA	SOS	O			-	-	35.3		-					-	-
6.1459	EBA	SOS	O	-	24.0	18.1		22.3	-	-	-	-	-	-	-	-
6.1731	EBA	SOS	O		19.4	12.6	-	27.9		-	-	-	-	-	-	-
6.1870A-B	EBA	SOS	O	-	20.7		-	-	51.6	-	-		-		-	-
6.1913	EBA	SOS	O		24.0			33.6	-	-		-			-	-
6.1915	EBA	SOS	O	-		-	-	34.0	-	-	-	-	-	-	-	-
6.1956	EBA	SOS	O	-	-	6.8	-	30.2				76.5		43.6	43.1	
6.1957	EBA	SOS	O	-	22.1	13.3	-	-	-	-	-	-	-	-	-	-
6.2178A-B	EBA	SOS	O	-	24.9		-			-	-	-	-	-	-	-
6.2188A-B	EBA	SOS	O	-	20.5	-	-	25.7	-	-					-	-
5.3526	EBA	SOS	C	-		12.2	-	-		-	-	-	-	-	-	-
5.3595A	EBA	SOS	C	-	22.2	15.3	-	24.4			-	-	-	-	-	
5.3607	EBA	SOS	C		-	16.5	-	22.5	-	-	-	-		-	-	-
6.0140.	EBA	SOS	C	-	19.2	15.2	38.8	22.1	-	-	-	-	-	-	-	-
6.0551	EBA	SOS	C	-	22.6	17.8	-	21.0	48.4	70.3	-	-	-	-	-	-
6.0972	EBA	SOS	C	-	20.1	11.5	-	30.0	-	-	-	-	-	-	-	-
6.1323	EBA	SOS	C		-	-		27.0			-	-	-	-	-	-
6.1653	EBA	SOS	C	-	22.2	18.3	38.5	22.1	-						-	
6.1933	EBA	SOS	C		20.8	15.4	39.4	20.1	38.6	71.0	-	-	-	-	-	-
6.2067	EBA	SOS	C	-	22.6		-	-					-	-	-	
6.2068	EBA	SOS	C		21.5	12.6	-	32.4		-				-		

Table 17d) cont.

MANDIBLE				A	B	C	D	E	F	G	H	I	J	K	L	M
6.2069	EBA	SOS	C	-		15.8		31.8		-	-	-	-	-	-	-
6.2207A-B	EBA	SOS	C	-	24.1	18.3	36.0	25.7	52.5	78.9	[47.6]	124.0	141.0	-	-	
6.2576	EBA	SOS	C		21.0	15.0	-	26.6	-	-	-	-		-	-	-
4.0684	EBA	BTH	O	-	26.0	16.0	-	28.0	-	-	-	109.0	-	66.0	61.5	-
7.0209	IA	SOS	O/C	-	23.5	15.5	-	-	-	-			-	-	-	-
7.0295	IA	SOS	O/C	36.9	22.3	16.7	44.0	22.7	52.4	74.1	-	-			-	-
7.0362	IA	SOS	O/C	-	23.5	-	-	-	-	-	-	-	-	62.0	60.4	91.5
7.0741	IA	SOS	O/C	-	20.4	16.1	40.5	21.5		-	-	-		-	-	-
7.0768	IA	SOS	O/C			-	-	-	-	-		-	-	62.1	57.5	-
7.0985A-B	IA	SOS	O/C	35.6	23.7	19.0		17.9	36.0	64.1	-	-	-	-		-
7.1246A-B	IA	SOS	O/C	34.6		-	-	-	44.6	-	56.7			69.0	63.7	-
7.1312	IA	SOS	O/C	-	22.4	20.0	44.3	21.4	-	-			-	-		-
7.1475	IA	SOS	O/C	-	22.6	21.3		25.5	-	-	-	-	-	-	-	-
7.1496	IA	SOS	O/C		24.2	19.7		23.3		-	-	-		-		-
7.1507	IA	SOS	O/C	-	20.9	16.1	-	22.2	-	-				-	-	-
7.1790A-C	IA	SOS	O/C	36.4	20.4	17.1	44.2	19.2	45.2	63.9	-		-	-	-	-
7.1792A-C	IA	SOS	O/C	34.8	20.1	17.4	39.0	19.4	35.8	64.0	-	-	-	-	-	-
7.2191	IA	SOS	O/C		16.8	15.8	36.6	21.5	48.0	70.2	-			-	-	-
7.0364	IA	SOS	O		-	17.9				-			-	-	-	-
7.0951	IA	SOS	O	-	23.9	19.6	-	23.9	50.9	74.6	-	-				-
7.1558A-D	IA	SOS	O		20.5	17.4		23.6	49.7	73.3				-	-	-
7.0390.	IA	SOS	C	31.9	20.4	15.5	40.0	[20.8]	[48.8]	[70.1]	49.0	118.4	135.1	65.5	57.9	-
4.0711	IA	BTH	O/C	-	26.0	16.5	-	28.0	-	-	-	-	-	-	-	-
4.0946	IA	BTH	O/C	36.0	20.0	15.0		18.0	48.0	66.0	-	-	-	-	-	-
5.1249	IA	BTH	O/C		-	11.8			-		-			·	-	-
5.1492	IA	BTH	O/C	-	24.2	17.2	-	21.3	-	-	-	-	-	-	-	-
4.0360A-C	IA	BTH	O					21.0	51.0	74.5				-		-
4.0608	IA	BTH	O	40.0	24.0	19.5	-	26.0	53.5	78.3	56.0	131.0	151.0	70.5	66.5	-
4.0998	IA	BTH	O		26.0	17.0	35.0	30.1	-	-		-	-		-	-
5.1343	IA	BTH	O	-	24.4	16.2	-	28.5	-		-	-	-	-	-	-
4.0757	IA	BTH	C	33.5	19.0			20.0	50.0	70.0		-		-	-	-

A Height of mandible behind M3
B Height of mandible in front M1, lingual
C Height of mandible in front of P2
D Length of diastema
E Length of the premolar row, lingual
F Length of molar row
G Length of cheektooth row
H Length of Gonion caudale- aboral border M3 alveolus
I Length Gonion caudale-oral border of P2 alveolus
J Length Gonion caudale- most aboral indentation of mental foramen
K Aboral height of vertical ramus-Gonion ventrale
L Middle height of vertical ramus-Gonion ventrale
M Length of angle: Gonion caudale-Infradentale

Table 17e)

MANDIBULAR TEETH				L P4	W P4	L M1	W M1	L M2	W M2	L M3	W M3
5.0564	EBA	SOS	O/C			12.8	7.4	15.2	7.7	-	-
5.1724A-E	EBA	SOS	O/C	-		15.5	8.2			-	-
5.1976A-B	EBA	SOS	O/C	-	-	15.0	7.5	-	-	-	-
5.2136A-J	EBA	SOS	O/C	12.3	8.0	14.8	8.9	19.0	8.9		-
5.2296A-C	EBA	SOS	O/C	10.3	7.9	11.4	8.3	-	-	-	
5.2297	EBA	SOS	O/C		-		-	15.0	7.8	-	-
5.2359	EBA	SOS	O/C	-	-	-	-	-	-	26.1	9.8
5.2502	EBA	SOS	O/C	-	-	-	-		-		8.6
5.2559	EBA	SOS	O/C	10.0	5.8	12.4	7.8	15.0	7.5	-	-
5.2647A-G	EBA	SOS	O/C	11.9	6.5	15.6	8.7	19.0	8.7		
5.2902	EBA	SOS	O/C	-	-	11.0	7.5	-	-	-	-
5.3504	EBA	SOS	O/C				-	16.1	8.8	-	-
5.3525	EBA	SOS	O/C	1.0	6.1	-		-		-	-
5.3527	EBA	SOS	O/C	-	-	14.5	17.4	15.7	7.0	-	-
5.3594	EBA	SOS	O/C	-		-		-		23.9	9.4
5.3595	EBA	SOS	O/C	11.1	6.3	-	-	-	-	-	
5.3608	EBA	SOS	O/C		-	11.9	7.5	-			-
6.0036	EBA	SOS	O/C			13.7	8.8	18.7	8.4	-	-
6.0040.	EBA	SOS	O/C				-	19.4	8.4	-	-
6.0047	EBA	SOS	O/C	7.1	7.2	9.7	6.5	-	-	-	-

Table 17e) cont.

MANDIBULAR TEETH				L P4	W P4	L M1	W M1	L M2	W M2	L M3	W M3
6.0079	EBA	SOS	O/C	9.7	6.3	-	-	-	-	-	-
6.0111	EBA	SOS	O/C	-	-	-	-	17.4	7.3	-	-
6.0129	EBA	SOS	O/C	-	-	15.1	7.7	-	-	-	-
6.0146	EBA	SOS	O/C	-	-	16.4	8.0	-	-	-	-
6.0173	EBA	SOS	O/C	-	-	15.3	7.4	-	-	-	-
6.0184	EBA	SOS	O/C	-	-	-	-	-	-	16.9	11.0
6.0185	EBA	SOS	O/C	-	-	-	-	18.0	6.8	-	-
6.0252	EBA	SOS	O/C	-	-	12.9	8.4	-	-	-	-
6.0405	EBA	SOS	O/C	-	-	-	-	16.6	7.8	-	-
6.0430.	EBA	SOS	O/C	-	-	-	-	-	-	-	8.4
6.0458	EBA	SOS	O/C	-	-	-	-	19.3	7.9	-	-
6.0471	EBA	SOS	O/C	-	-	-	-	15.0	7.9	-	-
6.0726	EBA	SOS	O/C	-	-	11.0	7.8	13.9	8.4	-	-
6.0753	EBA	SOS	O/C	-	-	13.2	8.4	-	-	-	-
6.0763A-D	EBA	SOS	O/C	-	-	16.1	8.1	-	-	-	-
6.0883	EBA	SOS	O/C	-	-	19.0	7.7	-	-	-	-
6.0884	EBA	SOS	O/C	-	-	-	-	-	-	-	8.3
6.0935	EBA	SOS	O/C	-	-	15.2	8.0	-	-	-	-
6.1014	EBA	SOS	O/C	9.0	7.3	10.9	7.5	14.8	-	-	-
6.1068	EBA	SOS	O/C	-	-	-	-	16.6	7.9	-	-
6.1155	EBA	SOS	O/C	-	-	-	-	17.2	7.9	-	-
6.1189A-D	EBA	SOS	O/C	-	-	14.0	8.2	18.2	7.8	-	-
6.1199	EBA	SOS	O/C	-	-	15.1	8.3	-	-	-	-
6.1533	EBA	SOS	O/C	9.4	6.7	-	-	-	-	-	-
6.1570.	EBA	SOS	O/C	-	-	16.4	8.0	-	-	-	-
6.1589A-E	EBA	SOS	O/C	-	-	16.7	7.0	-	-	-	-
6.1619A-E	EBA	SOS	O/C	-	-	16.9	8.0	-	-	-	-
6.1620.	EBA	SOS	O/C	-	-	10.6	7.3	-	-	-	-
6.1670A-H	EBA	SOS	O/C	-	-	14.8	7.8	-	-	-	-
6.1682	EBA	SOS	O/C	-	-	13.7	7.8	-	-	-	-
6.1732	EBA	SOS	O/C	-	6.4	11.0	7.9	14.4	8.9	22.4	8.5
6.1815	EBA	SOS	O/C	-	-	-	-	15.8	7.9	-	-
6.1828A-B	EBA	SOS	O/C	9.7	5.9	-	-	-	-	-	-
6.1850.	EBA	SOS	O/C	-	-	-	-	14.0	8.9	-	-
6.1906A-F	EBA	SOS	O/C	-	-	16.2	7.7	-	-	-	-
6.1911A-F	EBA	SOS	O/C	11.2	6.4	13.0	8.6	16.5	9.2	26.4	8.8
6.1914	EBA	SOS	O/C	-	-	-	-	-	-	22.2	9.4
6.1934	EBA	SOS	O/C	-	-	13.8	7.9	-	-	-	-
6.2015A-B	EBA	SOS	O/C	-	-	-	-	17.6	-	-	-
6.2017	EBA	SOS	O/C	-	-	-	-	15.8	-	-	-

Table 17e) cont.

MANDIBULAR TEETH				L P4	W P4	L M1	W M1	L M2	W M2	L M3	W M3
6.2106	EBA	SOS	O/C	-	-	-	-	-	-	-	8.2
6.2107	EBA	SOS	O/C	-	-	11.9	7.4	-	-	-	-
6.2189A-D	EBA	SOS	O/C	-	-	13.5	6.6	-	-	-	-
6.2208	EBA	SOS	O/C	10.7	6.6	12.4	7.8	16.0	8.3	-	-
6.2283	EBA	SOS	O/C	-	-	-	-	17.7	-	-	-
6.2370A-E	EBA	SOS	O/C	12.2	7.0	14.3	7.8	-	-	-	-
6.2472A-B	EBA	SOS	O/C	9.5	6.9	-	-	-	-	-	-
6.2503	EBA	SOS	O/C	-	-	-	-	15.7	8.8	-	-
6.2625	EBA	SOS	O/C	-	-	13.4	9.4	-	-	-	-
5.2811A-D	EBA	SOS	O	-	-	17.0	7.2	-	-	-	-
5.3565	EBA	SOS	O	-	-	16.8	6.8	18.6	7.7	-	-
5.3571	EBA	SOS	O	-	-	15.8	7.0	-	-	-	-
5.3606	EBA	SOS	O	-	-	16.8	6.5	-	-	-	-
5.3629	EBA	SOS	O	-	-	14.0	7.4	17.2	7.0	-	-
6.0028	EBA	SOS	O	-	-	15.8	7.8	18.0	7.4	-	-
6.0041	EBA	SOS	O	-	-	14.5	7.6	18.0	7.1	-	-
6.0126	EBA	SOS	O	-	-	16.3	7.8	-	-	-	-
6.0174A-B	EBA	SOS	O	8.8	6.4	10.7	7.4	[13.5]	-	20.4	-
6.0256	EBA	SOS	O	9.9	6.3	13.6	9.0	16.8	8.8	-	-
6.0260.	EBA	SOS	O	-	-	16.0	7.5	-	-	-	-
6.0334	EBA	SOS	O	8.7	6.4	10.6	7.9	13.4	8.4	22.3	8.1
6.0335A-B	EBA	SOS	O	9.4	7.8	10.0	7.4	13.7	8.8	23.7	8.7
6.0470.	EBA	SOS	O	-	-	-	-	-	-	-	7.3
6.0578A-D	EBA	SOS	O	10.6	6.4	13.1	8.0	15.9	8.4	25.6	8.7
6.0608	EBA	SOS	O	-	-	13.8	7.8	18.3	19.4	-	-
6.0882	EBA	SOS	O	-	-	16.0	7.5	-	-	-	-
6.0936	EBA	SOS	O	-	-	-	-	-	-	22.7	9.0
6.0990A-C	EBA	SOS	O	-	-	17.0	8.2	-	-	-	-
6.1156	EBA	SOS	O	-	-	-	-	-	-	21.2	8.0
6.1302	EBA	SOS	O	-	-	17.9	7.5	-	-	-	-
6.1459	EBA	SOS	O	9.5	5.5	12.7	7.3	16.0	7.8	-	-
6.1483	EBA	SOS	O	-	-	-	-	-	-	22.2	9.0
6.1622	EBA	SOS	O	-	-	-	-	-	-	21.0	8.4
6.1731	EBA	SOS	O	-	-	13.0	6.3	-	-	-	-
6.1870A-B	EBA	SOS	O	9.8	6.3	11.4	7.9	15.4	8.5	21.5	7.9
6.2104	EBA	SOS	O	-	-	15.7	6.4	-	-	-	-
6.2105	EBA	SOS	O	9.8	6.9	12.5	7.6	15.5	8.8	-	-
6.2178A-B	EBA	SOS	O	-	-	15.3	8.2	7.3	8.4	-	-
6.2188A-B	EBA	SOS	O	10.2	5.9	12.5	7.6	16.7	7.4	-	-
6.2419A-C	EBA	SOS	O	-	-	15.8	7.0	-	-	-	-

Table 17e) cont.

MANDIBULAR TEETH				L P4	W P4	L M1	W M1	L M2	W M2	L M3	W M3
5.3595	EBA	SOS	C	9.6	5.4	12.8	6.2	-	-	-	-
5.3607	EBA	SOS	C	9.9	6.4	11.0	8.0	14.1	7.9	-	-
6.0140.	EBA	SOS	C	10.3	6.0	11.8	7.2	14.0	7.9	-	-
6.0551	EBA	SOS	C	8.0	6.9	10.7	7.6	13.0	8.8	23.9	9.0
6.0972	EBA	SOS	C	-	-	14.9	5.8	-	-	-	-
6.1323	EBA	SOS	C	-	-	14.3	6.2	-	-	-	-
6.1569A-B	EBA	SOS	C	-	-	15.6	6.9	-	-	-	-
6.1592	EBA	SOS	C	-	-	-	-	-	-	26.7	9.5
6.1653	EBA	SOS	C	8.8	7.4	10.7	8.0	14.9	8.6	-	-
6.1933	EBA	SOS	C	8.8	6.6	12.0	7.2	14.1	8.4	19.9	8.1
6.2067	EBA	SOS	C	-	-	14.8	6.8	-	-	-	-
6.2207A-B	EBA	SOS	C	11.7	6.3	-	-	17.3	-	-	-
4.0371	EBA	BTH	O/C	-	-	-	-	16.0	8.5	-	-
5.1315	EBA	BTH	O/C	9.9	-	-	-	-	-	-	-
4.0684	EBA	BTH	O	-	-	15.0	7.5	18.0	-	-	-
4.1523	EBA	BTH	O	-	-	-	-	-	-	24.0	8.5
7.0091	IA	SOS	O/C	-	-	13.9	7.8	-	-	-	-
7.0092	IA	SOS	O/C	-	-	10.6	7.3	-	-	-	-
7.0209	IA	SOS	O/C	-	-	13.2	7.5	16.5	7.8	-	-
7.0234	IA	SOS	O/C	-	-	12.9	8.1	-	-	-	-
7.0295	IA	SOS	O/C	10.2	7.2	11.8	8.2	15.2	9.1	22.7	8.8
7.0362	IA	SOS	O/C	-	-	13.6	7.5	16.4	7.6	-	-
7.0389	IA	SOS	O/C	-	-	13.3	7.2	-	-	-	-
7.0392	IA	SOS	O/C	-	-	11.5	7.4	-	-	-	-
7.0682	IA	SOS	O/C	8.5	6.2	9.4	7.0	-	-	-	-
7.0687	IA	SOS	O/C	-	-	-	-	-	-	21.2	8.2
7.0688	IA	SOS	O/C	-	-	15.4	7.5	-	-	-	-
7.0706	IA	SOS	O/C	-	-	10.5	7.6	-	-	-	-
7.0741	IA	SOS	O/C	7.8	6.4	9.2	6.8	13.8	8.2	-	-
7.0985A-B	IA	SOS	O/C	-	-	10.0	6.8	12.2	7.8	-	8.0
7.0986A-D	IA	SOS	O/C	-	-	14.2	8.2	-	-	-	-
7.1011A-B	IA	SOS	O/C	-	-	-	-	-	-	8.9	-
7.1312	IA	SOS	O/C	7.7	6.9	9.9	7.4	14.4	8.7	-	8.8
7.1426A-B	IA	SOS	O/C	-	-	10.1	6.6	13.2	7.3	21.0	7.6
7.1507	IA	SOS	O/C	10.0	6.0	12.8	7.0	-	-	-	-
7.1549	IA	SOS	O/C	-	-	14.5	8.4	-	-	-	-
7.1558A-D	IA	SOS	O/C	10.3	5.8	11.4	6.8	14.4	7.4	21.1	7.7
7.1790A-C	IA	SOS	O/C	7.4	6.0	9.7	7.4	12.2	8.5	21.4	8.4
7.1792A-C	IA	SOS	O/C	7.6	6.1	9.5	7.3	12.6	8.6	21.6	8.2
7.2191	IA	SOS	O/C	8.2	6.5	10.2	6.8	13.6	9.4	22.2	8.3

Table 17e) cont.

MANDIBULAR TEETH				L P4	W P4	L M1	W M1	L M2	W M2	L M3	W M3
7.0364	IA	SOS	O	11.4	5.9	-	-	-	-	-	-
7.0388	IA	SOS	O	-	-	15.3	7.6	-	-	-	-
7.0391	IA	SOS	O	8.7	6.4	-	-	-	-	-	-
7.0462	IA	SOS	O	-	-	-	-	-	-	20.7	7.3
7.0464	IA	SOS	O	-	-	14.0	7.4	-	-	-	-
7.0766	IA	SOS	O	-	-	-	-	-	-	23.4	8.8
7.0769	IA	SOS	O	-	-	13.7	6.0	-	-	-	-
7.0807	IA	SOS	O	-	-	-	-	16.1	8.2	-	-
7.0951	IA	SOS	O	-	-	-	-	14.7	7.9	21.4	8.3
7.1508	IA	SOS	O	-	-	-	-	-	-	22.8	8.0
7.1785	IA	SOS	O	-	-	14.1	7.2	-	-	-	-
7.1786A-B	IA	SOS	O	-	-	14.5	7.2	-	-	-	-
7.1788	IA	SOS	O	-	-	14.9	7.1	-	-	-	-
7.1789	IA	SOS	O	-	-	14.4	6.8	-	-	-	-
7.0390.	IA	SOS	C	8.4	6.2	9.6	6.9	13.0	8.2	-	-
7.1050A-B	IA	SOS	C	-	-	14.1	7.0	-	-	-	-
4.0037	IA	BTH	O/C	-	-	-	-	19.0	8.0	-	-
4.0098	IA	BTH	O/C	-	-	-	-	18.0	8.0	-	-
4.0268	IA	BTH	O/C	-	-	14.5	8.0	-	-	-	-
4.0271	IA	BTH	O/C	-	-	-	-	18.5	7.0	-	-
4.0277	IA	BTH	O/C	-	-	-	-	18.0	9.0	-	-
4.0305	IA	BTH	O/C	-	-	15.0	7.5	-	-	-	-
4.0313	IA	BTH	O/C	-	-	13.0	7.0	17.5	8.0	-	8.0
4.0315	IA	BTH	O/C	-	-	-	-	16.0	5.5	-	-
4.0388	IA	BTH	O/C	-	-	-	7.5	-	-	-	-
4.0533A-E	IA	BTH	O/C	-	-	13.0	8.0	-	-	-	-
4.0711	IA	BTH	O/C	-	-	13.3	7.6	17.8	7.8	-	-
4.0946	IA	BTH	O/C	-	-	9.5	7.0	13.0	9.0	24.0	9.5
4.0957	IA	BTH	O/C	-	-	-	-	-	-	23.0	9.5
4.0990.	IA	BTH	O/C	-	-	-	-	17.5	8.2	-	-
4.1018	IA	BTH	O/C	-	-	15.0	8.0	-	-	-	-
5.1415	IA	BTH	O/C	-	-	-	-	17.2	7.3	-	-
5.1484	IA	BTH	O/C	-	-	14.0	7.3	-	-	-	-
4.0027A-E	IA	BTH	O	10.0	6.7	12.9	[7.7]	-	-	-	-
4.0260.	IA	BTH	O	-	-	-	-	14.5	8.0	22.5	7.5
4.0360A-C	IA	BTH	O	-	-	12.0	8.0	16.0	9.0	-	7.0
4.0499	IA	BTH	O	-	-	16.2	8.0	18.5	7.5	-	-
4.0608	IA	BTH	O	10.5	5.8	13.0	7.5	17.0	8.0	20.5	8.0
4.0849A-C	IA	BTH	O	9.5	7.0	10.5	7.5	14.5	8.5	23.5	9.0
4.0998	IA	BTH	O	-	-	15.0	8.0	18.5	7.0	-	-

Table 17e) cont.

MANDIBULAR TEETH				L P4	W P4	L M1	W M1	L M2	W M2	L M3
5.1343	IA	BTH	O	-	-	15.7	7.8	17.2	7.9	-
4.0757	IA	BTH	C	9.0	6.5	11.0	8.0	14.0	8.5	23.5

Table 17f)

ATLAS				GLF	GB	GL	BFcr	BFcd	H
5.0205	EBA	SOS	O/C	41.8	-	-	-	-	-
6.0336	EBA	SOS	O/C	43.1	-	-	-	-	-
6.1058	EBA	SOS	O/C	42.1	[57.3]	42.5	48.0	41.2	34.0
6.1734	EBA	SOS	O/C	47.0	-	52.8	45.9	47.1	36.0
6.2113	EBA	SOS	C	51.2	-	62.5	-	-	-
7.0019	IA	SOS	O	46.9	[63.5]	55.0	46.5	42.9	35.2
7.0134	IA	SOS	O	42.3	63.7	47.8	46.6	41.2	34.0
7.1804	IA	SOS	O	41.0	60.0	45.5	44.3	41.0	34.4
7.1805	IA	SOS	O	42.9	61.7	48.0	45.8	46.9	36.0
7.2491	IA	SOS	O	41.3	55.9	44.6	41.8	40.7	33.2
7.2493	IA	SOS	O	37.6	-	-	-	-	-
4.0079	IA	BTH	O/C	-	-	-	-	50.0	41.0
5.1252	IA	BTH	C	45.0	-	49.0	48.5	46.0	38.0

Table 17g)

AXIS				LCDe	BFcr	BPacd	BPtr	SBV
5.3545	EBA	SOS	O/C	-	41.5	-	-	-
6.0416	EBA	SOS	O/C	68.4	-	-	-	-
6.0554	EBA	SOS	O/C	-	42.9	-	-	-
6.1841	EBA	SOS	O/C	-	44.4	-	-	-
6.2080.	EBA	SOS	C	61.4	-	-	-	-
7.0909	IA	SOS	O	61.2	51.5	-	[52.5]	30.9
7.1799	IA	SOS	O	-	39.9	28.2	38.8	20.8
7.1800.	IA	SOS	O	-	44.2	31.4	37.5	25.0
7.2487	IA	SOS	O	-	-	26.4	32.7	18.4
7.0809	IA	SOS	C	-	41.3	-	-	22.2
4.0070.	IA	BTH	O/C	-	41.0	-	-	-
4.0278	IA	BTH	O/C	-	[36]	-	-	-
4.1011	IA	BTH	O/C	[67]	45.0	37.3	-	-

Table 17h)

CERVICAL VERT				PL	GLPa	BPacr	BPacd	BFcr	BFcd	HFcr	HFcd	H
5.3568	EBA	SOS	O/C	-	34.1	30.1	20.6	-	-	-	16.7	-
6.0328	EBA	SOS	O/C	-	37.8	40.0	36.6	-	-	-	-	-
6.0467	EBA	SOS	O/C	-	34.6	-	-	14.6	18.8	15.6	16.0	-
6.1046	EBA	SOS	O/C	-	34.1	34.0	36.2	-	-	-	-	-
6.1503	EBA	SOS	O/C	-	38.3	34.2	35.4	17.1	21.8	16.0	18.3	41.5
6.1736A-B	EBA	SOS	O/C	-	-	36.0	-	-	-	-	-	-
6.2003	EBA	SOS	O/C	-	39.1	35.8	35.0	-	24.8	-	18.0	[40]
6.2211	EBA	SOS	O/C	-	33.5	-	-	17.9	19.0	18.9	-	-
7.0131	IA	SOS	O/C	34.5	41.4	30.3	29.6	17.7	19.8	14.0	17.6	29.3
7.0770.	IA	SOS	O/C	22.0	35.6	-	32.9	14.6	26.0	15.8	17.8	56.5
7.0943	IA	SOS	O/C	-	51.6	38.9	-	-	-	-	-	-
7.1278	IA	SOS	O/C	30.5	39.9	31.1	31.1	17.9	20.4	15.3	16.8	-
7.1814	IA	SOS	O/C	-	38.6	33.7	33.3	-	-	-	-	-
7.1815	IA	SOS	O/C	29.4	40.0	35.0	35.1	18.7	22.3	17.4	17.7	44.4
7.1816	IA	SOS	O/C	24.7	34.0	36.8	37.6	16.0	20.5	13.9	17.4	47.0
7.1817	IA	SOS	O/C	-	46.7	29.6	30.0	-	-	-	-	-
7.1818	IA	SOS	O/C	32.8	43.3	34.0	31.5	20.2	22.7	16.7	19.3	41.4
7.1819	IA	SOS	O/C	-	44.1	32.2	31.9	-	-	-	-	-
7.1820.	IA	SOS	O/C	35.0	48.1	31.0	30.3	20.8	23.0	17.9	18.6	38.1
7.1821	IA	SOS	O/C	-	32.7	32.6	33.4	-	-	-	-	-
7.1823	IA	SOS	O/C	30.5	36.9	29.5	29.9	18.0	19.9	16.5	17.6	38.4
7.1824	IA	SOS	O/C	31.3	43.5	26.8	27.8	16.4	19.9	15.2	17.9	33.7
7.1820.	IA	SOS	O/C	21.6	35.2	36.0	32.7	15.0	26.4	14.9	16.5	52.0
7.1829	IA	SOS	O/C	-	35.3	35.3	36.4	-	-	-	-	-
7.1834	IA	SOS	O/C	30.6	40.5	28.8	28.9	27.3	20.6	15.1	18.6	-
7.1835	IA	SOS	O/C	-	42.5	38.1	28.9	-	-	-	-	-
7.1896	IA	SOS	O/C	20.6	33.3	37.9	-	16.7	25.4	15.0	17.4	-
7.2498	IA	SOS	O/C	-	43.0	32.9	33.4	-	-	-	-	-
7.2499	IA	SOS	O/C	-	41.5	34.3	34.5	-	-	-	-	-
7.2500.	IA	SOS	O/C	-	36.7	35.0	35.4	-	-	-	-	-
4.0060.	IA	BTH	O/C	-	52.0	-	-	-	23.0	-	25.0	-
4.0877A-B	IA	BTH	O/C	-	38.0	39.5	41.0	16.0	21.5	17.0	16.0	-
4.1003	IA	BTH	O/C	18.0	35.5	41.5	36.0	17.0	17.0	16.0	27.5	-
4.1094A-E	IA	BTH	O/C	33.5	-	-	35.5	21.0	25.0	19.0	23.0	-
4.1094B	IA	BTH	O/C	-	42.0	38.5	38.0	19.0	25.0	19.0	21.0	-
5.1483	IA	BTH	O/C	-	43.0	-	-	-	-	-	-	-

Table 17i)

THORACIC VERT				PL	BFcr	BFcd	HFcr	HFcd	H	BPtr
6.0329	EBA	SOS	O/C	-	20.9	26.4	14.3	15.4	-	-
5.2084	EBA	SOS	O/C	-	-	[29]	-	15.5	-	-
7.0135	IA	SOS	O/C	21.0	21.5	26.0	15.9	16.3	[74]	45.1
7.0689	IA	SOS	O/C	-	-	-	-	-	50.8	35.5
7.1860.	IA	SOS	O/C	20.7	18.0	24.1	15.1	25.8	-	38.6
7.1866	IA	SOS	O/C	19.1	23.5	25.3	15.0	14.9	-	47.9
7.1867	IA	SOS	O/C	20.5	22.0	26.9	14.6	14.5	-	41.6
7.1869	IA	SOS	O/C	20.5	19.2	22.4	15.4	15.2	-	39.0
7.1870.	IA	SOS	O/C	20.4	18.9	27.0	14.5	14.9	-	42.3
7.2511	IA	SOS	O/C	21.6	18.8	26.9	14.9	15.2	-	41.4
7.2512	IA	SOS	O/C	-	-	-	-	-	-	43.3
7.2513	IA	SOS	O/C	-	-	-	-	-	-	34.7
7.2514	IA	SOS	O/C	-	-	-	-	-	-	37.2
4.1004	IA	BTH	O/C	-	16.0	14.0	20.5	24.5	-	-
4.1089	IA	BTH	O/C	-	-	27.0	-	15.5	-	-
4.1090.	IA	BTH	O/C	-	22.5	27.0	16.5	16.5	-	-

Table 17k)

SACRAL VERT				GB	BFcr	HFcr	GL	PL
7.1897	IA	SOS	O/C	65.3	25.9	10.6	-	-
7.1898A-C	IA	SOS	O/C	73.2	29.2	12.2	-	-
4.0805	IA	BTH	O/C	83.0	32.0	15.0	-	-
4.0880.	IA	BTH	O/C	-	18.5	11.0	30.0	24.0
4.1007	IA	BTH	O/C	65.0	[41.5]	20.5	37.0	23.5
4.1096	IA	BTH	O/C	-	12.5	-	22.0	19.5

Table 17l)

SCAPULA				HS	DHA	SLC	GLP	LG	BG	Ld
5.1101	EBA	SOS	O/C	-	-	[24]	-	-	-	-
5.1900.	EBA	SOS	O/C	-	-	18.5	-	-	-	-
5.1981	EBA	SOS	O/C	-	-	20.0	35.6	30.5	23.3	-
5.2149A-B	EBA	SOS	O/C	-	-	-	19.0	-	-	-
6.0130.	EBA	SOS	O/C	-	-	17.6	-	-	-	-
6.2192	EBA	SOS	O/C	-	-	24.2	-	-	-	-
5.0215	EBA	SOS	O	-	-	17.0	-	-	-	-
5.0358	EBA	SOS	O	-	-	19.1	-	-	22.1	-
5.0411	EBA	SOS	O	-	-	-	34.0	27.5	23.0	-
5.0566	EBA	SOS	O	-	-	18.9	33.5	27.0	21.1	-
5.2148	EBA	SOS	O	-	-	21.5	33.7	27.8	22.1	-
6.0366	EBA	SOS	O	-	-	21.2	36.2	27.5	23.4	-

Table 17j)

LUMBAR VERT				PL	GLPa	BPacr	BPacd	BFcr	BFcd	HFcr	HFcd	H	BPtr
5.2394	EBA	SOS	O/C	-	48.0	-	-	-	-	-	-	-	-
6.0134	EBA	SOS	O/C	32.5	45.3	-	-	-	-	18.1	-	-	-
6.0192	EBA	SOS	O/C	28.5	-	-	-	-	-	-	-	-	-
6.0462	EBA	SOS	O/C	29.9	40.0	-	-	18.8	20.6	16.4	16.1	42.8	-
6.1305	EBA	SOS	O/C	30.0	-	-	-	23.2	31.0	17.3	16.6	[40]	-
6.1735	EBA	SOS	O/C	-	-	-	-	29.6	27.6	15.9	17.7	50.0	-
6.1909	EBA	SOS	O/C	31.3	43.4	-	-	20.7	23.4	15.9	16.0	-	-
7.1222	IA	SOS	O/C	27.0	36.4	26.0	14.8	28.7	32.3	19.7	19.0	-	-
7.1613	IA	SOS	O/C	-	[39]	-	21.9	-	-	-	-	40.0	-
7.1614	IA	SOS	O/C	-	38.5	30.2	25.7	-	-	-	-	-	-
7.1887	IA	SOS	O/C	31.0	40.4	28.5	20.5	20.3	22.3	15.4	14.1	43.0	102.8
7.1888	IA	SOS	O/C	31.3	41.3	30.4	23.4	21.6	23.4	15.0	13.7	42.4	102.4
7.1889	IA	SOS	O/C	-	39.1	25.4	18.8	-	-	-	-	-	-
7.1890.	IA	SOS	O/C	27.3	38.8	34.4	28.9	22.6	28.8	15.0	12.7	42.0	88.1
7.1891	IA	SOS	O/C	-	41.8	24.4	19.9	-	-	-	-	-	84.2
7.1893	IA	SOS	O/C	20.3	-	-	-	22.8	26.9	15.9	14.6	-	-
7.2526	IA	SOS	O/C	29.3	41.2	23.0	16.5	16.8	14.5	16.6	14.3	45.7	-
7.2527	IA	SOS	O/C	29.9	42.8	24.0	17.8	19.0	-	15.4	-	46.2	-
7.2528	IA	SOS	O/C	30.4	42.7	25.3	19.4	19.1	21.0	16.2	-	45.6	-
7.2529	IA	SOS	O/C	31.0	41.9	23.3	18.5	18.5	20.9	16.1	13.7	-	-
7.2531	IA	SOS	O/C	27.8	38.6	20.7	14.9	18.9	19.5	14.5	14.3	43.9	-
7.2532	IA	SOS	O/C	29.4	40.7	22.8	15.7	18.5	19.6	14.9	15.0	44.7	-
7.2535	IA	SOS	O/C	38.3	38.9	21.0	14.5	19.8	20.8	15.3	14.9	45.4	-
7.2536	IA	SOS	O/C	28.3	39.0	20.9	14.8	-	-	-	-	-	-
7.2645	IA	SOS	O/C	26.0	35.0	19.0	13.9	22.8	26.8	13.7	14.3	45.6	-
4.0607	IA	BTH	O/C	33.0	-	-	-	24.0	21.5	17.0	18.0	51.0	88.0
4.0878	IA	BTH	O/C	-	-	-	-	24.0	-	18.5	16.0	-	-
4.0879	IA	BTH	O/C	30.0	-	-	-	24.0	23.0	17.0	16.0	-	-
4.0914	IA	BTH	O/C	-	-	-	-	20.0	20.5	18.0	14.0	38.0	-
4.1005	IA	BTH	O/C	33.0	-	-	-	18.0	17.0	22.1	25.2	47.0	-
4.1006	IA	BTH	O/C	29.5	-	-	-	26.0	32.5	16.5	16.0	-	31.4
4.1086A-F	IA	BTH	O/C	33.0	-	-	-	23.0	24.0	19.0	16.5	-	-
4.1087A-C	IA	BTH	O/C	33.0	-	-	-	23.0	-	18.0	15.0	-	-
4.1088	IA	BTH	O/C	-	-	-	-	26.0	27.0	16.0	14.0	-	-

Table 17l) cont.

SCAPULA				HS	DHA	SLC	GLP	LG	BG	Ld
6.0558	EBA	SOS	O	-	-	21.8	32.5	26.9	21.0	-
6.1186A-B	EBA	SOS	O	-	-	-	-	-	24.5	-
6.1672	EBA	SOS	O	-	-	21.1	-	-	-	-
6.2348A-D	EBA	SOS	O	165.0	-	20.4	36.7	27.8	-	-
6.2420A-B	EBA	SOS	O	-	-	21.8	37.5	28.6	24.8	-
5.3625	EBA	SOS	C	-	-	21.8	-	-	-	-
6.1545	EBA	SOS	C	-	-	18.8	-	25.8	21.0	-
6.1708	EBA	SOS	C	-	-	19.0	30.8	23.2	19.4	-
6.1709	EBA	SOS	C	-	-	17.7	-	-	-	-
6.1937	EBA	SOS	C	-	-	15.1	-	-	-	-
6.2083	EBA	SOS	C	-	-	19.3	-	-	-	-
6.2114A-B	EBA	SOS	C	-	-	17.6	-	-	-	-
7.0502	IA	SOS	O/C	-	-	21.3	-	-	24.4	-
7.0691	IA	SOS	O/C	-	-	-	32.0	26.2	19.3	-
7.1170.	IA	SOS	O/C	-	-	19.4	-	-	-	-
7.0049	IA	SOS	O	-	-	19.6	29.9	23.9	20.2	-
7.0303	IA	SOS	O	-	-	21.2	34.9	26.8	21.8	-
7.0417	IA	SOS	O	-	-	18.4	36.3	28.7	23.2	-
7.0503	IA	SOS	O	-	-	21.0	37.0	29.5	25.0	-
7.0772	IA	SOS	O	-	-	16.5	29.5	25.0	19.5	-
7.0847	IA	SOS	O	-	-	17.0	33.0	26.9	21.9	-
7.0910.	IA	SOS	O	-	-	19.9	-	-	-	-
7.1171	IA	SOS	O	-	-	23.2	34.9	29.9	22.9	-
7.1636	IA	SOS	O	133.6	132.6	16.2	27.9	22.6	19.6	86.0
7.1637A-C	IA	SOS	O	132.1	128.6	15.8	28.3	24.2	19.5	-
7.1638	IA	SOS	O	-	-	14.9	29.0	23.7	18.3	-
7.1639	IA	SOS	O	-	-	14.9	28.7	24.0	18.2	-
7.2206	IA	SOS	O	132.8	-	18.2	31.3	25.3	-	-
4.0201	IA	BTH	O/C	-	-	[25]	-	-	-	-
4.0846A-H	IA	BTH	O/C	-	-	19.0	-	-	-	-
4.0870.	IA	BTH	O/C	-	-	21.0	36.0	27.5	23.0	-
4.0691A-K	IA	BTH	O	-	-	21.0	-	26.5	-	-

Table 17m)

HUMERUS				GL	Bp	SD	Bd	BT	
5.1766	EBA	SOS	O/C	-	-	15.0	-	-	
5.2692	EBA	SOS	O/C	-	-	6.3	-	-	
6.0276A-H	EBA	SOS	O/C	-	-	11.6	26.6	25.5	
6.0805	EBA	SOS	O/C	-	-	-	35.2	32.1	
6.1548	EBA	SOS	O/C	-	-	8.0	-	-	

Table 17m) cont.

HUMERUS				GL	Bp	SD	Bd	BT	
6.1710.	EBA	SOS	O/C	-	-	15.5	-	-	
5.0143	EBA	SOS	O	-	-	-	32.9	31.9	
5.0218	EBA	SOS	O	-	-	-	32.0	30.0	
5.0219	EBA	SOS	O	-	-	-	31.0	29.5	
5.0386	EBA	SOS	O	-	-	-	28.5	27.0	
5.0406A-B	EBA	SOS	O	-	-	-	31.9	29.9	
5.0432	EBA	SOS	O	-	-	-	31.5	[29]	
5.0501	EBA	SOS	O	-	-	-	28.5	27.0	
5.0532	EBA	SOS	O	-	-	-	35.0	32.5	
5.0638A-B	EBA	SOS	O	-	-	-	32.2	29.7	
5.3603	EBA	SOS	O	-	-	19.6	35.6	33.8	
6.0032	EBA	SOS	O	-	-	-	32.9	30.8	
6.0226	EBA	SOS	O	-	-	-	30.3	29.8	
6.0352	EBA	SOS	O	-	-	-	33.6	29.9	
6.0643	EBA	SOS	O	-	-	-	33.4	31.3	
6.0940.	EBA	SOS	O	-	-	18.0	[33.8]	32.8	
5.0996	EBA	SOS	O	-	-	15.5	33.0	32.0	
6.1099	EBA	SOS	O	-	-	-	33.8	29.9	
6.1185	EBA	SOS	O	-	-	17.8	41.9	37.9	WILD
6.1348	EBA	SOS	O	-	-	-	37.8	34.2	
6.1418A-B	EBA	SOS	O	-	-	-	35.0	32.9	
6.1438	EBA	SOS	O	-	-	-	27.6	25.6	
6.1574	EBA	SOS	O	-	-	-	29.7	28.4	
6.1763	EBA	SOS	O	-	-	-	34.5	33.6	
6.1851	EBA	SOS	O	-	-	14.3	29.8	28.0	
6.1938	EBA	SOS	O	-	-	-	29.7	28.6	
6.2119A-B	EBA	SOS	O	-	-	-	34.6	33.2	
6.2351	EBA	SOS	O	-	-	-	46.3	45.6	WILD
6.2505	EBA	SOS	O	-	-	-	32.5	[30.5]	
6.2564	EBA	SOS	O	-	-	11.9	29.4	26.7	
6.0098	EBA	SOS	C	-	-	-	31.5	29.3	
6.1547	EBA	SOS	C	-	-	13.8	32.0	31.2	
6.1670.	EBA	SOS	C	-	-	-	30.4	28.3	
6.1738	EBA	SOS	C	-	-	[14.4]	28.6	26.4	
7.0206	IA	SOS	O/C	-	-	-	-	26.8	
7.1328	IA	SOS	O/C	-	-	16.0	-	-	
7.0100.	IA	SOS	O	-	-	-	30.3	27.3	
7.0101	IA	SOS	O	-	-	-	31.7	31.0	
7.0136	IA	SOS	O	-	[29.5]	-	-	-	
7.0137A-C	IA	SOS	O	121.5	36.0	10.6	27.7	25.9	

Table 17m) cont.

HUMERUS				GL	Bp	SD	Bd	BT
7.0153	IA	SOS	O	-	-	-	29.4	27.3
7.0172	IA	SOS	O	-	-	-	33.4	31.9
7.0301	IA	SOS	O	-	-	-	31.0	28.6
7.0396	IA	SOS	O	-	-	15.0	31.8	29.6
7.0438	IA	SOS	O	-	-	-	31.5	29.4
7.0504	IA	SOS	O	-	-	-	31.1	29.6
7.0748	IA	SOS	O	-	-	-	29.4	27.5
7.0855	IA	SOS	O	-	-	-	31.2	29.7
7.0933	IA	SOS	O	-	-	-	29.9	27.6
7.1173	IA	SOS	O	-	-	-	31.4	30.0
7.1202	IA	SOS	O	-	-	-	30.3	28.2
7.1223	IA	SOS	O	-	-	-	-	32.2
7.1354	IA	SOS	O	-	-	18.8	37.3	34.7
7.1653	IA	SOS	O	143.2	38.0	14.8	30.3	27.4
7.1654	IA	SOS	O	131.8	36.9	11.6	28.9	27.0
7.1655A-B	IA	SOS	O	142.2	36.7	14.0	29.3	27.2
7.1656	IA	SOS	O	-	[38.3]	14.6	-	-
7.1657A-B	IA	SOS	O	-	-	13.8	30.3	28.0
7.2209	IA	SOS	O	-	-	13.5	29.0	27.5
7.2210.	IA	SOS	O	-	-	12.2	[27.2]	25.6
7.2211A-B	IA	SOS	O	-	-	11.6	[26.9]	25.6
7.2212A-B	IA	SOS	O	-	35.3	13.8	-	-
7.0020.	IA	SOS	C	-	-	-	27.3	[26.3]
4.0291	IA	BTH	O/C	-	-	9.5	[23.5]	-
4.0496	IA	BTH	O/C	-	-	14.0	-	-
4.0801	IA	BTH	O/C	-	-	-	-	31.0
5.1385	IA	BTH	O/C	-	-	[17]	-	-
4.0470.	IA	BTH	O	-	-	-	29.0	26.0
4.0572A-B	IA	BTH	O	-	-	14.5	31.0	30.5
4.0830.	IA	BTH	O	-	-	-	29.5	28.0
4.1001	IA	BTH	O	-	48.3	-	-	-
4.1002	IA	BTH	O	-	-	-	32.0	31.0
4.1067A-C	IA	BTH	O	-	-	15.5	34.5	32.0
5.1299	IA	BTH	O	-	-	-	-	[31]
5.1653	IA	BTH	O	-	-	15.8	33.2	30.5

Table 17n)

RADIUS				GL	Bp	BFp	SD	Bd	BFd	
5.0367	EBA	SOS	O/C	-	-	-	15.0	-	-	
5.2097	EBA	SOS	O/C	-	-	-	17.6	-	-	
5.2188	EBA	SOS	O/C	-	-	-	[17.7]	-	-	
5.3564	EBA	SOS	O/C	-	-	-	[15.5]	-	-	
5.3608	EBA	SOS	O/C	-	-	-	16.5	-	-	
6.0057A-B	EBA	SOS	O/C	-	-	-	[14.6]	-	-	
6.0110.	EBA	SOS	O/C	-	-	-	-	28.1	23.3	
6.0133	EBA	SOS	O/C	-	-	-	17.7	-	-	
6.0188	EBA	SOS	O/C	-	-	-	16.9	-	-	
6.0215	EBA	SOS	O/C	-	[29.9]	-	-	-	-	
6.0338	EBA	SOS	O/C	-	-	-	16.7	-	-	
6.0379	EBA	SOS	O/C	-	-	-	15.0	-	-	
6.0897	EBA	SOS	O/C	-	-	-	-	32.8	26.4	
6.0797	EBA	SOS	O/C	-	35.5	32.5	-	-	-	
6.0977	EBA	SOS	O/C	-	-	-	17.8	-	-	
6.1190.	EBA	SOS	O/C	-	-	-	11.9	-	-	
6.1892	EBA	SOS	O/C	-	-	-	13.0	-	-	
5.3630.	EBA	SOS	O	-	32.0	28.3	16.0	-	-	
5.3538	EBA	SOS	O	-	31.1	29.9	-	-	-	
6.0054	EBA	SOS	O	-	-	-	[18.5]	31.6	26.0	
6.0081	EBA	SOS	O	-	-	-	-	34.3	27.7	
6.0258	EBA	SOS	O	-	-	-	-	32.5	25.7	
6.0259	EBA	SOS	O	-	-	-	-	29.7	25.3	
6.1034	EBA	SOS	O	-	32.3	29.0	[15.4]	-	-	
6.1474	EBA	SOS	O	-	32.0	28.9	-	-	-	
6.1531	EBA	SOS	O	-	-	-	18.0	-	-	
6.1994	EBA	SOS	O	-	34.6	30.8	-	-	-	
6.2120.	EBA	SOS	O	-	36.7	32.9	-	-	-	
6.2181	EBA	SOS	O	-	33.0	31.0	16.0	-	-	
5.2193	EBA	SOS	O	-	-	-	23.0	-	-	WILD
5.2153	EBA	SOS	C	-	29.5	-	-	-	-	
6.0425	EBA	SOS	C	-	30.8	27.6	-	-	-	
6.0426	EBA	SOS	C	-	-	-	[14.7]	26.0	23.7	
6.2047A-C	EBA	SOS	C	-	30.2	28.8	[14.4]	-	-	
6.2213	EBA	SOS	C	-	30.7	27.1	16.4	-	-	
6.2009	EBA	SOS	C	-	28.2	25.3	-	-	-	
7.0469	IA	SOS	O/C	-	-	-	-	29.3	27.5	
7.0022	IA	SOS	O	-	36.9	33.9	-	-	-	
7.0211	IA	SOS	O	-	-	-	-	32.8	28.6	
7.0749	IA	SOS	O	-	-	-	-	30.5	25.5	

Table 17n) cont.

RADIUS				GL	Bp	BFp	SD	Bd	BFd
7.0750.	IA	SOS	O	-	-	-	-	32.3	26.0
7.0913	IA	SOS	O	-	-	-	18.1	34.4	33.3
7.0953	IA	SOS	O	154.0	33.2	28.8	16.3	30.0	27.8
7.1423	IA	SOS	O	-	34.9	30.4	-	-	-
7.1624	IA	SOS	O	156.4	30.5	29.5	14.9	28.1	23.6
7.1666	IA	SOS	O	-	30.4	27.3	15.5	-	-
7.1667	IA	SOS	O	-	28.7	26.6	14.1	27.4	23.1
7.1670.	IA	SOS	O	150.5	30.7	28.2	15.4	28.9	24.4
7.1671	IA	SOS	O	-	31.5	28.6	17.7	29.4	26.8
7.0052	IA	SOS	C	-	30.9	28.8	-	-	-
7.0102	IA	SOS	C	-	31.9	29.2	-	-	-
7.0197	IA	SOS	C	-	30.1	27.9	15.6	-	-
7.0810.	IA	SOS	C	-	29.3	28.2	-	-	-
7.1355	IA	SOS	C	-	35.3	32.5	-	-	-
7.1535	IA	SOS	C	-	34.1	32.3	-	-	-
7.0685	IA	SOS	C	-	35.3	33.6	24.1	-	-
7.1204	IA	SOS	C	-	29.8	27.5	18.2	28.0	25.0
4.0191	IA	BTH	O/C	-	-	-	[16.5]	-	-
4.0380.	IA	BTH	O/C	-	-	-	15.5	-	-
4.1505	IA	BTH	O/C	-	-	-	9.8	[19]	-
5.1698	IA	BTH	O/C	-	-	-	[18.2]	-	-
4.0692	IA	BTH	O	-	30.5	28.0	24.5	-	-
4.0792	IA	BTH	O	-	-	-	16.0	33.5	-
4.0871A-B	IA	BTH	O	151.0	34.0	29.5	18.0	32.5	26.5
4.0872A-G	IA	BTH	O	151.5	34.0	30.0	18.0	32.0	25.5

Table 17p)

2ND&3RD CARPAL				GB
6.0978	EBA	SOS	O/C	15.2
6.1920.	EBA	SOS	O/C	15.4
7.0397	IA	SOS	O/C	17.7
7.1122	IA	SOS	O/C	16.4
7.1425	IA	SOS	O/C	15.1
7.2375	IA	SOS	O/C	13.4
7.2376	IA	SOS	O/C	13.4
4.1070B	IA	BTH	O/C	16.3

Table 17o)

ULNA				LO	DPA	SDO	BPC
6.1259	EBA	SOS	O/C	-	23.4	-	-
5.2105	EBA	SOS	O/C	-	27.9	-	21.8
5.2156	EBA	SOS	O/C	-	-	-	19.6
5.0641	EBA	SOS	O	-	24.1	21.2	17.3
5.0948	EBA	SOS	O	-	31.2	25.3	21.3
5.2083A-B	EBA	SOS	O	44.0	28.9	25.2	20.2
5.2155	EBA	SOS	O	-	25.0	22.0	19.2
5.3476	EBA	SOS	O	-	25.5	20.0	-
5.3536	EBA	SOS	O	-	25.7	22.0	17.9
5.3630.	EBA	SOS	O	-	-	-	17.8
6.0465	EBA	SOS	O	36.9	23.5	20.6	18.6
6.0476	EBA	SOS	O	-	-	-	20.4
6.0724	EBA	SOS	O	36.8	24.6	21.0	20.0
6.1035	EBA	SOS	O	-	20.6	17.5	18.7
6.1100.	EBA	SOS	O	-	26.9	21.8	18.5
6.1353	EBA	SOS	O	-	21.6	21.4	19.4
6.1600A-B	EBA	SOS	O	-	21.3	-	-
6.1922	EBA	SOS	O	-	-	-	18.7
6.2328	EBA	SOS	O	-	-	-	19.0
6.2396	EBA	SOS	O	39.9	26.7	22.2	18.1
6.2582	EBA	SOS	O	-	-	-	19.6
5.2153	EBA	SOS	C	-	-	-	22.0
5.3480.	EBA	SOS	C	38.8	24.2	20.5	19.9
6.0029	EBA	SOS	C	41.0	25.8	23.0	21.0
6.0148	EBA	SOS	C	40.4	25.3	20.8	-
6.1598	EBA	SOS	C	-	22.4	19.7	20.9
6.1958	EBA	SOS	C	35.6	24.6	20.3	18.9
7.0370.	IA	SOS	O/C	-	22.3	19.6	15.5
7.0505	IA	SOS	O/C	-	27.6	24.0	20.8
7.1121	IA	SOS	O/C	37.9	26.3	21.7	-
7.1225	IA	SOS	O	-	28.1	23.9	19.8
7.1342	IA	SOS	O	-	18.1	-	-
7.1490.	IA	SOS	O	38.4	25.2	21.2	17.4
7.1672	IA	SOS	O	39.3	24.7	21.0	17.4
7.1673	IA	SOS	O	-	23.1	-	18.0
7.2237	IA	SOS	O	40.3	25.5	21.2	21.4
7.0685	IA	SOS	C	-	30.8	-	23.7
7.1483	IA	SOS	C	-	26.7	-	18.2
7.1674	IA	SOS	C	34.3	23.1	19.0	21.0
4.0873	IA	BTH	O	-	29.0	24.5	17.5

Table 17q)

PELVIS				LA	LAR	SB	SH	SC	LFo	LS	SEX
6.0383	EBA	SOS	O/C	-	-	8.2	14.8	41.0	-	-	M
6.0423A-D	EBA	SOS	O/C	22.9	26.2	8.3	12.5	34.0	-	-	
6.0567	EBA	SOS	O/C	-	-	10.7	15.0	44.0	-	-	
6.2149	EBA	SOS	O/C	29.3	23.9	-	-	-	-	-	F
6.2183	EBA	SOS	O/C	-	-	8.4	12.3	35.0	-	-	
6.2216	EBA	SOS	O/C	-	-	9.0	16.4	41.5	-	-	
6.0268A-B	EBA	SOS	O	-	-	6.9	12.6	28.5	-	-	F
6.1693A-B	EBA	SOS	O	32.1	26.9	10.8	18.2	50.0	-	-	M
6.2127	EBA	SOS	O	28.8	23.2	8.0	13.6	35.5	-	-	F
5.2302	EBA	SOS	C	-	-	7.3	16.0	42.0	-	-	F
5.3618	EBA	SOS	C	-	-	11.0	17.3	61.5	-	-	M
6.1307	EBA	SOS	C	27.3	22.7	8.7	15.5	41.5	-	-	F
6.1842	EBA	SOS	C	-	-	10.3	14.6	42.5	-	-	F
7.0990.	IA	SOS	O	-	-	9.6	16.1	44.5	-	-	M
7.1055	IA	SOS	O	26.2	23.1	8.6	14.0	40.0	32.0	40.7	F
7.1081A-B	IA	SOS	O	31.0	26.6	-	-	-	32.3	-	F
7.1178	IA	SOS	O	27.0	24.4	7.2	13.9	39.0	-	-	F
7.1680.	IA	SOS	O	26.4	23.0	7.8	15.0	42.9	39.4	-	F
7.1681	IA	SOS	O	26.4	23.0	7.8	13.6	38.5	35.1	-	F
7.1682A-B	IA	SOS	O	-	-	7.9	13.2	39.0	35.4	-	F
7.1683A-B	IA	SOS	O	26.3	22.8	7.9	12.4	39.5	33.6	-	F
7.1684	IA	SOS	O	-	-	9.9	15.2	45.0	-	-	M
7.2275	IA	SOS	O	30.8	24.4	9.0	-	-	-	-	M
7.2278	IA	SOS	O	-	-	7.2	11.2	38.0	-	-	F
7.2279A-B	IA	SOS	O	-	-	8.8	15.1	43.0	-	-	
7.1205	IA	SOS	C	26.2	23.7	-	-	-	-	-	F
4.1513	IA	BTH	O/C	-	-	-	8.8	5.9	-	-	
4.0033	IA	BTH	O	-	-	9.5	18.0	46.5	-	-	F
4.0292	IA	BTH	O	-	-	8.0	15.0	39.0	-	-	F
4.0874A-B	IA	BTH	O	32.0	27.0	10.0	17.0	45.0	-	-	F

Table 17r)

FEMUR				Bp	DC	SD	Bd
6.0306	EBA	SOS	O/C	43.4	21.1	-	-
6.0669	EBA	SOS	O/C	-	-	8.9	-
6.0671	EBA	SOS	O/C	-	22.2	-	-
6.0673	EBA	SOS	O/C	-	20.9	-	-
6.0889	EBA	SOS	O/C	-	[21]	-	-
6.2049	EBA	SOS	O/C	-	20.6	-	-
5.3490.	EBA	SOS	O	-	22.1	-	-
6.1063	EBA	SOS	O	-	21.4	-	-
6.1335	EBA	SOS	O	-	-	-	39.0
6.1346	EBA	SOS	O	54.2	24.0	-	-
6.1355A-B	EBA	SOS	O	-	24.4	-	-
6.0452	EBA	SOS	C	-	19.6	-	-
7.0752	IA	SOS	O/C	-	20.8	-	-
7.0776	IA	SOS	O/C	-	20.1	-	-
7.0860.	IA	SOS	O/C	-	19.6	-	-
7.1056	IA	SOS	O/C	-	20.0	-	-
7.1376	IA	SOS	O/C	-	21.8	-	-
7.1377	IA	SOS	O/C	-	18.6	-	-
7.1378	IA	SOS	O/C	-	19.4	-	-
7.1628	IA	SOS	O/C	-	-	14.9	-
7.0506	IA	SOS	O	-	-	-	36.2
7.0945	IA	SOS	O	-	-	-	44.8
7.1124	IA	SOS	O	-	20.1	-	-
7.1357	IA	SOS	O	-	18.4	-	-
7.1695A-D	IA	SOS	O	40.4	18.5	-	33.8
7.2287	IA	SOS	O	42.5	19.6	-	-
7.2288	IA	SOS	O	-	-	-	[33]
7.2289	IA	SOS	O	-	-	13.0	[35.7]
7.2294A-B	IA	SOS	O	-	-	-	34.3
7.2295A-C	IA	SOS	O	-	-	15.0	36.0
7.2296	IA	SOS	O	-	-	15.4	-
7.2297	IA	SOS	O	-	-	12.7	34.7
4.0869	IA	BTH	O/C	-	-	17.0	-
4.0861	IA	BTH	O	-	20.0	-	-
4.1076A-B	IA	BTH	O	-	-	-	40.0
4.1077	IA	BTH	O	-	-	-	40.0

Table 17s)

PATELLA				GL	GB
6.0767	EBA	SOS	O/C	-	24.5
6.2027	EBA	SOS	O/C	34.0	23.9
7.0213	IA	SOS	O	26.5	19.2
7.0969	IA	SOS	O	31.6	22.8
7.1428	IA	SOS	O	-	21.5
7.2309	IA	SOS	O	26.1	20.2
7.2310.	IA	SOS	O	26.2	-
7.2311	IA	SOS	O	-	20.6
7.2312	IA	SOS	O	24.0	15.7
7.2313	IA	SOS	O	25.5	-
7.2314	IA	SOS	O	28.7	20.8
7.2317	IA	SOS	O	25.5	-

Table 17u)

CALCANEUS				GL	GB
5.2067	EBA	SOS	O/C	-	22.0
5.2147	EBA	SOS	O/C	-	19.0
5.2187	EBA	SOS	O/C	60.0	23.5
5.2392	EBA	SOS	O/C	64.2	23.0
6.0002	EBA	SOS	O/C	54.9	19.0
6.0418	EBA	SOS	O/C	60.5	22.4
6.0485	EBA	SOS	O/C	59.0	21.4
6.0667	EBA	SOS	O/C	63.3	24.0
6.0728	EBA	SOS	O/C	61.7	21.9
6.0750.	EBA	SOS	O/C	56.2	-
6.1429	EBA	SOS	O/C	-	22.4
6.1467	EBA	SOS	O/C	62.0	24.0
6.1476	EBA	SOS	O/C	-	[27]
6.1660.	EBA	SOS	O/C	66.6	24.0
6.2028	EBA	SOS	O/C	61.9	22.4
6.2155	EBA	SOS	O/C	54.9	19.0
6.2610.	EBA	SOS	O/C	68.0	23.6
7.0508	IA	SOS	O	59.0	21.2
7.1022	IA	SOS	O	-	[20.4]
7.1304	IA	SOS	O	66.4	25.4
7.1380.	IA	SOS	O	-	21.4
7.1400.	IA	SOS	O	52.3	18.9
7.2342	IA	SOS	O	53.5	-
4.0461	IA	BTH	O	-	19.5
4.0664	IA	BTH	O	-	20.0

Table 17t)

TIBIA				Bp	SD	CD	Bd	
5.2078	EBA	SOS	O/C	-	-	-	26.3	
5.2100.	EBA	SOS	O/C	-	-	-	30.4	
5.2665	EBA	SOS	O/C	-	-	-	30.5	
5.285	EBA	SOS	O/C	[45]	-	-	-	
5.2896	EBA	SOS	O/C	-	-	-	29.2	
5.2897	EBA	SOS	O/C	-	-	-	30.7	
5.3535	EBA	SOS	O/C	-	-	-	27.5	
5.3541	EBA	SOS	O/C	-	[13.9]	-	-	
6.0122	EBA	SOS	O/C	-	13.7	-	-	
6.0143	EBA	SOS	O/C	-	-	-	29.3	
6.0153	EBA	SOS	O/C	-	-	-	30.0	
6.0285	EBA	SOS	O/C	-	-	-	32.6	
6.0325	EBA	SOS	O/C	-	-	-	23.5	
6.0363	EBA	SOS	O/C	-	-	-	27.0	
6.0371	EBA	SOS	O/C	-	15.9	46.0	28.8	
6.0437	EBA	SOS	O/C	-	-	-	28.7	
6.0493	EBA	SOS	O/C	-	-	-	30.6	
6.0903	EBA	SOS	O/C	-	-	-	35.2	WILD
6.1152	EBA	SOS	O/C	-	18.0	50.5	32.2	
6.1281	EBA	SOS	O/C	-	-	-	31.9	
6.1579	EBA	SOS	O/C	-	[14.4]	43.0	24.2	
6.1580.	EBA	SOS	O/C	-	-	-	26.0	
6.1659	EBA	SOS	O/C	-	14.1	-	-	
6.1688	EBA	SOS	O/C	-	15.3	45.0	28.7	
6.1855	EBA	SOS	O/C	-	-	[12.5]	27.9	
6.1902	EBA	SOS	O/C	-	-	42.0	26.2	
6.2129	EBA	SOS	O/C	-	-	-	27.0	
6.2153	EBA	SOS	O/C	-	-	-	26.7	
6.2154	EBA	SOS	O/C	-	-	-	26.7	
6.2195	EBA	SOS	O/C	-	-	-	29.3	
6.2331	EBA	SOS	O/C	-	-	-	22.4	
6.2411	EBA	SOS	O/C	-	-	-	28.8	
6.2554	EBA	SOS	O/C	-	-	-	28.2	
6.2607	EBA	SOS	O/C	-	13.9	-	-	
5.1705	EBA	BTH	O/C	-	13.9	42.0	26.0	
7.0026	IA	SOS	O/C	-	-	-	26.6	
7.0057	IA	SOS	O/C	-	13.3	41.0	25.2	
7.0145	IA	SOS	O/C	-	-	-	28.1	
7.0187	IA	SOS	O/C	-	-	-	29.8	
7.0374	IA	SOS	O/C	-	-	-	27.7	

Table 17t) cont.

TIBIA				Bp	SD	CD	Bd
7.0475	IA	SOS	O/C	-	-	-	25.4
7.0507A-B	IA	SOS	O/C	-	13.4	37.5	24.9
7.0677	IA	SOS	O/C	-	14.5	42.3	23.4
7.0678	IA	SOS	O/C	-	-	-	30.2
7.1006	IA	SOS	O/C	-	-	-	29.8
7.1020.	IA	SOS	O/C	46.8	-	-	-
7.1030.	IA	SOS	O/C	-	-	-	28.7
7.1230.	IA	SOS	O/C	-	-	-	31.4
7.1231	IA	SOS	O/C	-	-	-	28.6
7.1343	IA	SOS	O/C	-	-	-	27.4
7.1359	IA	SOS	O/C	-	-	-	28.2
7.1630.	IA	SOS	O/C	-	13.6	44.0	24.9
7.2318	IA	SOS	O/C	-	12.8	40.0	23.5
7.2319	IA	SOS	O/C	-	14.6	45.0	-
7.2325A-B	IA	SOS	O/C	40.7	13.6	42.0	-
7.2327	IA	SOS	O/C	38.1	-	-	-
7.2335	IA	SOS	O/C	39.4	-	-	-
4.0263	IA	BTH	O/C	-	-	-	26.0
4.0267	IA	BTH	O/C	-	-	-	28.0
4.0867A-B	IA	BTH	O/C	[39]	17.0	48.5	30.0
4.0868A-B	IA	BTH	O/C	-	16.5	48.5	30.5
4.1078	IA	BTH	O/C	45.0	-	-	-
5.1471	IA	BTH	O/C	-	-	-	29.7
5.1519	IA	BTH	O/C	-	15.4	-	-

Table 17v)

TALUS				GLl	GLm	Dl	Dm	Bd
6.0612	EBA	SOS	O/C	31.4	29.7	17.3	[17.6]	19.7
6.0706	EBA	SOS	O/C	32.0	30.1	[18]	[17.9]	20.0
6.1359	EBA	SOS	O/C	32.1	30.6	17.5	[18.5]	[18.8]
6.1395	EBA	SOS	O/C	28.9	26.7	-	-	-
6.1396	EBA	SOS	O/C	30.2	29.8	17.0	-	[19.5]
6.1411	EBA	SOS	O/C	34.4	32.9	19.0	[19.4]	[21.6]
6.1881	EBA	SOS	O/C	[33.8]	-	19.3	-	-
6.2156	EBA	SOS	O/C	-	26.0	-	16.3	18.2
6.2271	EBA	SOS	O/C	34.0	32.0	-	-	-
5.0391	EBA	SOS	O	[28.9]	27.6	[16.5]	-	[19]
5.0409	EBA	SOS	O	29.1	28.0	16.8	16.1	19.3
5.1770.	EBA	SOS	O	32.9	31.5	18.0	18.9	20.9
5.1897	EBA	SOS	O	33.5	32.0	28.9	[29]	22.2

Table 17v) cont.

TALUS				GLl	GLm	Dl	Dm	Bd
5.1926	EBA	SOS	O	34.2	31.2	18.2	19.4	22.2
5.3537	EBA	SOS	O	28.7	27.8	16.3	17.6	18.2
5.3560.	EBA	SOS	O	30.0	29.0	16.5	17.6	18.0
6.0152	EBA	SOS	O	30.6	30.5	17.6	19.0	20.4
6.0287	EBA	SOS	O	26.9	25.3	15.7	15.8	18.3
6.0307	EBA	SOS	O	31.0	29.7	17.5	18.4	20.8
6.0398	EBA	SOS	O	26.6	26.2	15.0	15.2	16.6
6.0443	EBA	SOS	O	31.9	30.0	18.1	19.1	21.2
6.0644	EBA	SOS	O	28.7	27.5	16.4	17.1	19.5
6.0705	EBA	SOS	O	33.9	32.3	18.6	20.0	21.6
6.1315	EBA	SOS	O	33.6	31.5	19.7	20.2	22.0
6.1326	EBA	SOS	O	31.2	30.1	17.6	19.0	20.2
6.1629	EBA	SOS	O	27.8	27.0	15.8	17.6	17.3
6.1683	EBA	SOS	O	29.7	28.5	17.1	18.5	20.7
6.1723	EBA	SOS	O	29.6	29.0	-	17.4	18.8
6.1893	EBA	SOS	O	26.8	26.5	26.0	15.9	17.0
6.1894	EBA	SOS	O	30.5	29.3	17.6	19.5	19.9
6.1939	EBA	SOS	O	27.3	25.3	14.4	15.1	17.0
6.2452	EBA	SOS	O	-	30.3	-	17.9	21.3
5.1738	EBA	SOS	C	26.0	24.0	13.5	14.0	16.0
5.2301	EBA	SOS	C	25.0	24.0	13.7	14.9	16.9
6.0873	EBA	SOS	C	29.4	27.0	15.0	15.9	18.3
6.1360.	EBA	SOS	C	31.1	29.6	16.9	18.0	18.9
6.1406	EBA	SOS	C	30.9	29.2	17.0	18.0	20.4
6.1602	EBA	SOS	C	31.9	30.0	16.9	17.2	21.6
6.2157	EBA	SOS	C	-	26.0	-	16.6	17.6
6.2491	EBA	SOS	C	33.4	31.3	28.6	19.4	21.5
6.2534	EBA	SOS	C	30.5	29.2	17.8	19.1	19.6
7.1332	IA	SOS	O/C	28.0	25.4	-	-	[17.5]
7.1344	IA	SOS	O/C	-	-	-	-	18.3
7.1575	IA	SOS	O/C	29.7	28.8	-	-	-
7.0104	IA	SOS	O	30.2	28.8	16.8	17.3	20.0
7.0587	IA	SOS	O	29.6	27.6	16.6	17.6	18.9
7.0609	IA	SOS	O	30.2	[29.7]	16.8	-	-
7.0679	IA	SOS	O	31.9	30.2	17.5	17.8	20.3
7.0935	IA	SOS	O	34.1	31.8	18.2	-	21.4
7.1058	IA	SOS	O	27.7	26.8	15.1	16.3	17.3
7.1059	IA	SOS	O	28.8	27.8	16.1	17.8	19.2
7.1379	IA	SOS	O	27.9	27.3	15.2	16.2	18.0
7.2351	IA	SOS	O	-	28.0	-	18.0	-

Table 17v) cont.

TALUS				GLl	GLm	Dl	Dm	Bd
7.0224	IA	SOS	C	26.9	26.4	15.5	17.7	17.8
4.1558	IA	BTH	O	30.7	28.8	16.9	17.8	18.8
5.1265	IA	BTH	O	33.0	31.0	18.0	18.5	20.5
5.1310.	IA	BTH	O	31.2	30.2	19.0	20.0	20.0
5.1561	IA	BTH	C	28.7	26.3	[15.7]	[15.3]	18.0
5.1652	IA	BTH	C	27.0	25.2	14.6	13.9	16.9

Table 17w)

CENTROQUARTAL				GB
6.1050.	EBA	SOS	O/C	24.9
6.2065	EBA	SOS	O/C	29.7
7.0477	IA	SOS	O/C	25.3
7.0708	IA	SOS	O/C	23.5
7.1280.	IA	SOS	O/C	24.5
7.1555	IA	SOS	O/C	22.9

Table 17x)

LATERAL MALLEOLUS				GB
6.0311	EBA	SOS	O/C	17.0
6.1265	EBA	SOS	O/C	16.9
6.1882	EBA	SOS	O/C	17.5
7.0478	IA	SOS	O/C	15.5
4.1080.	IA	BTH	O/C	16.5

Table 17y)

METAPODIAL				GL	Bp	SD	CD	DD	Bd	MTC
5.2235	EBA	SOS	O/C	-	[25.5]	-	-	-	-	MTC
5.2579	EBA	SOS	O/C	-	25	-	-	-	-	MTC
5.2689	EBA	SOS	O/C	-	21.1	13.6	41	9.8	-	MTC
5.2909	EBA	SOS	O/C	-	-	[17]	-	-	-	MTC
5.2969A-C	EBA	SOS	O/C	-	29	[15.5]	-	-	-	MTC
6.0251	EBA	SOS	O/C	-	23	13.3	40.5	9.8	-	MTC
6.1047A-B	EBA	SOS	O/C	115	22.9	10	28.5	7.5	-	MTC
6.1306	EBA	SOS	O/C	-	-	[12]	34.5	-	-	MTC
6.1549	EBA	SOS	O/C	-	-	[15]	-	-	-	MTC
6.1576	EBA	SOS	O/C	-	-	11.2	35.5	10	-	MTC
6.1764	EBA	SOS	O/C	-	[23]	12.9	-	-	-	MTC
6.2125	EBA	SOS	O/C	-	-	13.7	38	9.9	-	MTC
5.1886	EBA	SOS	O	-	25	-	-	-	-	MTC
5.2183	EBA	SOS	O	-	-	14.7	44	10.5	27.1	MTC
5.2660.	EBA	SOS	O	132	24.5	15	45	9.3	25.9	MTC
5.2777A-B	EBA	SOS	O	-	-	-	-	-	25.3	MTC
5.2820.	EBA	SOS	O	[142.5]	24.2	12.7	42.5	9.8	-	MTC
6.0274A-C	EBA	SOS	O	129.9	23.8	13	40.5	9.4	24.6	MTC
5.0355	EBA	SOS	O	-	-	-	-	10.4	26.7	MTC
6.0590.	EBA	SOS	O	-	-	-	-	13.1	29.6	MTC
6.0791	EBA	SOS	O	-	24.5	-	-	-	-	MTC
6.0996	EBA	SOS	O	128.5	23.3	12.9	40	9	25.6	MTC

Table 17y) cont.

METAPODIAL				GL	Bp	SD	CD	DD	Bd		
6.1059	EBA	SOS	O	-	23.9	-	-	-	-	MTC	
6.1260.	EBA	SOS	O	-	22.9	15	-	-	-	MTC	
6.1477	EBA	SOS	O	137.5	22	12.2	38	9	23.7	MTC	
6.2531	EBA	SOS	O	139.5	25.7	16.6	47.5	10.8	28.2	MTC	
6.2558	EBA	SOS	O	-	-	-	-	[11.1]	28	MTC	
6.2598	EBA	SOS	O	-	27.7	16.7	-	-	-	MTC	
6.2600.	EBA	SOS	O	139.5	24.7	13.9	42.5	10.5	26.4	MTC	
5.0536	EBA	SOS	C	-	24.1	16	44	9.7	-	MTC	
5.1977	EBA	SOS	C	105.9	23.8	15.8	45	9.4	27	MTC	
5.2152	EBA	SOS	C	-	-	-	-	[9.7]	26.2	MTC	
6.2148	EBA	SOS	C	-	-	-	-	-	25.9	MTC	
6.2525	EBA	SOS	C	-	26.4	17.8	48.5	11.6	-	MTC	
6.2532	EBA	SOS	C?	-	-	-	-	12.5	34	MTC	WILD
5.2192	EBA	SOS	O/C	-	-	14.1	45	11.1	-	MTT	
5.2236	EBA	SOS	O/C	-	-	[11.4]	-	-	-	MTT	
6.0427	EBA	SOS	O/C	-	-	10.5	37	10.8	-	MTT	
6.0981	EBA	SOS	O/C	-	-	11.1	34	9.5	-	MTT	
6.1318	EBA	SOS	O/C	-	-	[13.2]	41.5	11.3	-	MTT	
6.1430.	EBA	SOS	O/C	-	-	[12.6]	40.5	[10.8]	-	MTT	
6.1818	EBA	SOS	O/C	-	20.7	10.9	-	-	-	MTT	
6.1910.	EBA	SOS	O/C	-	20.8	-	-	-	-	MTT	
6.2131	EBA	SOS	O/C	-	-	-	44.5	12	-	MTT	
5.3531	EBA	SOS	O	-	23.5	-	-	-	-	MTT	
6.0477	EBA	SOS	O	-	-	-	-	10.8	26.7	MTT	
6.1383	EBA	SOS	O	-	-	-	-	-	26	MTT	
6.1501	EBA	SOS	O	135.5	20.8	11	32.2	9	23.1	MTT	
6.1502	EBA	SOS	O	-	-	-	-	10.7	25.7	MTT	
6.1714A-B	EBA	SOS	O	133.5	24	13.8	45	11.7	28.4	MTT	
6.0996	EBA	SOS	C	-	-	-	-	-	30.4	MTT	
5.2821	EBA	SOS	O	-	-	-	-	-	[24]	MTP	
6.0131	EBA	SOS	O	-	-	-	-	-	27.7	MTP	
6.1456	EBA	SOS	O	-	-	-	-	-	27.1	MTP	
5.1605	EBA	BTH	O/C	-	24.8	14	44	10	-	MTC	
7.0686	IA	SOS	O/C	-	-	13.1	-	-	-	MTC	
7.1091	IA	SOS	O/C	-	24.3	14	45	9.8	-	MTC	
7.0608	IA	SOS	O	-	22.6	13.7	40.5	8.5	-	MTC	
7.0858	IA	SOS	O	-	-	-	-	10.8	27.3	MTC	
7.0954	IA	SOS	O	-	-	-	-	10.2	26	MTC	
7.1054	IA	SOS	O	-	23.8	-	-	-	-	MTC	
7.2243	IA	SOS	O	115.7	21.4	11	38	8.4	24.5	MTC	

Table 17y) cont.

METAPODIAL				GL	Bp	SD	CD	DD	Bd	
7.0697	IA	SOS	C	-	23.2	14	-	10	-	MTC
7.0989	IA	SOS	C	-	-	-	-	10.4	-	MTC
7.0027	IA	SOS	O/C	-	17.5	9	-	7.6	-	MTT
7.0692	IA	SOS	O/C	-	19.4	11.3	-	8.5	-	MTT
7.0401	IA	SOS	O	-	22.3	-	-	-	-	MTT
7.0588	IA	SOS	O	-	-	-	-	10.1	-	MTT
7.0727	IA	SOS	O	-	21.1	-	-	-	-	MTT
7.1080.	IA	SOS	O	-	20.9	11.7	-	-	-	MTT
7.1463	IA	SOS	O	-	22.9	12.8	-	-	-	MTT
7.1631	IA	SOS	O	-	19	-	-	-	-	MTT
7.2359	IA	SOS	O	-	19.7	10.8	37	9	-	MTT
7.2361	IA	SOS	O	-	19.4	10.9	37	9.4	-	MTT
7.1512	IA	SOS	O/C	-	-	-	-	-	25.3	MTP
4.0269	IA	BTH	O/C	-	-	-	-	[11.5]	-	MTC
4.1073A-B	IA	BTH	O/C	-	25	-	-	-	-	MTC
4.1542	IA	BTH	O/C	-	24	-	-	-	-	MTC
5.1523	IA	BTH	O/C	-	-	8.7	31	8	-	MTC
5.1636A-D	IA	BTH	O/C	-	24.5	12.6	[41]	[10]	-	MTC
5.1547	IA	BTH	O/C	-	-	13.8	[42]	-	-	MTC
4.0303	IA	BTH	O	128.5	25	15	44	10	27	MTC
4.0606	IA	BTH	O	133	24	15	46	10.5	26.5	MTC
4.0617	IA	BTH	O	-	25.5	16.5	50	11	-	MTC
4.0728A-B	IA	BTH	O	[117]	22.5	12.5	39	9	-	MTC
4.0135	IA	BTH	O/C	-	-	12	40	10	-	MTT
4.0320.	IA	BTH	O/C	-	-	12	38	-	-	MTT
4.0408	IA	BTH	O/C	-	-	12	-	-	-	MTT
4.0676A-B	IA	BTH	O/C	-	-	12.5	-	-	-	MTT
5.1521	IA	BTH	O/C	-	-	11	39.5	[9.5]	-	MTT
4.0031A-B	IA	BTH	O	132.5	21.5	12.5	9	37.5	26	MTT
4.0134	IA	BTH	O	-	23.5	13	11	42.5	-	MTT
4.0273	IA	BTH	O	-	21	11	10	39.5	-	MTT
4.0844	IA	BTH	O	-	21	12	9	38	-	MTT
4.0859	IA	BTH	O	153.7	24	13	10.4	42	27	MTT
4.0999	IA	BTH	O	-	23	14	11.2	46	[27.2]	MTT
4.1026A-G	IA	BTH	O	152.9	22.5	13.9	11	-	25.5	MTT
5.1282	IA	BTH	O	141	21.5	12.2	9.8	38	24	MTT
5.1345B	IA	BTH	O	-	21.5	11.7	35	8.6	23.2	MTT
5.1706A-D	IA	BTH	O	-	-	13	10.7	42	25.5	MTT
4.1016	IA	BTH	C	117.5	19.5	12	39	9.5	24.5	MTT
4.0589	IA	BTH	O/C	-	-	-	-	-	25	MTP

Table 17z)

PHALANX 1				GLpe	Bp	SD	Bd
5.1778	EBA	SOS	O/C	12.2	-	-	-
5.2900.	EBA	SOS	O/C	-	11.0	-	-
6.0151	EBA	SOS	O/C	-	9.0	-	-
6.0389	EBA	SOS	O/C	-	12.5	-	-
6.0916	EBA	SOS	O/C	-	13.7	-	-
6.0982	EBA	SOS	O/C	-	14.3	-	-
6.1539	EBA	SOS	O/C	-	13.0	-	-
5.1978	EBA	SOS	O	38.0	[14]	12.0	13.0
5.2077	EBA	SOS	O	35.5	13.2	10.4	12.0
5.2298	EBA	SOS	O	36.3	13.5	6.8	12.5
5.2965	EBA	SOS	O	41.0	15.0	11.3	13.9
5.3539	EBA	SOS	O	33.8	12.7	9.8	11.6
5.3546	EBA	SOS	O	41.7	13.9	10.8	13.3
6.0030.	EBA	SOS	O	41.7	13.7	10.5	13.3
6.0031	EBA	SOS	O	-	-	10.3	12.1
6.0033	EBA	SOS	O	40.0	12.0	9.6	11.3
6.0117	EBA	SOS	O	38.9	-	-	10.9
6.0257	EBA	SOS	O	39.5	13.3	10.7	12.6
6.0297	EBA	SOS	O	-	[13.3]	12.3	12.6
6.0385	EBA	SOS	O	37.9	13.9	11.0	-
6.0402	EBA	SOS	O	-	-	7.9	9.6
6.0502	EBA	SOS	O	-	-	8.7	10.8
6.0646	EBA	SOS	O	-	-	10.2	11.4
6.0702	EBA	SOS	O	36.4	12.0	10.4	12.0
6.0983	EBA	SOS	O	37.2	13.4	10.1	11.8
6.0984	EBA	SOS	O	-	-	10.0	11.5
6.1051A-B	EBA	SOS	O	29.8	11.3	8.0	10.0
6.1283	EBA	SOS	O	38.5	14.2	10.9	12.6
6.1361A-B	EBA	SOS	O	41.8	14.1	12.4	13.0
6.1362	EBA	SOS	O	37.3	12.1	9.7	10.7
6.1603	EBA	SOS	O	40.4	14.4	12.1	13.6
6.1661	EBA	SOS	O	38.6	12.8	10.3	11.7
6.1662	EBA	SOS	O	-	-	12.7	13.3
6.1950.	EBA	SOS	O	-	-	9.2	10.9
6.2000.	EBA	SOS	O	[36.6]	-	-	12.4
6.2158	EBA	SOS	O	32.4	11.8	9.6	10.3
6.2535	EBA	SOS	O	39.7	12.9	10.8	11.9
6.2536	EBA	SOS	O	38.6	13.5	11.5	13.8
6.0034	EBA	SOS	C	35.0	12.5	10.9	12.5
6.0035	EBA	SOS	C	36.1	12.8	11.0	12.3

Table 17z) cont.

PHALANX 1				GLpe	Bp	SD	Bd
6.1581	EBA	SOS	C	37.8	13.9	12.6	13.9
6.1582	EBA	SOS	C	39.6	13.4	11.1	13.3
6.2090.	EBA	SOS	C	-	-	-	12.6
6.2217	EBA	SOS	C	35.2	13.0	10.9	12.3
7.0225	IA	SOS	O/C	-	12.0	-	-
7.0239	IA	SOS	O/C	-	11.0	-	-
7.0403A-B	IA	SOS	O/C	39.9	-	-	-
7.0971	IA	SOS	O/C	-	-	-	10.9
7.2408	IA	SOS	O/C	-	11.9	-	-
7.0028	IA	SOS	O	33.0	12.3	9.7	11.0
7.0062	IA	SOS	O	35.9	11.9	8.9	10.5
7.0163	IA	SOS	O	31.2	12.8	10.0	11.7
7.0178.	IA	SOS	O	33.1	11.9	9.2	11.4
7.0189	IA	SOS	O	-	-	9.6	10.5
7.0229	IA	SOS	O	33.8	12.2	9.0	11.0
7.0230.	IA	SOS	O	-	-	10.0	11.7
7.0380.	IA	SOS	O	-	-	8.7	9.8
7.0404	IA	SOS	O	33.0	11.8	8.9	10.5
7.0442	IA	SOS	O	34.5	12.3	9.7	10.3
7.0479	IA	SOS	O	34.2	12.0	8.7	10.5
7.0481	IA	SOS	O	37.0	13.1	10.2	11.5
7.0547	IA	SOS	O	39.7	13.4	10.8	12.7
7.0645	IA	SOS	O	34.9	11.9	9.4	10.5
7.0669	IA	SOS	O	-	-	9.5	-
7.0670.	IA	SOS	O	-	-	-	8.8
7.0700.	IA	SOS	O	35.9	14.5	12.1	12.9
7.0777	IA	SOS	O	33.9	12.5	10.0	11.1
7.0811	IA	SOS	O	33.3	12.5	10.6	11.0
7.0864	IA	SOS	O	-	-	-	10.8
7.0914	IA	SOS	O	39.7	14.1	11.7	13.3
7.0956	IA	SOS	O	34.4	12.4	10.8	11.0
7.0959	IA	SOS	O	34.0	12.0	9.5	10.7
7.1007A-B	IA	SOS	O	36.7	12.4	10.7	12.1
7.1023	IA	SOS	O	[36.8]	-	10.5	11.9
7.1060.	IA	SOS	O	34.9	11.9	9.7	10.7
7.1061	IA	SOS	O	34.0	11.4	8.8	10.0
7.1127	IA	SOS	O	-	-	8.8	11.2
7.1128	IA	SOS	O	-	-	9.5	10.4
7.1255	IA	SOS	O	-	-	-	11.2
7.1282	IA	SOS	O	43.6	13.1	10.6	12.4

Table 17z) cont.

PHALANX 1				GLpe	Bp	SD	Bd
7.1283	IA	SOS	O	37.2	12.6	9.8	11.7
7.1432	IA	SOS	O	-	-	-	10.3
7.1433A-B	IA	SOS	O	-	-	-	9.5
7.1464	IA	SOS	O	35.9	12.8	10.3	11.3
7.1479	IA	SOS	O	-	-	9.5	10.7
7.1498	IA	SOS	O	-	-	7.8	9.0
7.1541A-B	IA	SOS	O	36.5	13.0	10.9	13.4
7.1632	IA	SOS	O	-	-	-	9.7
7.1716	IA	SOS	O	32.9	12.8	9.9	11.4
7.2394	IA	SOS	O	31.5	13.3	9.2	11.5
7.2395	IA	SOS	O	-	-	9.8	10.8
7.2396	IA	SOS	O	-	-	-	11.1
7.2397	IA	SOS	O	-	-	10.3	11.8
7.2398	IA	SOS	O	31.4	12.0	8.7	11.5
7.2399	IA	SOS	O	[32.6]	11.3	-	-
7.2400.	IA	SOS	O	31.4	11.1	8.9	10.2
7.2401	IA	SOS	O	-	-	-	10.8
7.2403	IA	SOS	O	30.3	10.3	8.7	9.6
7.2404	IA	SOS	O	31.3	12.1	8.5	11.4
7.2405	IA	SOS	O	31.6	11.5	8.4	-
7.2406	IA	SOS	O	-	-	9.0	10.4
7.2407	IA	SOS	O	-	-	9.3	10.6
7.2409	IA	SOS	O	-	-	-	10.3
7.2411	IA	SOS	O	-	-	9.0	-
7.2414	IA	SOS	O	30.4	10.6	8.8	-
7.2415	IA	SOS	O	-	-	-	10.9
7.3000.	IA	SOS	O	35.5	12.6	9.2	10.9
7.0177	IA	SOS	C	36.7	10.9	8.4	10.4
7.0480.	IA	SOS	C	34.0	12.1	11.1	11.2
7.1497	IA	SOS	C	36.3	11.8	8.9	12.3
7.1526	IA	SOS	C	35.3	11.0	8.9	10.7
4.0390.	IA	BTH	O/C	-	-	[10.7]	-
4.0456	IA	BTH	O/C	-	-	8.5	-
4.0525	IA	BTH	O/C	-	-	7.5	-
4.0679	IA	BTH	O/C	-	-	8.0	-
4.1074	IA	BTH	O/C	36.0	13.0	10.0	12.0
4.0057	IA	BTH	O	37.0	14.0	11.0	12.0
4.0265A-B	IA	BTH	O	40.0	14.0	12.0	14.0
4.0682	IA	BTH	O	40.0	13.0	10.0	11.0
4.0700.	IA	BTH	O	39.5	14.0	11.0	13.0

Table 17z) cont.

PHALANX 1				GLpe	Bp	SD	Bd
4.0919	IA	BTH	O	35.0	12.5	10.0	11.5
4.1300.	IA	BTH	O	38.2	14.2	13.0	12.3
5.1346	IA	BTH	O	-	11.1	8.9	10.0
4.1507	IA	BTH	O	33.6	12.7	9.7	11.4
4.1565	IA	BTH	O	33.2	10.0	9.0	10.6
5.1459	IA	BTH	O	37.5	13.0	11.5	12.2
4.0136	IA	BTH	C	39.0	13.5	10.5	13.0
4.0754	IA	BTH	C	38.5	15.5	14.0	14.0

Table 17aa)

PHALANX 2				GL	Bp	SD	Bd
5.1899	EBA	SOS	O/C	-	-	7.2	-
6.0132	EBA	SOS	O/C	22.6	12.1	8.5	9.4
6.0503	EBA	SOS	O/C	20.8	10.2	7.2	8.1
6.0703	EBA	SOS	O/C	24.6	12.0	9.3	9.9
6.0729	EBA	SOS	O/C	-		8.5	-
6.0985	EBA	SOS	O/C	23.4	13.0	10.0	10.5
6.1238	EBA	SOS	O/C	23.8	13.2	9.9	11.1
6.1309	EBA	SOS	O/C	19.4	11.1		8.2
6.1365	EBA	SOS	O/C	23.0	11.0	7.9	7.2
6.1386	EBA	SOS	O/C	22.3	11.0	7.8	8.9
6.1469	EBA	SOS	O/C	26.6	13.3	8.6	9.9
6.1504	EBA	SOS	O/C	23.2	10.8	7.7	8.7
6.1663	EBA	SOS	O/C		[12.4]	9.0	
6.1940.	EBA	SOS	O/C	20.8	10.9	8.9	
5.1832	EBA	SOS	O	22.5	11.2	7.2	[7.8]
5.2238	EBA	SOS	O	20.0	10.9	6.9	7.5
6.2134	EBA	SOS	O	29.2	13.7	9.1	10.0
5.3533	EBA	SOS	C	24.2	-	9.3	10.0
6.1052	EBA	SOS	C	22.0	12.2	9.3	10.5
6.1347	EBA	SOS	C	20.5	12.7	9.4	9.8
7.0381	IA	SOS	O/C	21.7	-	-	-
7.0029	IA	SOS	O	19.6	10.7	7.9	8.4
7.0030.	IA	SOS	O	20.7	10.6	7.2	8.0
7.0107	IA	SOS	O	21.8	12.3	9.8	9.8
7.0179	IA	SOS	O	19.4	12.6	10.0	9.8
7.0405A-B	IA	SOS	O	24.1	11.7	8.5	9.4
7.0406	IA	SOS	O	-	-	7.8	8.7
7.0420.	IA	SOS	O	20.8	11.5	8.9	9.8
7.0781	IA	SOS	O	17.4	9.4	7.2	7.8
7.1064	IA	SOS	O	21.5	11.4	8.3	9.1
7.1072	IA	SOS	O	19.3	10.9	7.8	7.7
7.1233	IA	SOS	O	17.6	11.5	9.9	9.0
7.1256	IA	SOS	O	20.8	12.6	10.5	10.6
7.1385	IA	SOS	O	22.6	13.0	10.2	10.5
7.1386	IA	SOS	O	20.3	10.8	8.1	8.4
7.1434	IA	SOS	O	12.3	22.8	9.0	9.1
7.1633	IA	SOS	O	19.8	11.3	8.3	8.8
7.2427	IA	SOS	O	18.8	11.8	7.7	9.1
7.2428	IA	SOS	O	18.4	11.9	8.0	8.9
7.2429	IA	SOS	O	18.7	10.6	7.6	9.0
7.2430.	IA	SOS	O	18.8	10.9	9.0	9.6
7.2431	IA	SOS	O	-	-	7.2	-
7.2436	IA	SOS	O	-	-		8.8
7.2437	IA	SOS	O	-	-	-	8.6
7.2439	IA	SOS	O	18.5	9.7	7.5	7.9
7.0199	IA	SOS	C	21.9	11.8	8.7	9.0
7.0639	IA	SOS	C	23.8	12.1	8.5	9.6
7.0654	IA	SOS	C	21.1	12.0	9.1	10.0
7.0671	IA	SOS	C	20.7	10.3	6.9	8.2
7.0780.	IA	SOS	C	22.9	12.3	9.3	9.7

Table 17aa) cont.

PHALANX 2				GL	Bp	SD	Bd
7.1008	IA	SOS	C	19.6	11.3	8.9	9.6
7.1131	IA	SOS	C	22.3	11.5	8.1	8.9
7.1132	IA	SOS	C	21.2	10.9	8.0	8.8
7.1133	IA	SOS	C	20.0	11.6	9.6	9.8
7.1208	IA	SOS	C	18.1	12.1	10.2	10.4
7.1404	IA	SOS	C	28.0	13.8	9.8	10.5
4.1527	IA	BTH	O/C	[21.6]	11.5	8.7	[7.5]
4.0110.	IA	BTH	O	20.0	10.5	7.5	8.0
4.1075	IA	BTH	O	23.0	12.2	9.5	10.5
5.1576	IA	BTH	O	-	-	8.0	9.2
4.0448	IA	BTH	C	25.0	13.0	10.0	11.0

Table 17ab)

PHALANX 3				DLS	Ld	MBS
5.1898	EBA	SOS	O/C	-	-	5.2
6.0400.	EBA	SOS	O/C	-	-	6.6
5.2237	EBA	SOS	O	32.0	26.9	6.5
6.0704	EBA	SOS	O	28.8	21.6	5.4
6.1053	EBA	SOS	O	30.9	23.7	6.0
6.1054	EBA	SOS	O	27.5	22.1	6.0
6.1632	EBA	SOS	O	37.8	31.0	7.2
6.0037	EBA	SOS	C	-	-	4.1
7.0640.	IA	SOS	O	27.5	19.0	4.7
7.1634	IA	SOS	O	25.0	16.9	5.3
7.2445	IA	SOS	O	26.6	19.8	4.5
7.2446	IA	SOS	O	29.2	22.5	4.8
7.2447	IA	SOS	O	25.9	20.9	5.0
7.2448	IA	SOS	O	27.8	21.1	4.6
7.2449	IA	SOS	O	23.7	-	5.3
7.2451	IA	SOS	O	26.9	21.0	4.6
7.0782	IA	SOS	C	29.9	24.6	5.6
7.0812	IA	SOS	C	31.0	25.0	5.8
4.0058	IA	BTH	O	25.5	21.0	6.0
4.0297	IA	BTH	C	-	-	5.0

Table 18. *Sus scrofa* domesticus/*S. scrofa* Measurements.

Table 18a)

CRANIAL			A	B	C	D	E	F
5.2549	EBA	SOS	45.0	51.3	38.3	28.7	-	-
4.0615	IA	BTH	-	-	-	-	13.5	9.0

A Least breadth of the squamous part of the occipital bone

B Greatest breadth of the squamous part of the occipital bone

C Parietal length: Akrokranion-Nasion

D Least breadth of the parietal

E Length of canine alveolus

F Width of canine alveolus

Table 18b)

MAXILLARY TEETH			L P4	W P4	L M1	W M1	L M2	W M2	L M3	W M3
4.0536	IA	BTH	-	-	-	-	16.0	14.0	-	-
4.0615	IA	BTH	-	-	-	-	-	-	-	-
4.0794	IA	BTH	-	-	-	-	18.0	14.0	-	-
5.0060A-M	IA	BTH	11.0	10.5	12.0	13.5	17.0	13.0	23.5	16.0
5.1687A-C	IA	BTH	-	-	-	-	15.3	15.2	-	-

Table 18c)

MANDIBLE			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
5.0531	EBA	SOS	-	-	-	-	-	-	-	-	-	-	-	-	[25.7]	-	-	-
7.0423	IA	SOS	-	-	-	-	-	-	-	-	-	-	-	-	34.3	-	-	-
4.0159	IA	BTH	-	-	-	-	-	-	-	-	37.5	65.0	-	-	-	45.0	-	-
4.0192A-G	IA	BTH	-	-	-	-	-	30.0	43.0	35.0	-	-	-	-	27.5	30.0	-	-
4.0314	IA	BTH	-	-	-	-	-	-	-	33.0	-	-	-	-	18.0	23.0	-	-
4.0665	IA	BTH	-	-	-	-	-	-	-	-	-	28.0	-	-	-	20.4	-	-
4.0724A-C	IA	BTH	144.0	-	125.0	-	-	32.0	39.0	29.0	27.5	-	-	26.0	24.0	30.5	7.5	-
4.0793	IA	BTH	-	-	-	-	-	-	-	-	-	-	62.0	-	-	-	-	-
4.0809A-Q	IA	BTH	-	151.0	-	114.5	97.0	63.0	-	34.5	34.5	63.0	-	44.0	41.0	41.0	13.0	29.0
4.1561A-F	IA	BTH	-	-	-	-	-	-	-	-	-	-	-	-	34.0	-	-	-

A Length from angle: Gonion caudale to Infradentale

B Length of horizontal ramus: aboral border of alveolus of M3-Infradentale

C Length: Gonion caudale to oral border of alveolus of P2

D Length from aboral border of M3 alveolus to aboral border of canine alveolus

E Length of cheektooth row M3-P2 along alveoli

F Length of molar row along alveoli

G Length of premolar row P1-P4 along alveoli

H Length of premolar row P2-P4 measured along alveoli

I Length of oral border of alveolus of P2 to aboral border of the alveolus of I3

J Length of median section of body of mandible: from mental prominence - Infradentale

K Oral height of vertical ramus: Gonion caudale-Cronion

L Height of mandible behind M3 from most aboral point of alveolus on lingual side

M Height of mandible in front of M1

N Height of mandible in front of P2

O Greatest diameter of canine alveolus

P Breadth of two halves across alveoli of canine teeth.

Table 18d)

MANDIBLE			L P4	W P4	L M1	W M1	L M2	W M2	L M3	W M3
5.0531	EBA	SOS	-	-	13.6	9.5	-	-	-	-
7.0423	IA	SOS	-	-	-	-	-	-	29.7	-
4.0113	-	-	-	-	-	-	-	-	-	-
4.0159	-	-	-	-	-	-	-	-	-	-
4.0192A-G	6	9	-	-	14.0	10.0	-	-	-	-
4.0314	-	7	17.0	7.0	-	-	-	-	-	-
4.0665	-	6.7	-	-	-	-	-	-	-	-
4.0724A-C	4.5	6	10.0	7.0	15.0	8.5	16.5	10.5	-	-
4.0793	-	-	-	-	14.0	10.5	-	-	-	-
4.0809A-Q	-	11	13.5	8.5	14.0	10.0	18.5	12.5	29.0	13.5
4.0930A-B	-	-	-	-	-	-	-	-	-	-
4.1561A-F	-	-	-	-	[14]	10.2	17.3	12.3	-	-
5.1556	-	-	-	-	15.5	19.2	-	-	-	-
5.0011A-D	-	-	-	-	16.0	9.3	-	-	-	-
5.1600.	-	-	-	-	-	-	16.8	10.7	-	-

Table 18e)

SCAPULA			SLC
6.2161	EBA	SOS	23.0

Table 18f)

HUMERUS			SD	Bd	BT
5.2225	EBA	SOS	-	36.8	26.0
5.2692	EBA	SOS	6.2	-	-

Table 18g)

RADIUS			Bp
7.0241	EBA	SOS	28.8

Table 18h)

TALUS			GLl	GLm	Dl	Dm	Bd
6.2160.	EBA	SOS	34.4	32.3	17.5	18.0	17.0

Table 18i)

CALCANEUS			GL	
6.0351	EBA	SOS	111.5	WILD

Table 18j)

METATARSAL			GL	LeP	Bp	Bd		
6.0291	EBA	SOS	120.9	115.9	23.3	23.7	IV	WILD
6.0292	EBA	SOS	-	-	21.5	-	III	WILD
4.0102	IA	BTH	43.1	-	-	-	II	
5.1419	IA	BTH	47.5	-	-	-	II	

Table 18k)

PHALANX 1			GLPe	Bp	SD	Bd	
6.1492	EBA	SOS	45.4	23.0	18.2	19.3	WILD
6.2159	EBA	SOS	32.3	14.3	12.9	13.9	
4.0901	IA	BTH	31.5	13.5	10.5	12.0	

Table 19. *Canis familiaris/C. lupus* Measurements.

Table 19a)

MAXILLARY TEETH			LC	LP3	WP3	LP4	WP4	LM1	WM1	LM2	WM2	A	B
5.2773A-E	EBA	SOS	29.6	8.3	4.0	-	-	-	-	-	-	-	-
6.0496	EBA	SOS	-	-	-	17.1	8.5	-	-	-	-	-	15.7
6.1969	EBA	SOS	-	-	-	18.4	10.1	-	-	-	-	-	-
7.1306	IA	SOS	-	-	-	17.0	8.8	12.7	14.3	6.4	8.7	18.5	18.3

A Length of molar row

B Length of carnassial alveolus

Table 19b)

MANDIBLE			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
6.1884	EBA	SOS	-	-	-	-	-	-	-	-	-	39.5	-	-	13.0	[52.6]	26.9	-	[52.6]	23.8
7.1556A-B	EBA	SOS	147.5	150.0	142.5	133.0	121.5	136.0	87.3	80.9	76.0	38.8	43.0	23.4	29.5	63.7	26.5	22.0	-	-

A Total Length

B Length from angular process to Infradentale

C Length from indentation between condyle process & angular process - Infradentale

D Length: condyle process- aboral border of canine alveolus

E Length: indentation between condyle & angular process - aboral border of canine alveolus

F Length: angular process- aboral border of canine alveolus

G Length aboral border of alveolus of M3- aboral border of canine alveolus

H Length cheektooth row P1-M3 along alveoli

I Length cheektooth row P2-M3 along alveoli

K Length premolar row P1-P4 along alveoli

L Length premolar row P2-P4 along alveoli

M Greatest thickness of the body of the jaw [below M1]

N Height of the vertical ramus

O Height of mandible behind M1

P Height of mandible between P2 & P3

Q Height of mandible behind M3

R Length of the carnassial alveolus

Table 19c)

MANDIBULAR TEETH			L M1	W M1	L M2	W M2
5.3528	EBA	SOS	22.9	9.2	-	-
6.0384	EBA	SOS	23.2	9.3	-	-
6.1884	EBA	SOS	23.8	9.6	10.0	7.6

Table 19d)

ATLAS			GB	GL	BFcr	BFcd	GLF	LAd	H
5.3636	EBA	SOS	83.9	42.9	40.2	32.7	33.4	16.2	27.5
6.1743	EBA	SOS	-	-	45.6	36.3	33.0	18.1	28.8
6.2164	EBA	SOS	70.3	32.3	37.1	28.4	26.0	13.0	26.0
5.0033	IA	BTH	-	-	-	-	[26.7]	-	-

Table 19e)

AXIS			LCDe	LAPa	BFcr	BPacd	SBV	BFcd	H
7.1210.	IA	SOS	43.0	40.8	24.3	23.5	17.3	15.1	30.7

Table 19f)

CERVICAL VERT			PL	GLPa	BPacr	BFcr	BFcd	HFcr	HFcd
6.0917	EBA	SOS	23.0	37.2	30.4	13.5	15.4	10.0	13.9

Table 19g)

SCAPULA			SLC	GLP	LG	BG
5.3611	EBA	SOS	23.0	29.8	23.6	16.0
6.0505	EBA	SOS	25.8	28.9	24.3	16.6
6.1928	EBA	SOS	24.6		-	-

Table 19h)

HUMERUS			Bd
7.1130.	IA	SOS	33.2

Table 19i)

RADIUS			SD	Bd
6.0157	EBA	SOS	12.1	22.1

Table 19j)

PELVIS			LAR
7.1285	IA	SOS	19.4

Table 19k)

FEMUR			SD	CD	Bd
4.0639A-F	IA	BTH	13.5	45.5	[31]

Table 19l)

CALCANEUS			GL	GB
5.3509	EBA	SOS	41.9	18.0

Table 19m)

TALUS			GL
7.1305	IA	SOS	[28.1]

Table 19n)

METAPODIAL			GL	Bd		
6.0101	EBA	SOS	-	12.5		WILD
7.0200.	IA	SOS	51.2	9.2	MTC V	

Table 19o)

PHALANX 1			Bp	GL	SD	Bd
7.1286	IA	SOS	8.6	25.8	5.6	7.3

Table 19p)

PHALANX 2			Bp	GL	SD	Bd
7.0191	IA	SOS	8.1	5.6	6.9	13.5

Table 20. *Gallus gallus* domesticus Measurements.

Table 20a)

HUMERUS			Bp
5.1384	IA	BTH	18.1

Table 20b)

RADIUS			SC	Bd
4.0961	IA	BTH	2.5	5.1

Table 20c)

TARSOMETATARSUS			GL	Bp	SC	Bd
7.1438	IA	SOS	-	-	[6.4]	-
4.0153	IA	BTH	60.2	10.0	4.9	10.0

Table 21. *Camelus* sp. Measurements.

HUMERUS			Bd	BT
5.1587	IA	BTH	93.5	80.5

Table 22. *Bison bison* Measurements.

Table 22a)

RADIUS			Bd	BFd
4.0128	IA	BTH	80.0	68.0

Table 22b)

PHALANX 1			GLpe	Bp	SD	Bd
6.2958	EBA	SOS	69.8	38.4	32.7	41.4
6.0024	EBA	SOS	58.5	34.8	28.0	30.6

Table 22c)

PHALANX 2			GL	Bp	SD	Bd
6.0586	EBA	SOS	44.7	32.5	27.9	27.5
6.0853	EBA	SOS	45.5	35.1	26.3	28.0
6.1402	EBA	SOS	44.9	36.8	28.6	31.8

Table 23. *Cervus elaphus* Measurements.

Table 23a)

ANTLER			A	B	C	D	
5.2405	EBA	SOS	169.0	108.0	152.0	-	
5.3486	EBA	SOS	171.0	-	-	134.0	RIGHT
			162.0	-	-	-	LEFT
4.0814	IA	BTH	235.5	-	-	-	

A Circumference of burr

B Proximal circumference of burr- circumference of distal end of pedicle

C Distal circumference of burr

D Least frontal breadth-least breadth of forehead aboral of orbits

Table 23b)

RADIUS			Bd
4.0158	IA	BTH	53.0

Table 23c)

PHALANX 2			GL	Bp	SD	Bd
6.1435	EBA	SOS	47.0	26.4	19.3	21.9

Table 23d)

PHALANX 3			DLS	Ld	MBS
6.1995	EBA	SOS	16.7	53.6	17.9

Table 24. *Dama dama* Measurements.

Table 24a)

CALCANEUS			GL	GB
7.1180.	IA	SOS	75.7	25.4

Table 24b)

PHALANX 2			GL	Bp	SD	Bd
7.0623	IA	SOS	28.5	15.3	11.5	12.4

Table 25. *Ursus arctos* Measurements.

Table 25a)

MANDIBULAR TEETH			LP4	WP4	LM1	WM1	LC
5.1971	EBA	SOS	12.8	6.3	21.0	10.0	59.5

Table 25b)

METATARSAL			GL	Bd	
6.2184	EBA	SOS	55.2	12.1	I

Table 25c)

PHALANX 1			GL	Bp	SD	Bd
6.1633	EBA	SOS	35.6	15.4	10.8	12.4

Table 25d)

PHALANX 3			GL	Bp
6.1966	EBA	SOS	48.9	13.4

Table 26. *Vulpes vulpes* Measurements.

Table 26a)

ULNA			GL	DPA	SDO	BPC
6.1107	EBA	SOS	151.0	16.3	14.5	10.2
6.0478	EBA	SOS	-	-	-	11.0
7.0655	IA	SOS	-	16.4	13.3	10.3

Table 26b)

PELVIS			GL	LA	LAR	LS	SH	SB	SC	LFo	GBTc	GBA	GBTi	SBI
6.1104A	EBA	SOS	96.5	16.4	15.5	31.3	13.8	6.3	35.5	21.7	48.7	52.0	72.2	50.8

Table 26c)

TIBIA			SD	Bd
7.1536	IA	SOS	6.7	15.0

Table 26d)

METATARSAL			GL	SD	Bd	
7.0226	IA	SOS	37.7	3.9	5.4	II
7.1066	IA	SOS	-	-	6.1	

Table 26e)

PHALANX 1			GL	Bp	SD	Bd
6.1110.	EBA	SOS	26.1	6.5	3.7	5.0

Table 27. *Meles meles* Measurements.

Table 27a)

MAXILLARY TEETH			LM1	WM1
4.0523A-B	IA	BTH	14.5	11.0

Table 27b)

MANDIBLE			LM1	WM1	A
4.0523C	IA	BTH	16.2	7.7	30.1

A Height of the vertical ramus

Table 27c)

ATLAS			GL	GB	BFcr	BFcd	H
7.0813	EBA	SOS	55.8	23.7	24.9	32.3	18.9

Table 28. *Mustela nivalis* Measurements.

Table 28a)

CRANIAL			A	B	C	D	E	F	G	H	I	J	K	L	M
7.0149	IA	SOS	41.5	42.5	39.0	28.9	17.5	10.4	17.8	9.2	8.0	4.4	13.4	21.4	11.1

N	O	P	Q	R	S	T	U	V	W	X	Y
6.9	6.0	18.4	7.5	8.9	11.6	15.1	7.3	10.3	6.8	11.9	11.6

A Total Length: Akrokranion-Prosthion

B Condylobasal Length: aboral border of occipital condyles-Prosthion

C Basal Length: Basion-Prosthion

D Upper neurocraniun length: Akrokranion- Frontal midpoint

F Facial length: Frontal midpoint-Prosthion

F Snout length: oral border of orbits-Prosthion

G Median palatal length: Staphylion-Prosthion

H Length cheektooth row

I Length premolar row

J Length carnassial (P4)

K Greatest diameter of auditory bulla

L Greatest mastoid breadth

M Greatest breadth of occipital condyles

N Greatest breadth of foramen magnum

O Height of formamen magnum

P Greatest neuroncranium breadth

Q Least breadth of skull

R Least breadth between the orbits

S Frontal breadth: Ectaorbitale-Ectaorbitale

T Greatest palatal breadth

U Least palatal breadth

V Breadth at canine alveolus

W Greatest inner height of orbit

X Skull height

Y Height of occipital triangle

Table 29. *Vormela peregusna* Measurements.

CRANIAL			A	B	C	D	E	F	G	H	I	J	K	L	M
4.0669	IA	BTH	57.5	58.0	54.0	37.0	20.0	11.5	25.5	14.0	12.0	7.8	15.0	33.1	14.3

N	O	P	Q	R	S	T	U	V	W	X	Y
8.3	7.5	[27.5]	11.0	17.5	21.0	[22.8]	[13.9]	16.1	10.0	18.0	17.5

A Total Length: Akrokranion-Prosthion
B Condylobasal Length: aboral border of occipital condyles-Prosthion
C Basal Length: Basion-Prosthion
D Upper neurocraniun length: Akrokranion- Frontal midpoint
F Facial length: Frontal midpoint-Prosthion
F Snout length: oral border of orbits-Prosthion
G Median palatal length: Staphylion-Prosthion
H Length cheektooth row
I Length premolar row
J Length carnassial (P4)
K Greatest diameter of auditory bulla
L Greatest mastoid breadth
M Greatest breadth of occipital condyles
N Greatest breadth of foramen magnum
O Height of formamen magnum
P Greatest neuroncranium breadth
Q Least breadth of skull
R Least breadth between the orbits
S Frontal breadth: ectaorbitale-ectaorbitale
T Greatest palatal breadth
U Least palatal breadth
V Breadth at canine alveolus
W Greatest inner height of orbit
X Skull height
Y Height of occipital triangle

Table 30. *Castor fiber* Measurements.

TIBIA			SD
7.1250.	IA	SOS	9.4

Table 31. *Lepus europaeus* Measurements.

Table 31a)

HUMERUS			SD	Bd
6.1885A-B	EBA	SOS	5.4	11.4

Table 31b)

FEMUR			DC	SD
7.0703	IA	SOS	9.8	9.4

Table 31c)

TALUS			GL
5.3530.	EBA	SOS	16.7

Table 31d)

METATARSAL			GL	Bp	SD	Bd	
6.0317	EBA	SOS	-	-	-	5.3	
6.0469	EBA	SOS	-	-	-	6.8	
6.0598	EBA	SOS	-	-	-	5.9	
6.2586	EBA	SOS	53.5	-	-	6.1	
5.3510.	EBA	SOS	65.0	-	-	6.7	IV
6.0739	EBA	SOS	60.8	-	-	6.1	IV
6.1583	EBA	SOS	57.8	-	-	6.1	II
7.0702	IA	SOS	55.0	5.0	3.6	6.1	IV

Table 32. *Anser albifrons* Measurements.

CORACOID			GL	Lm
6.1886	EBA	SOS	80.0	72.3

Table 33. *Anas platyrhynchos* Measurements.

Table 33a)

HUMERUS			SC	Bd
4.0767	IA	BTH	-	14.5
5.1464	IA	BTH	7.2	14.4

Table 33b)

CARPOMETACARPUS			GL	Bp	Did
7.0793	IA	SOS	56.4	12.7	7.8

Table 33c)

FEMUR			Bd	Dd
6.1457	EBA	SOS	9.9	7.6

Table 34. *Circus aeruginosus* Measurements.

ULNA			Did
6.1974	EBA	SOS	10.0

Table 35. *Aquila chrysaetos* Measurements.

Table 35a)

CORACOID			Lm
4.0019	IA	BTH	68.9

Table 35b)

CARPOMETACARPUS			GL	L	Bp	Did
6.2165	EBA	SOS	115.0	98.2	23.4	18.2

Table 36. *Perdix perdix* Measurements.

Table 36a)

FEMUR			SD
4.0112	IA	BTH	3.6

Table 36b)

TIBIOTARSUS			SC	Dd
4.0348	IA	BTH	3.2	[6.6]

Table 37. *Alectoris chukar* Measurements.

FEMUR			GL	SC
5.2575	EBA	SOS	[58.5]	4.3

Table 38. *Coturnix coturnix* Measurements.

Table 38a)

HUMERUS			GL	Bp	SD	Bd
7.1457	IA	SOS	34.4	7.4	2.5	5.3

Table 38b)

CARPOMETACARPUS			GL	Bp	Did
7.1458	IA	SOS	19.6	4.8	2.9

Table 39. *Grus grus* Measurements.

Table 39a)

ULNA			Bp
6.1948	EBA	SOS	21.0

Table 39b)

TIBIOTARSUS			SC
6.0074	EBA	SOS	[10.7]

Table 40. *Otis tarda* Measurements.

Table 40a)

CORACOID			GL	Lm	Bb	BF
5.3587	EBA	SOS	76.0	66.5	33.9	30.0

Table 40b)

TARSOMETATARSUS			Bd
6.2020.	EBA	SOS	20.6

Table 41. *Athene noctua* Measurements.

HUMERUS			SC	Bd
5.2539	EBA	SOS	[3.1]	8.8

Table 42ai)

ELEMENT	MEASUREMENT	LOG RATIO
Scapula	SLC	-0.16
Scapula	SLC	-0.16
Scapula	SLC	-0.13
Scapula	SLC	-0.11
Scapula	SLC	-0.08
Scapula	SLC	-0.06
Humerus	BT	-0.12
Humerus	BT	-0.12
Humerus	BT	-0.11
Humerus	BT	-0.11
Humerus	BT	-0.10
Humerus	BT	-0.09
Humerus	BT	0.02
Radius	Bd	-0.17
Radius	Bd	-0.16
Radius	Bd	-0.11
Radius	Bd	-0.11
Radius	Bd	-0.03
Radius	Bd	-0.02
Tibia	Bd	-0.19
Tibia	Bd	-0.18
Tibia	Bd	-0.12
Tibia	Bd	-0.10
Tibia	Bd	-0.10
Tibia	Bd	-0.09
Tibia	Bd	-0.09
Tibia	Bd	-0.07
Tibia	Bd	-0.07
Tibia	Bd	-0.07
Tibia	Bd	-0.06
Tibia	Bd	-0.05
Tibia	Bd	-0.02
Tibia	Bd	-0.01
Talus	Bd	-0.07
Talus	Bd	-0.07
Talus	Bd	-0.07
Talus	Bd	-0.07
Talus	Bd	-0.07

Table 42ai) cont.

ELEMENT	MEASUREMENT	LOG RATIO
Talus	Bd	-0.06
Talus	Bd	-0.06
Talus	Bd	-0.06
Talus	Bd	-0.06
Talus	Bd	-0.05
Talus	Bd	-0.05
Talus	Bd	-0.05
Talus	Bd	-0.04
Talus	Bd	-0.03
Talus	Bd	-0.03
Talus	Bd	-0.03
Talus	Bd	-0.03
Talus	Bd	-0.02
Talus	Bd	-0.02
Talus	Bd	-0.02
Talus	Bd	-0.02
Talus	Bd	-0.02
Talus	Bd	-0.01
Talus	Bd	-0.01
Talus	Bd	0.00
Talus	Bd	0.01
Talus	Bd	0.02
Metacarpal	Bd	-0.13
Metacarpal	Bd	-0.12
Metacarpal	Bd	-0.06
Metacarpal	Bd	-0.05
Metacarpal	Bd	-0.05
Metacarpal	Bd	-0.04
Metacarpal	Bd	-0.02
Metacarpal	Bd	-0.01
Metatarsal	Bd	-0.11
Metatarsal	Bd	-0.11
Metatarsal	Bd	-0.11
Metatarsal	Bd	-0.10
Metatarsal	Bd	-0.10
Metatarsal	Bd	-0.06
Metatarsal	Bd	-0.03
Metatarsal	Bd	-0.03

Table 42aii.

ELEMENT	MEASUREMENT	LOG RATIO
Calcaneus	GL	-0.12
Calcaneus	GL	-0.03
Calcaneus	GL	-0.03
Talus	GLl	-0.19
Talus	GLl	-0.15
Talus	GLl	-0.15
Talus	GLl	-0.14
Talus	GLl	-0.14
Talus	GLl	-0.13
Talus	GLl	-0.13
Talus	GLl	-0.13
Talus	GLl	-0.12
Talus	GLl	-0.12
Talus	GLl	-0.12
Talus	GLl	-0.11
Talus	GLl	-0.11
Talus	GLl	-0.11
Talus	GLl	-0.11
Talus	GLl	-0.10
Talus	GLl	-0.10
Talus	GLl	-0.10
Talus	GLl	-0.10
Talus	GLl	-0.09
Talus	GLl	-0.09
Talus	GLl	-0.08
Talus	GLl	-0.05
Talus	GLl	-0.05
Talus	GLl	-0.05
Talus	GLl	-0.04
Talus	GLl	-0.02
Talus	GLl	-0.01
F/L Phalanx 1	GLpe	-0.12
F/L Phalanx 1	GLpe	-0.12
F/L Phalanx 1	GLpe	-0.08
F/L Phalanx 1	GLpe	-0.07
F/L Phalanx 1	GLpe	-0.06
F/L Phalanx 1	GLpe	-0.06
F/L Phalanx 1	GLpe	-0.06

Table 42ai. Elements included in *Bos* Log Ratio Diagram for Breadth Indices from Early Bronze Age Sos Höyük.

Table 42aii. Elements included in *Bos* Log Ratio Diagram for Length Indices from Early Bronze Age Sos Höyük.

Table 42aii) cont.

ELEMENT	MEASUREMENT	LOG RATIO
F/L Phalanx 1	GLpe	-0.04
F/L Phalanx 1	GLpe	-0.04
F/L Phalanx 1	GLpe	-0.03
F/L Phalanx 1	GLpe	-0.03
F/L Phalanx 1	GLpe	-0.03
F/L Phalanx 1	GLpe	-0.02
F/L Phalanx 1	GLpe	0.00
H/L Phalanx 1	GLpe	-0.17
H/L Phalanx 1	GLpe	-0.15
H/L Phalanx 1	GLpe	-0.13
H/L Phalanx 1	GLpe	-0.13
H/L Phalanx 1	GLpe	-0.11
H/L Phalanx 1	GLpe	-0.11
H/L Phalanx 1	GLpe	-0.11
H/L Phalanx 1	GLpe	-0.10
H/L Phalanx 1	GLpe	-0.10
H/L Phalanx 1	GLpe	-0.10
H/L Phalanx 1	GLpe	-0.09
H/L Phalanx 1	GLpe	-0.09
H/L Phalanx 1	GLpe	-0.09
H/L Phalanx 1	GLpe	-0.08
H/L Phalanx 1	GLpe	-0.07
H/L Phalanx 1	GLpe	-0.06
H/L Phalanx 1	GLpe	-0.04
H/L Phalanx 1	GLpe	-0.04
H/L Phalanx 1	GLpe	-0.04

Table 42bi.

ELEMENT	MEASUREMENT	LOG RATIO
Radius	Bd	-0.20
Radius	Bd	-0.19
Radius	Bd	-0.17
Radius	Bd	-0.15
Radius	Bd	-0.14
Ulna	DPA	-0.15
Ulna	DPA	-0.08
Tibia	Bp	-0.21
Tibia	Bd	-0.20
Tibia	Bd	-0.16
Tibia	Bd	-0.14
Tibia	Bd	-0.12
Tibia	Bd	-0.07
Talus	Bd	-0.1
Talus	Bd	-0.08
Talus	Bd	-0.09
Talus	Bd	-0.13
Talus	Bd	-0.1
Talus	Bd	-0.07
Talus	Bd	-0.06
Talus	Bd	-0.09
Talus	Bd	-0.15
Talus	Bd	-0.08
Talus	Bd	-0.11
Talus	Bd	-0.15
Talus	Bd	-0.11
Talus	Bd	-0.08
Metacarpal	Bp	-0.19
Metacarpal	Bp	-0.18
Metacarpal	Bp	-0.15
Metacarpal	Bp	-0.08
Metacarpal	Bp	-0.08
Metacarpal	Bd	-0.13
Metacarpal	Bd	-0.11

Table 42bi) cont.

ELEMENT	MEASUREMENT	LOG RATIO
Metatarsal	Bp	-0.23
Metatarsal	Bp	-0.20
Metatarsal	Bp	-0.17
Metatarsal	Bp	-0.15
Metatarsal	Bp	-0.15
Metatarsal	Bd	-0.18
Metatarsal	Bd	-0.07

Table 42bii.

ELEMENT	MEASUREMENT	LOG RATIO
Talus	GLl	-0.15
Talus	GLl	-0.13
Talus	GLl	-0.12
Talus	GLl	-0.12
Talus	GLl	-0.12
Talus	GLl	-0.11
Talus	GLl	-0.08
Talus	GLl	-0.08
Talus	GLl	-0.05
Calcaneus	GL	-0.15
F/L Phalanx 1	GLPe	-0.14
F/L Phalanx 1	GLPe	-0.11
F/L Phalanx 1	GLPe	-0.09
F/L Phalanx 1	GLPe	-0.09
F/L Phalanx 1	GLPe	-0.08
H/L Phalanx 1	GLPe	-0.19
H/L Phalanx 1	GLPe	-0.19
H/L Phalanx 1	GLPe	-0.17
H/L Phalanx 1	GLPe	-0.13
H/L Phalanx 1	GLPe	-0.13
H/L Phalanx 1	GLPe	-0.10
H/L Phalanx 1	GLPe	-0.09
H/L Phalanx 1	GLPe	-0.06

Table 42aii. Elements included in *Bos* Log Ratio Diagram for Length Indices from Early Bronze Age Sos Höyük.

Table 42bi. Elements included in *Bos* Log Ratio Diagram for Breadth Indices from Iron Age Sos Höyük

Table 42bii. Elements included in *Bos* Log Ratio Diagram for Length Indices from Iron Age Sos Höyük

Table 42ci.

ELEMENT	MEASUREMENT	LOG RATIO
Scapula	BG	-0.11
Radius	Bd	-0.10
Radius	Bd	-0.06
Ulna	DPA	-0.10
Tibia	Bd	-0.20
Tibia	Bd	-0.19
Tibia	Bd	-0.18
Tibia	Bd	-0.16
Tibia	Bd	-0.14
Tibia	Bd	-0.11
Metacarpal	Bp	-0.15
Metacarpal	Bp	-0.14
Metacarpal	Bp	-0.11
Metacarpal	Bp	-0.06
Metacarpal	Bd	-0.04
Metatarsal	Bp	-0.18
Metatarsal	Bp	-0.15
Metatarsal	Bd	-0.16
Metatarsal	Bd	-0.16

Table 42cii.

ELEMENT	MEASUREMENT	LOG RATIO
Talus	GLl	-0.14
Talus	GLl	-0.10
Talus	GLl	-0.09
Talus	GLl	-0.09
Talus	GLl	-0.07
Talus	GLl	-0.04
F/L Phalanx 1	GLpe	-0.07
F/L Phalanx 1	GLpe	-0.01
H/L Phalanx 1	GLpe	-0.13
H/L Phalanx 1	GLpe	-0.12

Table 43. Length of *Bos* Mandibular Third Molars

SITE	PERIOD	RANGE	MEAN	S	NO.
various, Denmark	Boreal	42.5-54.8	48.5	2.8	34
Ali Kosh	Ali Kosh/Mohammad Jaffar	45-49	-	-	3
Fikirtepe	Neolithic	38-44	40.3	2.3	11
Çavi Tarlası	Early Chalcolithic	38-40	39.9	1.7	4
Sos Höyük	EBA	30.6-39	35.9	2.4	12
Hassek Höyük	EBA	37-40	38.7	1.5	3
Korucutepe	EBA	35;34.5	-	-	2
Lidar Höyük	EBA	36.5-41	39.0	1.9	4
Korucutepe	MBA	33.5-41	37.4	-	6
Lidar Höyük	MBA	34.5-39	37.5	1.2	12
Korucutepe	LBA	34-40	37.0	-	17
Lidar Höyük	LBA	35.5-41	37.8	2.3	8
Sos Höyük	IA	30.4-35.5	33.1	1.9	6
Büyüktepe Höyük	IA	31.5-39	34.9	3.1	4
Lidar Höyük	IA	33-40	35.7	2.8	13

Table 44. *Bos* Stature Data from Eastern Turkish Sites

Table 44a) Talus: Greatest Length of the Lateral Half (GLl)

SITE	PERIOD	RANGE	MEAN	S	NO.
Sos	EBA	53.5-79	65.5	5.7	31
Hassek	EBA	57.5-66	61.3	4.0	5
Lidar	EBA	55-65	60.4	3.6	6
Korucutepe	MBA	60.3-70.5	64.5	4.1	5
Lidar	MBA	59-71.5	64.2	3.9	17
Korucutepe	LBA	54.8-73	63.2	4.0	23
Lidar	LBA	54-68	61.5	4.5	26
Sos	IA	59.2-74.2	65.0	4.6	9
Büyüktepe	IA	60.5-75	67.8	4.7	6
Lidar	IA	55-65	61.4	3.5	11

Table 42ci. Elements included in *Bos* Log Ratio Diagram for Breadth Size Indices from Iron Age Büyüktepe Höyük

Table 42cii. Elements included in *Bos* Log Ratio Diagram for Length Indices from Iron Age Büyüktepe Höyük.

Table 44b) Forelimb Phalanx 1: Greatest Length of the Abaxial Half (GLpe)

SITE	PERIOD	RANGE	MEAN	S	NO.
Sos	EBA	52.0-65.5	60.6	4.5	13
Hassek	EBA	55-67.5	60.3	3.7	17
Lidar	EBA	48.5-60	55.2	3.9	7
Korucutepe	MBA	49.5-62	55.7	3.5	13
Lidar	MBA	48-65	55.3	4.7	38
Korucutepe	LBA	48-60.5	55.0	3.7	21
Lidar	LBA	49.5-65	55.4	4.3	18
Sos	IA	49.9-56.9	54.8	2.9	5
Büyüktepe	IA	59	-	-	1
Lidar	IA	49-56.5	52.0	2.7	6

Table 44c) Hindlimb Phalanx 1: Greatest Length of the Abaxial Half (GLpe)

SITE	PERIOD	RANGE	MEAN	S	NO.
Sos	EBA	49-66.4	58.2	4.9	19
Hassek	EBA	53-71	60.8	5.7	18
Lidar	EBA	52.5-63	56.8	4.6	6
Korucutepe	MBA	50-61	56.6	6.1	9
Lidar	MBA	47-64	57.9	4.1	31
Korucutepe	LBA	53.3-64.5	58.5	3.0	22
Lidar	LBA	48-65	57.8	4.6	22
Lidar	IA	52.5-65	58.4	5.0	13
Sos	IA	46.8-62.8	53.4	5.7	9
Büyüktepe	IA	54;53	53.5	-	2

Table 44d) Forelimb Phalanx 2: Greatest Length (GL)

SITE	PERIOD	RANGE	MEAN	S	NO.
Sos	EBA	33-44	39.1	2.9	18
Lidar	EBA	34-39.5	35.5	2.2	7
Hassek	EBA	35-45	39.1	2.8	14
Korucutepe	MBA	31-41.5	36.3	3.4	6
Lidar	MBA	30-43	36.8	3.1	41
Korucutepe	LBA	31-45.5	37.7	3.5	28
Lidar	LBA	32.5-42	37.6	2.8	19
Lidar	IA	31.5-37	35.1	1.9	8
Sos	IA	30.9-41.6	36.4	3.5	6
Büyüktepe	IA	36;42	39.0	-	2

Table 44e) Hindlimb Phalanx 2: Greatest Length (GL)

SITE	PERIOD	RANGE	MEAN	S	NO.
Sos	EBA	35.3-46.1	40.3	3.0	16
Lidar	EBA	32.5-39.5	35.7	2.4	7
Hassek	EBA	36-45	40.2	2.9	14
Korucutepe	MBA	36.5-43	38.4	3.1	4
Lidar	MBA	31.5-48	38.9	3.2	32
Korucutepe	LBA	33-44.5	38.3	3.1	24
Lidar	LBA	31-43	37.4	2.9	15
Lidar	IA	35-40	37.8	1.6	7
Sos	IA	34.6-37.3	36.2	1.4	4
Büyüktepe	IA	35.5;43	39.3	-	2

Table 45 a. *Bos* Dental Data from Sos Höyük and Büyüktepe Höyük

DEVELOPMENTAL STAGE	AGE (Months)	AGE GROUPINGS (Months)	EBA Sos	%	IA Sos	%	IA Büyüktepe	%
M1 not yet erupting	<6	0-6	0	4.0	0	0.0	0	11.1
M1 erupting	6		1		0		1	
M1 in wear/ M2 not erupting	6-18	6-18	1	8.0	1	11.1	1	11.1
M2 erupting	18		1		0		0	
M2 in wear/ M3 not erupting		18-30	1	4.0	0	0.0	0	11.1
M3 erupting	18-30		0		0		1	
M3 slightly worn	>30	>30	3	84.0	2	88.9	2	66.7
M3 medium worn			16		6		3	
M3 heavily worn			2		0		1	
NO. OF SPECIMENS			**25**		**9**		**9**	

Table 45bi. *Bos* Dental Data from Comparative Sites (%).

DEVELOPMENTAL STAGE	AGE GROUPINGS (Months)	CHALC Hassek	EBA Hassek	EBA Lidar	MBA Korucutepe	MBA Lidar	LBA Korucutepe	LBA Lidar	IA Lidar
M1 not yet erupting	0-6	14.3	9.5	10.0	0.0	28.2	12.8	9.5	21.6
M1 erupting									
M1 in wear/ M2 not erupting	6-18	14.3	9.5	0.0	21.4	0.0	10.6	4.8	21.6
M2 erupting									
M2 in wear/ M3 not erupting	18-30	14.3	4.8	15.0	14.3	12.8	14.9	14.3	10.8
M3 erupting									
M3 slightly worn	>30	57.1	76.2	75.0	64.3	59.0	61.7	71.4	46.0
M3 medium worn									
M3 heavily worn									

Table 45bii. *Bos* Dental Data from Comparative Sites (%).

DEVELOPMENTAL STAGE	EBA Demircihüyük	MBA Demircihüyü	EBA Sos	IA Sos	IA Büyüktepe
M1 not yet erupting	8.6	10.0	8.0	11.1	22.2
M1 erupting					
M1 in wear/ M2 not erupting					
M2 erupting	26.5	30.0	8.0	0.0	0.0
M2 in wear/ M3 not erupting					
M3 erupting	38.5	40.0	12.0	22.2	33.3
M3 slightly worn					
M3 medium worn	26.5	20.0	72.0	66.7	44.4
M3 heavily worn					

Table 46a. *Bos* Epiphyseal Fusion Data from Early Bronze Age Sos Höyük.

GROUP 1 (7-10 Months)

ELEMENT	NO. FUSED	NO. UNFUSED
Os Coxae	16	0
TOTAL	**16 (100.0%)**	**0**

GROUP 2 (12-20 Months)

ELEMENT	NO. FUSED	NO. UNFUSED
Prox. Radius	25	0
Prox. Phalanx 1	41	1
Prox. Phalanx 2	34	1
Dist. Humerus	25	3
TOTAL	**125 (96.2%)**	**5 (3.9%)**

GROUP 3 (24-30 Months)

ELEMENT	NO. FUSED	NO. UNFUSED
Dist. Tibia	15	3
Dist. Metacarpal	14	0
Dist. Metatarsal	9	1
Dist. Metapodial	4	1
TOTAL	**42 (89.4%)**	**5 (10.6%)**

GROUP 4 (42-48 Months)

ELEMENT	NO. FUSED	NO. UNFUSED
Prox. Humerus	4	1
Prox. Femur	9	3
Prox. Tibia	1	3
Dist. Radius	7	2
Dist. Femur	3	2
TOTAL	**24 (68.6%)**	**11 (31.4%)**

Table 46b.

GROUP 1 (7-10 Months)

ELEMENT	NO. FUSED	NO. UNFUSED
Os Coxae	8	1
TOTAL	**8 (88.9%)**	**1 (11.1%)**

GROUP 2 (12-20 Months)

ELEMENT	NO. FUSED	NO. UNFUSED
Prox. Radius	11	0
Prox. Phalanx 1	16	2
Prox. Phalanx 2	13	0
Dist. Humerus	9	1
TOTAL	**49 (94.2%)**	**3 (5.8%)**

GROUP 3 (24-30 Months)

ELEMENT	NO. FUSED	NO. UNFUSED
Dist. Tibia	6	2
Dist. Metacarpal	7	1
Dist. Metatarsal	2	1
Dist. Metapodial	8	0
TOTAL	**23 (85.2%)**	**4 (14.8%)**

GROUP 4 (42-48 Months)

ELEMENT	NO. FUSED	NO. UNFUSED
Prox. Humerus	1	3
Prox. Ulna	1	2
Prox. Femur	1	0
Prox. Tibia	1	3
Dist. Radius	9	0
Dist. Femur	1	1
TOTAL	**14 (60.9%)**	**9 (39.1%)**

Table 46c.

GROUP 1 (7-10 Months)

ELEMENT	NO. FUSED	NO. UNFUSED
Os Coxae	4	0
Dist. Scapula	1	0
TOTAL	**5 (100.0%)**	**0**

GROUP 2 (12-20 Months)

ELEMENT	NO. FUSED	NO. UNFUSED
Prox. Radius	5	0
Prox. Phalanx 1	5	0
Prox. Phalanx 2	4	0
Dist. Humerus	5	1
TOTAL	**19 (95.0%)**	**1 (5.0%)**

GROUP 3 (24-30 Months)

ELEMENT	NO. FUSED	NO. UNFUSED
Dist. Tibia	6	0
Dist. Metacarpal	2	1
Dist. Metatarsal	1	1
TOTAL	**9 (81.8%)**	**2 (18.2%)**

GROUP 4 (42-48 Months)

ELEMENT	NO. FUSED	NO. UNFUSED
Prox. Femur	0	1
Prox. Tibia	0	2
Dist. Radius	2	0
TOTAL	2 (40.0%)	3 (60.0%)

Table 46b. *Bos* Epiphyseal Fusion Data from Iron Age Sos Höyük.

Table 46c. *Bos* Epiphyseal Fusion Data from Iron Age Büyüktepe Höyük.

Table 47ai.

ELEMENT	MEASUREMENT	LOG RATIO
Scapula	SLC	-0.01
Scapula	SLC	0.02
Scapula	SLC	0.03
Scapula	SLC	0.04
Scapula	SLC	0.04
Scapula	SLC	0.05
Scapula	SLC	0.05
Scapula	BG	-0.02
Scapula	BG	-0.02
Scapula	BG	0.00
Scapula	BG	0.03
Scapula	BG	0.05
Scapula	BG	0.05
Humerus	BT	-0.06
Humerus	BT	-0.04
Humerus	BT	-0.02
Humerus	BT	-0.02
Humerus	BT	-0.01
Humerus	BT	0.00
Humerus	BT	0.00
Humerus	BT	0.01
Humerus	BT	0.01
Humerus	BT	0.02
Humerus	BT	0.03

Table 47ai) cont.

ELEMENT	MEASUREMENT	LOG RATIO
Humerus	BT	0.04
Humerus	BT	0.05
Humerus	BT	0.05
Humerus	BT	0.06
Radius	Bp	-0.03
Radius	Bp	-0.02
Radius	Bp	-0.01
Radius	Bp	0.01
Radius	Bp	0.04
Radius	Bd	-0.02
Radius	Bd	0.01
Radius	Bd	0.02
Radius	Bd	0.02
Radius	Bd	0.04
Ulna	BPC	-0.03
Ulna	BPC	-0.01
Ulna	BPC	-0.01
Ulna	BPC	-0.01
Ulna	BPC	0.00
Ulna	BPC	0.01
Ulna	BPC	0.01
Ulna	BPC	0.01
Ulna	BPC	0.02
Ulna	BPC	0.03

Table 47ai. Elements included in *Ovis* Log Ratio Diagam for Breadth Indices from Early Bronze Age Sos Höyük.

Table 47ai) cont.

ELEMENT	MEASUREMENT	LOG RATIO
Ulna	BPC	0.03
Ulna	DPA	-0.07
Ulna	DPA	-0.05
Ulna	DPA	-0.04
Ulna	DPA	-0.03
Ulna	DPA	0.02
Femur	DC	0.00
Femur	DC	0.02
Femur	DC	0.06
Femur	DC	0.06
Talus	Bd	-0.07
Talus	Bd	-0.06
Talus	Bd	-0.06
Talus	Bd	-0.05
Talus	Bd	-0.04
Talus	Bd	-0.03
Talus	Bd	-0.03
Talus	Bd	-0.02
Talus	Bd	-0.01
Talus	Bd	-0.01
Talus	Bd	0.00
Talus	Bd	0.01
Talus	Bd	0.01
Talus	Bd	0.02
Talus	Bd	0.02
Talus	Bd	0.03
Talus	Bd	0.03
Talus	Bd	0.03
Talus	Bd	0.04
Talus	Bd	0.04
Talus	Bd	0.05
Talus	Bd	0.05
Talus	Bd	0.05
Metacarpal	Bp	-0.06
Metacarpal	Bp	-0.04
Metacarpal	Bp	-0.03
Metacarpal	Bp	-0.02
Metacarpal	Bp	-0.02
Metacarpal	Bp	-0.01
Metacarpal	Bp	-0.01
Metacarpal	Bp	-0.01

Table 47ai) cont.

ELEMENT	MEASUREMENT	LOG RATIO
Metacarpal	Bp	-0.01
Metacarpal	Bp	0.00
Metacarpal	Bp	0.01
Metacarpal	Bp	0.04
Metacarpal	Bd	-0.05
Metacarpal	Bd	-0.05
Metacarpal	Bd	-0.03
Metacarpal	Bd	-0.03
Metacarpal	Bd	-0.02
Metacarpal	Bd	-0.02
Metacarpal	Bd	-0.01
Metacarpal	Bd	0.00
Metacarpal	Bd	0.00
Metacarpal	Bd	0.01
Metacarpal	Bd	0.02
Metatarsal	Bp	-0.03
Metatarsal	Bp	0.02
Metatarsal	Bp	0.03
Metatarsal	Bd	-0.05
Metatarsal	Bd	-0.01
Metatarsal	Bd	0.01
Metatarsal	Bd	0.03
Metatarsal	Bd	0.04
Calcaneus	Bd	0.03
Calcaneus	Bd	-0.03
Calcaneus	Bd	0.06
Calcaneus	Bd	0.05
Calcaneus	Bd	-0.03
Calcaneus	Bd	0.04
Calcaneus	Bd	0.02
Calcaneus	Bd	0.03

Table 47aii.

ELEMENT	MEASUREMENT	LOG RATIO
Talus	GLl	-0.07
Talus	GLl	-0.07
Talus	GLl	-0.07
Talus	GLl	-0.06
Talus	GLl	-0.05
Talus	GLl	-0.04
Talus	GLl	-0.04
Talus	GLl	-0.03
Talus	GLl	-0.03
Talus	GLl	-0.02
Talus	GLl	-0.02
Talus	GLl	-0.02
Talus	GLl	-0.01
Talus	GLl	-0.01
Talus	GLl	0.00
Talus	GLl	0.00
Talus	GLl	0.01
Talus	GLl	0.02
Talus	GLl	0.03
Talus	GLl	0.03
Talus	GLl	0.04
Talus	GLl	0.04
Calcaneus	GL	-0.07
Calcaneus	GL	-0.07
Calcaneus	GL	-0.06
Calcaneus	GL	-0.04
Calcaneus	GL	-0.03
Calcaneus	GL	-0.02
Calcaneus	GL	-0.02
Calcaneus	GL	-0.01
Calcaneus	GL	-0.01
Calcaneus	GL	0.00
Calcaneus	GL	0.02
Calcaneus	GL	0.03

Table 47bi.

ELEMENT	MEASUREMENT	LOG RATIO
Scapula	SLC	-0.09
Scapula	SLC	-0.08
Scapula	SLC	-0.07
Scapula	SLC	-0.06
Scapula	SLC	-0.03
Scapula	SLC	-0.03
Scapula	SLC	-0.02
Scapula	SLC	0.00
Scapula	SLC	0.01
Scapula	SLC	0.03
Scapula	SLC	0.04
Scapula	SLC	0.08
Scapula	BG	-0.08
Scapula	BG	-0.08
Scapula	BG	-0.05
Scapula	BG	-0.05
Scapula	BG	-0.05
Scapula	BG	-0.04
Scapula	BG	-0.01
Scapula	BG	0.00
Scapula	BG	0.00
Scapula	BG	0.02
Scapula	BG	0.02
Scapula	SLC	0.08
Scapula	BG	-0.08
Scapula	BG	-0.08
Scapula	BG	-0.05
Scapula	BG	-0.05
Scapula	BG	-0.05
Scapula	BG	-0.04
Scapula	BG	-0.01
Scapula	BG	0.00
Scapula	BG	0.00
Scapula	BG	0.02

Table 47aii. Elements included in *Ovis* Log Ratio Diagam for Length Indices from Early Bronze Age Sos Höyük.

Table 47bi. Elements included in *Ovis* Log Ratio Diagam for Breadth Indices from Iron Age Sos Höyük.

Table 47bi) cont.

ELEMENT	MEASUREMENT	LOG RATIO
Scapula	BG	0.02
Scapula	BG	0.06
Humerus	BT	-0.06
Humerus	BT	-0.06
Humerus	BT	-0.06
Humerus	BT	-0.05
Humerus	BT	-0.04
Humerus	BT	-0.04
Humerus	BT	-0.03
Humerus	BT	-0.03
Humerus	BT	-0.03
Humerus	BT	-0.03
Humerus	BT	-0.03
Humerus	BT	-0.03
Humerus	BT	-0.02
Humerus	BT	-0.02
Humerus	BT	-0.01
Humerus	BT	0.00
Humerus	BT	0.00
Humerus	BT	0.00
Humerus	BT	0.00
Humerus	BT	0.01
Humerus	BT	0.02
Humerus	BT	0.03
Humerus	BT	0.04
Humerus	BT	0.07
Radius	Bp	-0.07
Radius	Bp	-0.04
Radius	Bp	-0.04
Radius	Bp	-0.04
Radius	Bp	0.00
Radius	Bp	0.02
Radius	Bp	0.04
Radius	Bd	-0.05
Radius	Bd	-0.04
Radius	Bd	-0.03
Radius	Bd	-0.03
Radius	Bd	-0.02
Radius	Bd	-0.01
Radius	Bd	0.02
Radius	Bd	0.02

Table 47bi) cont.

ELEMENT	MEASUREMENT	LOG RATIO
Radius	Bd	0.05
Ulna	BPC	-0.04
Ulna	BPC	-0.04
Ulna	BPC	-0.02
Ulna	BPC	0.02
Ulna	BPC	0.05
Ulna	DPA	-0.08
Ulna	DPA	-0.05
Ulna	DPA	-0.04
Ulna	DPA	-0.03
Ulna	DPA	0.01
Femur	DC	-0.06
Femur	DC	-0.06
Femur	DC	-0.03
Femur	DC	-0.02
Talus	Bd	-0.05
Talus	Bd	-0.04
Talus	Bd	-0.02

Table 47c.

ELEMENT	MEASUREMENT	LOG RATIO
Humerus	BT	-0.05
Humerus	BT	-0.02
Humerus	BT	0.01
Humerus	BT	0.01
Humerus	BT	0.02
Humerus	BT	0.04
Radius	Bp	-0.06
Radius	Bp	0.01
Radius	Bp	0.01
Ulna	DPA	-0.04
Femur	DC	-0.02
Metacarpal	Bp	-0.05
Metacarpal	Bp	-0.02
Metatarsal	Bp	-0.02
Metatarsal	Bp	-0.02
Metatarsal	Bp	0.00
Metatarsal	Bp	0.03

Table 47bii.

ELEMENT	MEASUREMENT	LOG RATIO
Calcaneus	GL	-0.09
Calcaneus	GL	-0.08
Calcaneus	GL	-0.04
Calcaneus	GL	0.02
Talus	GLl	-0.05
Talus	GLl	-0.05
Talus	GLl	-0.04
Talus	GLl	-0.02
Talus	GLl	-0.02
Talus	GLl	-0.02
Talus	GLl	0.01
Talus	GLl	0.04
Talus	Bd	-0.01
Talus	Bd	-0.01
Talus	Bd	0.02
Talus	Bd	0.02
Talus	Bd	0.04
Metacarpal	Bp	-0.07
Metacarpal	Bp	-0.04
Metacarpal	Bp	-0.02
Metacarpal	Bd	-0.03
Metacarpal	Bd	-0.01
Metacarpal	Bd	0.01
Metatarsal	Bp	-0.07
Metatarsal	Bp	-0.06
Metatarsal	Bp	-0.06
Metatarsal	Bp	-0.03
Metatarsal	Bp	-0.03
Metatarsal	Bp	0.00
Metatarsal	Bp	0.01
Metatarsal	Bd	-0.09
Metatarsal	Bd	-0.06
Metatarsal	Bd	-0.05
Metatarsal	Bd	-0.03
Metatarsal	Bd	-0.02
Metatarsal	Bd	-0.02
Metatarsal	Bd	0.02
Metatarsal	Bd	0.03

Table 48ai.

ELEMENT	MEASUREMENT	LOG RATIO
Scapula	BG	-0.07
Scapula	BG	-0.10
Humerus	BT	-0.11
Humerus	BT	-0.08
Humerus	BT	-0.07
Humerus	BT	-0.04
Radius	Bp	-0.10
Radius	Bp	-0.08
Radius	Bp	-0.07
Radius	Bp	-0.06
Radius	Bp	-0.06
Radius	Bd	-0.11
Femur	DC	-0.07
Talus	Bd	-0.11
Talus	Bd	-0.09
Talus	Bd	-0.07
Talus	Bd	-0.06
Talus	Bd	-0.04
Talus	Bd	-0.03
Talus	Bd	-0.01
Talus	Bd	0.01
Talus	Bd	0.02
Metacarpal	Bp	-0.06
Metacarpal	Bp	-0.01
Metacarpal	Bd	-0.07
Metacarpal	Bd	-0.07
Metacarpal	Bd	-0.05
Metatarsal	Bd	0.03

Table 47bii. Elements included in Ovis Log Ratio Diagam for Length Indices from Iron Age Sos Höyük.

Table 47c. Elements included in *Ovis* Log Ratio Diagam for Breadth Indices from Iron Age Büyüktepe Höyük.

Table 48ai. Elements included in *Capra* Log Ratio Diagam for Breadth Indices from Early Bronze Age Sos Höyük.

Table 48aii.

ELEMENT	MEASUREMENT	LOG RATIO
Talus	GLl	-0.12
Talus	GLl	-0.11
Talus	GLl	-0.09
Talus	GLl	-0.04
Talus	GLl	-0.02
Talus	GLl	-0.02
Talus	GLl	-0.01
Talus	GLl	0.00
Talus	GLl	0.02
Phalanx 1	GLPe	-0.06
Phalanx 1	GLPe	-0.06
Phalanx 1	GLPe	-0.05
Phalanx 1	GLPe	-0.03
Phalanx 1	GLPe	-0.01

Table 48b.

ELEMENT	MEASUREMENT	LOG RATIO
Radius	Bp	-0.08
Radius	Bp	-0.08
Radius	Bp	-0.07
Radius	Bp	-0.06
Radius	Bp	-0.05
Radius	Bp	-0.02
Radius	Bp	0.00
Radius	Bp	0.00
Talus	Bd	-0.07
Metacarpal	Bp	-0.07
Metacarpal	Bd	-0.02

Table 48aii. Elements included in *Capra* Log Ratio Diagam for Length Indices from Early Bronze Age Sos Höyük.

Table 48b. Elements included in *Capra* Log Ratio Diagram for Breadth Indices from Iron Age Sos Höyük

Table 49a. *Ovis* Withers Heights from Early Bronze Age Sos Höyük

		GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
ELEMENT	NUMBER	RANGE	FACTOR	RANGE	MEAN	S
Metacarpal	7	129.9-142.5	4.89	62.84-69.68	66.32	2.66
Metatarsal	2	133.5;135.5	4.54	60.61;61.52	-	-
TOTAL	**9**			**60.61-69.68**	**65.16**	**3.28**

Table 49b. *Ovis* Withers Heights from Iron Age Sos Höyük

		GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
ELEMENT	NUMBER	RANGE	FACTOR	RANGE	MEAN	S
Humerus	4	121.5-142.2	4.24	51.5-60.7	57.10	4.32
Radius	3	150.5-154.0	3.96	59.6-61.9	60.75	-
Metacarpal	1	115.7	4.85	56.1	-	-
TOTAL	8			**51.5-61.9**	**58.38**	3.56

Table 49c. *Ovis* Withers Heights from Iron Age Büyüktepe Höyük

		GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
ELEMENT	NUMBER	RANGE	FACTOR	RANGE	MEAN	S
Radius	1	151.0	4.02	60.7	-	-
Metacarpal	3	117.0-133.0	4.89	57.21-65.04	61.7	-
Metatarsal	4	132.5-141	4.54	60.16-69.78	65.84	4.62
TOTAL	**8**			**57.21-69.78**	**63.65**	**4.41**

Table 49d. *Ovis* Withers Heights from Comparative Sites.

Table 49di. *Ovis* Withers Heights from Neolithic Fikirtepe

		GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
ELEMENT	NUMBER	RANGE	FACTOR	RANGE	MEAN	S
Humerus	1	137.0	4.28	58.64	-	-
Radius	3	136.5-148.5	4.02	54.87-59.70	57.35	-
Metacarpal	2	135.0;136.0	4.89	66.02-66.50	-	-
Metatarsal	4	126-139.5	4.54	57.20-63.30	60.84	2.59
TOTAL	10			**54.87-66.50**	**60.65**	**3.82**

Table 49dii. *Ovis* Withers Heights from Chalcolithic Hassek Höyük

		GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
ELEMENT	NUMBER	RANGE	FACTOR	RANGE	MEAN	S
Metacarpal	1	140.0	4.89	68.5		-
Metatarsal	1	163.0	4.54	74.0	-	-
TOTAL	**2**	**140.0;163.0**		**68.5;74.0**	**71.25**	**-**

Table 49d) cont.

Table 49diii. *Ovis* Withers Heights from Early Bronze Age Hassek Höyük

ELEMENT	NUMBER	GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
		RANGE	FACTOR	RANGE	MEAN	S
Radius	2	169.0;172.0	4.02	67.9;69.1	-	
Metatarsal	2	147.0;162.0	4.54	66.7;73.5		-
TOTAL	**4**			**67.9-73.5**	**69.3**	**2.97**

Table 49div. *Ovis* Withers Heights from Early Bronze Age Lidar Höyük

ELEMENT	NUMBER	GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
		RANGE	FACTOR	RANGE	MEAN	S
Metacarpal	**2**	**130.0-131.0**	**4.89**	**63.6-64.1**	**63.9**	

Table 49dv. *Ovis* Withers Heights from Middle Bronze Age Korucutepe

ELEMENT	NUMBER	GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
		RANGE	FACTOR	RANGE	MEAN	S
Radius	2	146.0;152.5	4.02	58.69;61.31	-	-
Metatarsus	3	126.0-140.5	4.54	57.2-63.79	59.85	-
TOTAL	**5**			**57.2-63.79**	**59.91**	**2.63**

Table 49dvi. *Ovis* Withers Heights from Middle Bronze Age Lidar Höyük

ELEMENT	NUMBER	GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
		RANGE	FACTOR	RANGE	MEAN	S
Metacarpal	**6**	**126.0-147.5**	**4.89**	**61.61-72.13**	**66.71**	**4.13**

Table 49dvii. *Ovis* Withers Heights from Late Bronze Age Korucutepe

ELEMENT	NUMBER	GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
		RANGE	FACTOR	RANGE	MEAN	S
Humerus	1	168	4.28	71.90	-	
Radius	1	180	3.96	71.28		-
Metacarpal	2	117.5;130.0	4.89	57.46;63.57	-	-
Metatarsal	4	126.0-154.0	4.55	57.33-70.07	61.65	5.86
TOTAL	**8**			**57.33-71.90**	**63.85**	**6.36**

Table 49dviii. *Ovis* Withers Heights from Late Bronze Age Lidar Höyük

ELEMENT	NUMBER	GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
		RANGE	FACTOR	RANGE	MEAN	S
Metacarpal	1	111.5	4.89	54.50	-	-
Metatarsal	2	149.0;167.5	4.54	67.65;76.05	-	-
TOTAL	**3**			**54.50-76.05**	**66.07**	**-**

Table 49dix. *Ovis* Withers Heights from Iron Age Lidar Höyük

ELEMENT	NUMBER	GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
		RANGE	FACTOR	RANGE	MEAN	S
Metacarpal	4	121.5-137.0	4.89	59.41-66.99	62.8	3.43
Metatarsal	1	151.0	4.54	68.60	-	-
TOTAL	**5**			**59.41-68.60.**	**65.70**	**3.95**

Table 50a. *Capra* Withers Heights from Early Bronze Age Sos Höyük

ELEMENT	NUMBER	GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
		RANGE	FACTOR	RANGE	MEAN	S
Metacarpal	**1**	**105.9**	**5.75**	**60.89**	**-**	**-**

Table 50b. *Capra* Withers Heights from Iron Age Büyüktepe Höyük

ELEMENT	NUMBER	GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
		RANGE	FACTOR	RANGE	MEAN	S
Metatarsal	**1**	**117.5**	**5.34**	**62.70**	**-**	**-**

Table 50c. *Capra* Withers Heights from Comparative Sites.

Table 50ci. *Capra* Withers Heights from Early Chalcolithic Çavi Tarlası

ELEMENT	NUMBER	GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
		RANGE	FACTOR	RANGE	MEAN	S
Metacarpal	**1**	**108.5**	**5.75**	**63.29**	**-**	**-**

Table 50c) cont.

Table 50cii. *Capra* Withers Heights from Chalcolithic Hassek Höyük

		GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
ELEMENT	NUMBER	RANGE	FACTOR	RANGE	MEAN	S
Metacarpal	**1**	**108.0**	**5.75**	**62.10**	**-**	**-**

Table 50ciii. *Capra* Withers Heights from Early Bronze Age Hassek Höyük

		GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
ELEMENT	NUMBER	RANGE	FACTOR	RANGE	MEAN	S
Radius	4	142.0-158.0	3.98	56.50-62.90	58.80	2.85
Metacarpal	4	99.0-118.0	5.75	56.90-67.90	62.33	5.14
Metatarsal	4	106.0-113.5	5.34	56.60-60.60	57.93	1.81
TOTAL	**12**			**56.50-67.90**	**59.63**	**3.78**

Table 50civ *Capra* Withers Heights from Early Hititte/Early Bronze Age Ikiztepe

		GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
ELEMENT	NUMBER	RANGE	FACTOR	RANGE	MEAN	S
Metatarsal	**1**	**112.7**	**5.34**	**60.18**	**-**	**-**

Table 50cv. *Capra* Withers Heights from Early Bronze Age Korucutepe

		GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
ELEMENT	NUMBER	RANGE	FACTOR	RANGE	MEAN	S
Metatarsal	**1**	**126.5**	**5.34**	**67.55**	**-**	**-**

Table 50cvi. *Capra* Withers Heights from Early Bronze Age Lidar Höyük

		GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
ELEMENT	NUMBER	RANGE	FACTOR	RANGE	MEAN	SD
Radius	1	152.0	3.98	60.50	-	-
Metacarpal	1	102.0	5.75	58.70	-	-
Metatarsal	2	114.0-130.0	5.34	60.90;69.40	-	-
TOTAL	**4**		**-**	**60.50-69.40**	**62.38**	**4.78**

Table 50cvii. *Capra* Withers Heights from Middle Bronze Age Korucutepe

		GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
ELEMENT	NUMBER	RANGE	FACTOR	RANGE	MEAN	SD
Metacarpal	**2**	**99.0;102.5**	**5.75**	**56.93;58.94**	**-**	**-**

Table 50cviii. *Capra* Withers Heights from Middle Bronze Age Lidar Höyük

		GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
ELEMENT	NUMBER	RANGE	FACTOR	RANGE	MEAN	SD
Radius	1	146.5	3.98	58.31	-	-
Metacarpal	4	102.5-109.5	5.75	53.48-62.96	59.52	4.42
Metatarsal	3	105.0-111.0	5.34	56.07-59.27	57.49	1.63
TOTAL	8			**53.48-62.96**	**58.61**	**3.19**

Table 50cix. *Capra* Withers Heights from Late Bronze Age Korucutepe

		GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
ELEMENT	NUMBER	RANGE	FACTOR	RANGE	MEAN	SD
Metacarpal	5	101.0-110.0	5.75	58.08-63.25	60.72	1.99
Metatarsal	2	107.5;111.5	5.34	57.41;59.54		-
TOTAL	**7**			**57.41-63.25**	**60.08**	**2.05**

Table 50cx. *Capra* Withers Heights from Late Bronze Age Lidar

		GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
ELEMENT	NUMBER	RANGE	FACTOR	RANGE	MEAN	SD
Metatarsal	**1**	**126.0**	**5.34**	**67.28**	**-**	**-**

Table 50cxi. *Capra* Withers Heights from Late Bronze Age Lidar

		GREATEST LENGTH IN MM		WITHERS HEIGHTS IN CM		
ELEMENT	NUMBER	RANGE	FACTOR	RANGE	MEAN	SD
Metatarsal	**1**	**125.0**	**5.34**	**66.75**	**-**	**-**

Table 51a. *Ovis/Capra* Dental Data from Early Bronze Age Sos Höyük

DEVELOPMENTAL STAGE	AGE (Months)	AGE GROUPINGS	O/C	%	O	%	C	%
M1 not yet erupting	<6	<12	0	27.6	0	25.7	0	33.3
M1 erupting	6		3		2		1	
M1 in wear/ M2 not erupted	6-12		6		3		0	
M2 erupting	12		7		3		1	
M2 in wear/ M3 not erupting	12-18	12-24	10	22.4	4	20.0	0	0.0
M3 erupting	18-24		3		2		0	
M3 slightly worn	24-48	24-48	10	17.2	6	22.9	1	16.7
M3 medium worn	>48	>48	19	32.8	8	31.4	3	50.0
M3 heavily worn			0		0		0	
NO. OF SPECIMENS			**58**		**28**		**6**	

Table 51b. *Ovis/Capra* Dental Data from Iron Age Sos Höyük

DEVELOPMENTAL STAGE	AGE (Months)	AGE GROUPINGS	O/C	%	O	%	C	%
M1 not yet erupting	<6	<12	2	23.9	0	44.4	0	0.0
M1 erupting	6		2		2		0	
M1 in wear/ M2 not erupted	6-12		1		0		0	
M2 erupting	12		6		6		0	
M2 in wear/ M3 not erupting	12-18	12-24	2	21.7	0	16.7	0	50.0
M3 erupting	18-24		8		3		1	
M3 slightly worn	24-48	24-48	6	13.0	4	22.2	0	0.0
M3 medium worn	>48	>48	19	41.3	3	16.7	1	50.0
M3 heavily worn			0		0		0	
NO. OF SPECIMENS			**46**		**18**		**2**	

Table 51c. *Ovis/Capra* Dental Data from Iron Age Büyüktepe Höyük

DEVELOPMENTAL STAGE	AGE (Months)	AGE GROUPINGS	O/C	%	O	%
M1 not yet erupting	<6	<12	0	11.8	0	0.0
M1 erupting	6		1		0	
M1 in wear/ M2 not erupted	6-12		0		0	
M2 erupting	12		1		0	
M2 in wear/ M3 not erupting	12-18	12-24	4	29.4	4	55.6
M3 erupting	18-24		1		1	
M3 slightly worn	24-48	24-48	3	17.7	2	22.2
M3 medium worn	>48	>48	6	41.2	2	22.2
M3 heavily worn			1		0	
NO. OF SPECIMENS			**17**		**9**	

Table 51di. *Ovis/Capra* Dental Data from Comparative Sites (%)

DEVELOPMENTAL STAGE	AGE (Months)	AGE GROUPINGS	CHALC Hassek	EBA Hassek	EBA Hayaz	EBA Korucutepe	EBA Lidar	MBA Korucutepe	MBA Lidar	LBA Korucutepe	LBA Lidar	IA Lidar
M1 not yet erupting	<6	<12	17.7	26.7	25.7	18.8	20.8	19.2	23.3	18.6	21.8	23.4
M1 erupting	6											
M1 in wear/ M2 not erupted	6-12											
M2 erupting	12											
M2 in wear/ M3 not erupting	12-18	12-24	17.7	17.8	15.7	6.3	20.8	23.1	20.7	22.0	17.3	15.3
M3 erupting	18-24											
M3 slightly worn	24-48	24-48	38.2	35.6	37.1	37.5	37.8	34.6	34.5	23.7	41.8	31.5
M3 medium worn	>48	>48	26.5	20.0	21.4	37.5	20.8	23.1	21.6	35.6	19.1	29.7
M3 heavily worn												

Table 51dii. *Ovis/Capra* Dental Data from Comparative Sites (%)

DEVELOPMENTAL STAGE	EBA Demircihüyük	MBA Demircihüyük	EBA Sos	IA Sos	IA Büyüktepe
M1 not yet erupting	17.8	19.0	15.5	10.9	5.9
M1 erupting					
M1 in wear/ M2 not erupted					
M2 erupting	27.0	31.0	29.3	17.4	29.4
M2 in wear/ M3 not erupting					
M3 erupting	33.6	22.4	22.4	30.4	23.5
M3 slightly worn					
M3 medium worn	21.6	27.6	32.8	41.3	41.2
M3 heavily worn					

Table 52ai) *Ovis/Capra* Epiphyseal Fusion Data from Early Bronze Age Sos Höyük

GROUP 1 (8-10 Months)

	O/C		O		C	
ELEMENT	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED
Dist. Scapula	44	1	7	0	6	0
Pelvis	13	4	3	0	4	0
Prox. Radius	34	2	9	0	6	0
Dist. Humerus	31	4	15	1	4	0
TOTAL	**122 (91.7%)**	**11 (8.3%)**	**34 (97.1%)**	**1 (2.9%)**	**20 (100.0%)**	**0**

GROUP 2 (12-24 Months)

	O/C		O		C	
ELEMENT	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED
Prox. Phalanx 1	29	9	18	7	5	0
Prox. Phalanx 2	11	1	7	1	3	0
Dist. Tibia	30	10	0	0	0	0
Dist. Metacarpal	16	11	12	1	2	1
Dist. Metatarsal	9	4	6	0	0	1
Dist. Metapodial	7	8	3	4	0	0
TOTAL	**102 (70.3%)**	**43 (29.7%)**	**46 (78.0%)**	**13 (22.0%)**	**10 (83.3%)**	**2 (16.7%)**

GROUP 3 (30-36 Months)

	O/C		O		C	
ELEMENT	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED
Prox. Ulna	4	3	3	3	0	0
Prox. Femur	6	14	2	3	2	1
Calcaneus	12	3	12	3	0	0
TOTAL	**22 (52.4%)**	**20 (47.6%)**	**17 (65.4%)**	**9 (34.6%)**	**2 (66.7%)**	**1 (33.3%)**

GROUP 4 (36-42 Months)

	O/C		O		C	
ELEMENT	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED
Prox. Humerus	0	5	0	1	0	0
Prox. Tibia	3	5	0	0	0	0
Dist. Radius	6	13	3	2	1	1
Dist. Femur	3	6	1	2	0	0
TOTAL	**9 (23.7%)**	**29 (76.3%)**	**4 (44.4%)**	**5 (55.6%)**	**1 (50.0%)**	**1 (50.0%)**

Table 52aii. Ratio of *Ovis* to *Capra* based upon the Number of Fused Specimens for each Epiphyseal Fusion Group

FUSION GROUP	*Ovis* :*Capra*
1	1.70:1
2	4.00:1
3	8.50:1
4	4.00:1

Table 52bi) *Ovis/Capra* Epiphyseal Fusion Data from Iron Age Sos Höyük

GROUP 1 (8-10 Months)

	O/C		O		C	
ELEMENT	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED
Dist. Scapula	23	9	11	6	0	0
Pelvis	14	16	11	0	1	0
Prox. Radius	33	11	8	1	8	0
Dist. Humerus	43	10	27	0	1	0
TOTAL	**113 (71.1%)**	**46 (28.9%)**	**57 (89.1%)**	7 (10.9%)	**10 (100.0%)**	**0**

GROUP 2 (12-24 Months)

	O/C		O		C	
ELEMENT	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED
Prox. Phalanx 1	47	35	38	27	4	0
Prox. Phalanx 2	36	9	24	9	12	0
Dist. Tibia	20	18	0	0	0	0
Dist. Metacarpal	6	9	5	0	1	0
Dist. Metatarsal	8	5	7	3	0	0
Dist. Metapodial	5	28	0	2	0	0
TOTAL	**122 (54.0%)**	**104 (46.0%)**	**74 (64.4%)**	**41 (35.6%)**	**17 (100.0%)**	**0**

GROUP 3 (30-36 Months)

	O/C		O		C	
ELEMENT	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED
Prox. Ulna	7	9	4	1	1	0
Prox. Femur	11	22	5	4	0	0
Calcaneus	6	12	5	2	0	0
TOTAL	24 (35.8%)	43 (64.2%)	14 (66.7%)	7 (33.3%)	1 (100.0%)	0

GROUP 4 (36-42 Months)

	O/C		O		C	
ELEMENT	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED
Prox. Humerus	10	31	6	5	0	0
Prox. Tibia	7	17	0	0	0	0
Dist. Radius	11	17	7	2	1	0
Dist. Femur	10	21	6	3	0	0
TOTAL	38 (30.7%)	86 (69.3%)	19 (65.5%)	10 (34.5%)	1 (100.0%)	0

Table 52bii. Ratio of *Ovis* to *Capra* based upon the Number of Fused Specimens for each Epiphyseal Fusion Group

FUSION GROUP	*Ovis :Capra*
1	5.7:1
2	4.0:1
3	14.0:1
4	19.0:1

Table 52c) *Ovis/Capra* Epiphyseal Fusion Data from Iron Age Büyüktepe Höyük

GROUP 1 (8-10 Months)

	O/C		O		C	
ELEMENT	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED
Dist. Scapula	5	0	1	0	0	0
Pelvis	4	2	3	0	0	0
Prox. Radius	7	0	5	0	0	0
Dist. Humerus	11	1	7	0	0	0
TOTAL	**27 (90.0%)**	**3 (10.0%)**	**16 (100.0%)**	**0**	**0**	**0**

GROUP 2 (12-24 Months)

	O/C		O		C	
ELEMENT	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED
Prox. Phalanx 1	19	1	11	1	2	0
Prox. Phalanx 2	3	1	2	1	1	0
Dist. Tibia	5	1	0	0	0	0
Dist. Metacarpal	3	3	3	3	0	0
Dist. Metatarsal	6	2	5	2	0	0
Dist. Metapodial	2	1	1	1	0	0
TOTAL	**38 (80.9%)**	**9 (19.1%)**	**22 (73.3%)**	**8 (26.7%)**	**3 (100.0%)**	**0**

GROUP 3 (30-36 Months)

	O/C		O		C	
ELEMENT	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED
Prox. Ulna	0	1	0	1	0	0
Prox. Femur	0	5	0	1	0	0
Calcaneus	0	2	0	2	0	0
TOTAL	**0**	8 (100.0%)	**0**	4 (100.0%)	**0**	**0**

GROUP 4 (36-42 Months)

	O/C		O		C	
ELEMENT	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED	NO. FUSED	NO. UNFUSED
Prox. Humerus	0	5	0	5	0	0
Prox. Tibia	1	4	0	0	0	0
Dist. Radius	1	6	0	3	0	0
Dist. Femur	1	3	0	2	0	0
TOTAL	**3 (14.3%)**	**18 (85.7%)**	**0**	**10 (100.0%)**	**0**	**0**

Table 53. Estimated Ages for Fœtal Ovicaprid Specimens from Iron Age Sos Höyük

ELEMENT	REG NO.	TRENCH	LOCUS	DIAPHYSEAL LENGTH (CM)	AGE (Days)
Humerus	7.2661	L16	1701	3.2	97.4
Tibia	7.2667	L16	1701	4.6	97.9
Radius	7.2662	L16	1701	3.6	98.9
*Scapula	7.2659	L16	1701	3.0	90-100
*Ulna	7.1573	L16	1715	4.0	90-100
Metacarpal	7.2670.	L16	1701	3.5	101.6
Metacarpal	7.0399	L16	1721	3.6	102.5
Metacarpal	7.2675	L16	1701	3.5	101.5
*Ulna	7.2664	L16	1701	3.9	[100]
Humerus	7.0783	L16	1701	4.6	114.7
Metacarpal	7.0786	L16	1701	4.7	115.2
Metacarpal	7.2668	L16	1701	4.7	115.6
Metatarsal	7.2669	L16	1701	5.0	116.8
Femur	7.2308	L16	1701	5.4	117.7
Tibia	7.6666	L16	1701	6.9	119.4
Tibia	7.2340.	L16	1701	7.0	120.0
Radius	7.2233	L16	1701	5.4	123.6
Metatarsal	7.2671	L16	1701	6.0	127.2
Metatarsal	7.2673	L16	1701	6.0	127.4
Humerus	7.2226	L16	1701	4.9	131.1
Radius	7.1235	J14	2507	6.1	132.6
Humerus	7.1664	L16	1701	6.0	133.6
Femur	7.1699	L16	1701	6.9	134.3
Femur	7.1698	L16	1701	6.9	134.4
Humerus	7.1665	L16	1701	6.0	134.5
Femur	7.1517	L16	1704	6.9	134.9
Radius	7.0053	L16	1704	6.2	135.5
Radius	7.0154	L16	1704	6.3	135.6
Tibia	7.0056	L16	1704	8.6	136.7
Radius	7.1669	L16	1701	6.5	140.2
Radius	7.1668	L16	1701	6.6	140.5
Tibia	7.1703	L16	1701	9.1	142.7

Table 54a. *Sus* Dental Data from Iron Age Büyüktepe Höyük

DEVELOPMENTAL STAGE	AGE (Months)	*Sus*
M1 not erupting/p2-p4 present	<6	0
M1 erupting	6	1
M1 in wear/M2 not erupting	6-12	1
M2 erupting	12	1
M2 in wear/M3 not erupting	12-18	1
M3 erupting	18-21	1
M3 in primary wear	24-36	1
M3 in secondary wear	>36	0
M3 in tertiary		0
NUMBER OF SPECIMENS		**6**

Table 54b. *Sus* Dental Data from Iron Age Lidar Höyük

DEVELOPMENTAL STAGE	AGE (Months)	*Sus*
M1 not erupting/p2-p4 present	<6	11
M1 erupting	6	6
M1 in wear/M2 not erupting	6-12	10
M2 erupting	12	4
M2 in wear/M3 not erupting	12-18	16
M3 erupting	18-21	7
M3 in primary wear	24-36	6
M3 in secondary wear	>36	2
M3 in tertiary		1
NUMBER OF SPECIMENS		**63**

Table 55.

ABBREVIATION	ELEMENT
MAX	Maxilla
MAND	Mandible
SCAP	Scapula
HUM	Humerus
RAD	Radius
CARPAL	Carpus
MTC	Metacarpal
PELVIS	Pelvis
FEM	Femur
TIB	Tibia
TALUS	Talus
CALC	Calcaneus
MTT	Metatarsal
P1	Phalanx 1
P3	Phalanx 3

Table 56.

Table 56a) Early Bronze Age Sos Höyük

SPECIES	No.	%
Bos	2	0.2
Ovis /Capra	54	4.0

Table 56b) Iron Age Sos Höyük

SPECIES	No.	%
Bos	4	0.8
Ovis /Capra	37	2.2

Table 56c) Iron Age Büyüktepe Hoyuk

SPECIES	No.	%
Equus caballus	2	3.6
Ovis /Capra	10	2.0

Table 55. Elements for Skeletal Part Representation

Table 56. Frequency of Pathology in the Assemblages.

FIGURES

Figure 1. Map of Turkey Showing the Location of the Sites of Sos Höyük (1) and Büyüktepe Höyük (2).

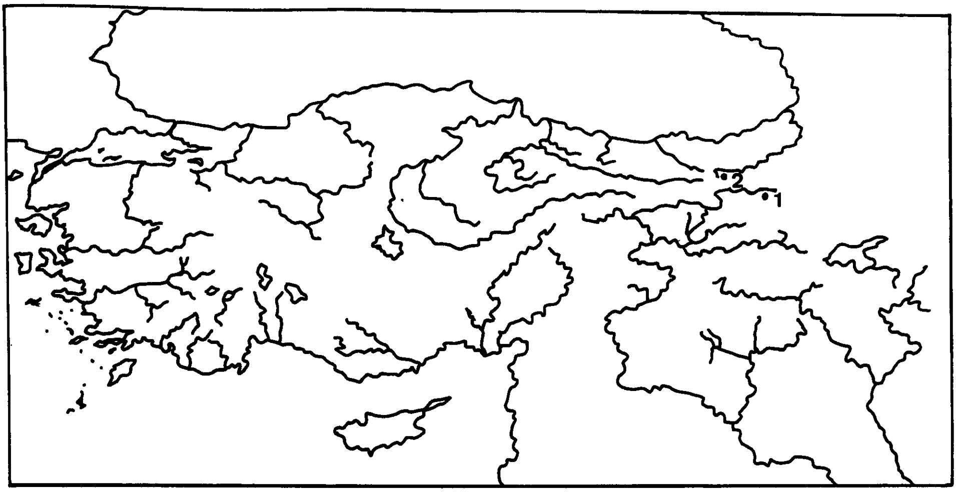


Figure 2. Map of Erzurum Plain: Sos Höyük (1); Pasinler (2); Erzurum (3); Ilica (4).

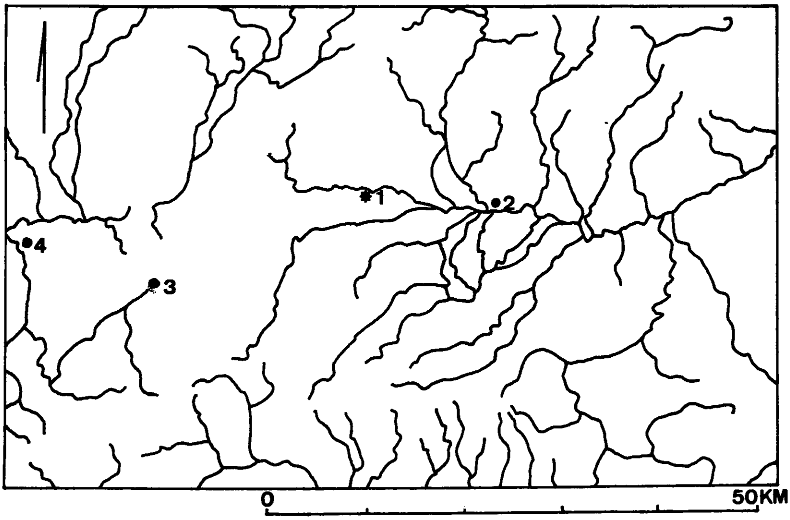


Figure 3. Map of Bayburt Plain: Büyüktepe Höyük (1); Ciftetas (2); Bayburt (3); Gümüshane (4).

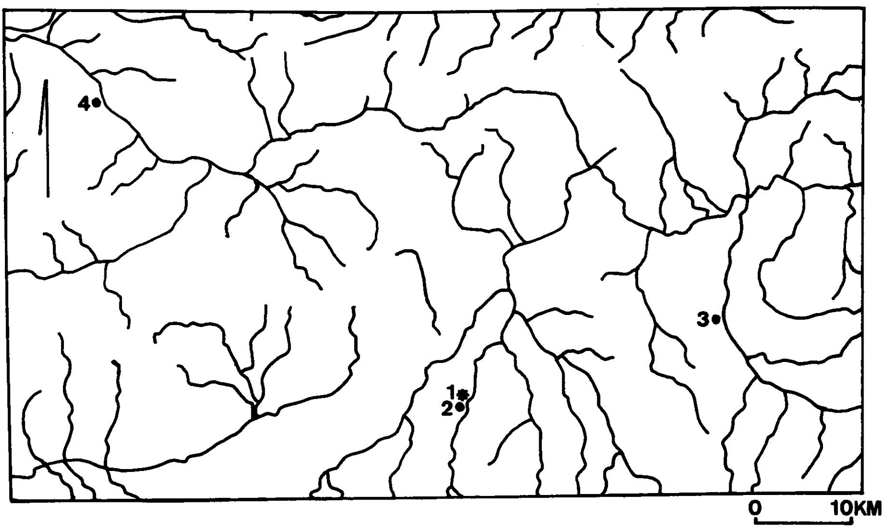


Figure 4. The Site of Sos Höyük. (Photograph by A. Sagona)

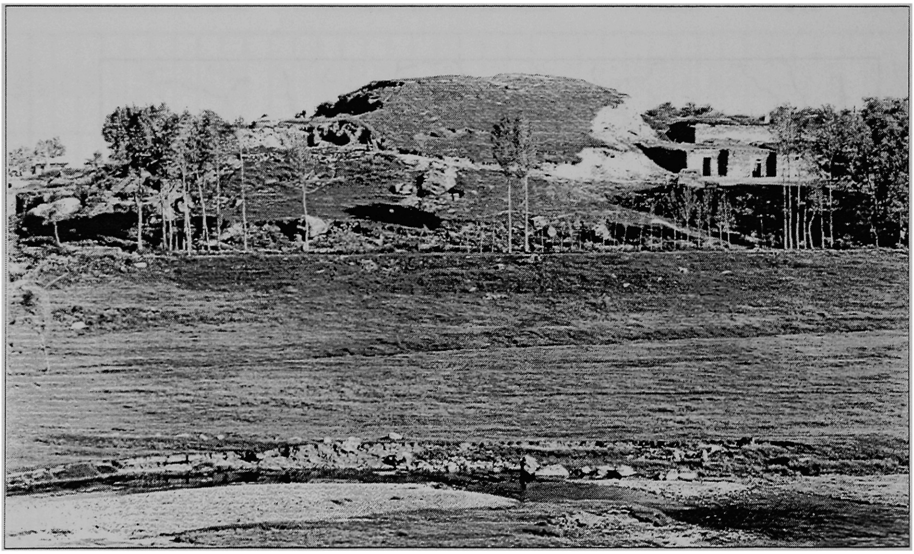


Figure 5. The Site of Büyüktepe Höyük. (Photograph by A. Sagona)

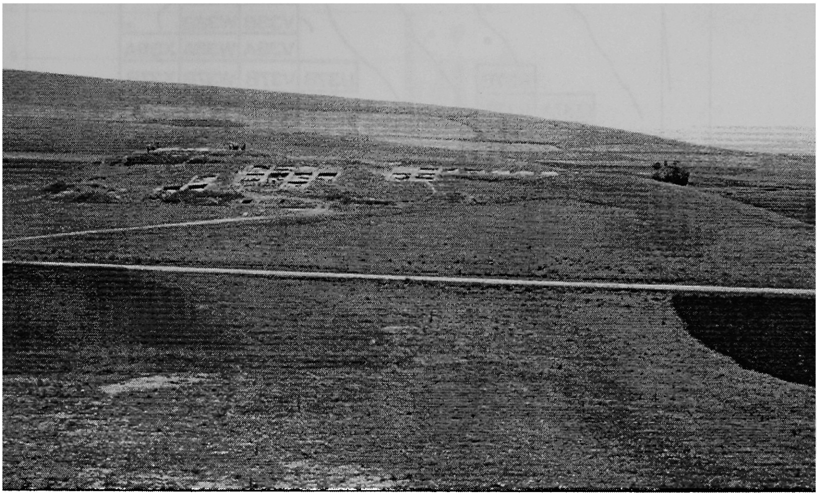


Figure 6. Site Plan of Sos Höyük, Contour Interval 2 metres, (adapted from Sagona, Sagona & Özkorucuklu 1995, Figure 2).

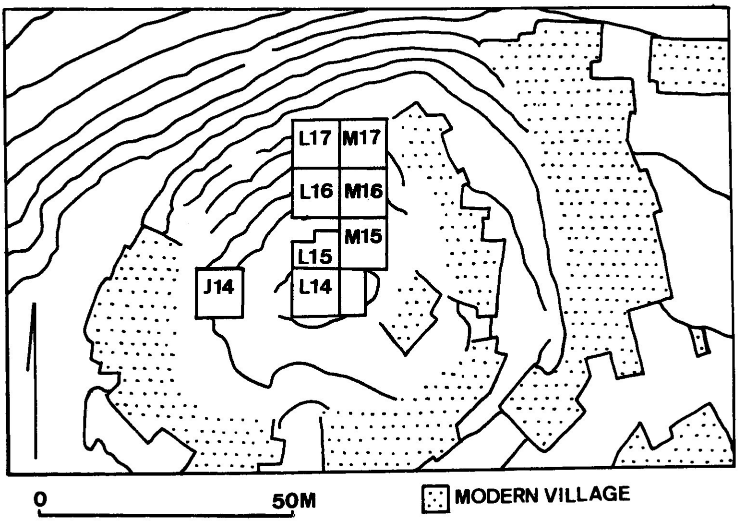


Figure 7. Site Plan of Büyüktepe Höyük, Contour Interval 2 metres, (adapted from Sagona, Sagona & Özkorucuklu 1993, Figure 1).

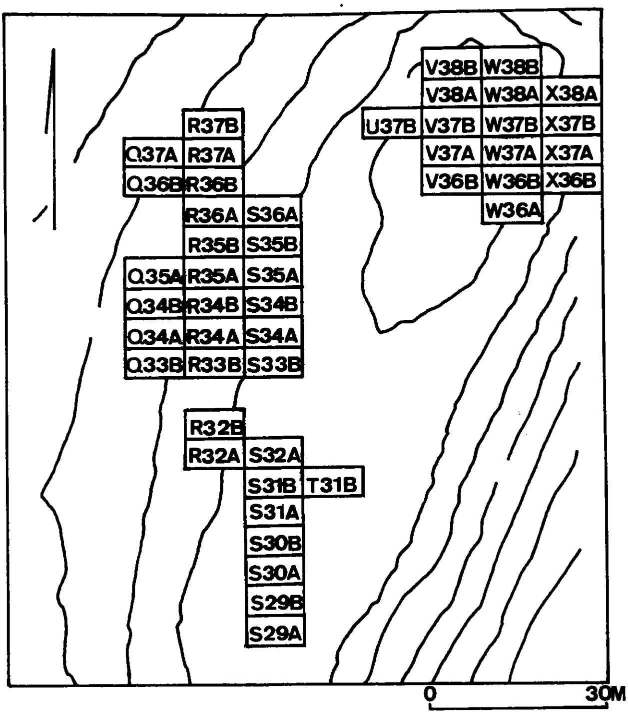


Figure 8. Map of Turkey showing Location of Main Comparative Sites used in the Current Study: Fikirtepe (1); Demircihüyük (2); Karatas-Semayük (3); Ikiztepe (4); Korucutepe (5); Gritille (6); Hassek Höyük (7); Cavi Tarlasi (8); Lidar Höyük (9); Hayaz Höyük (10).

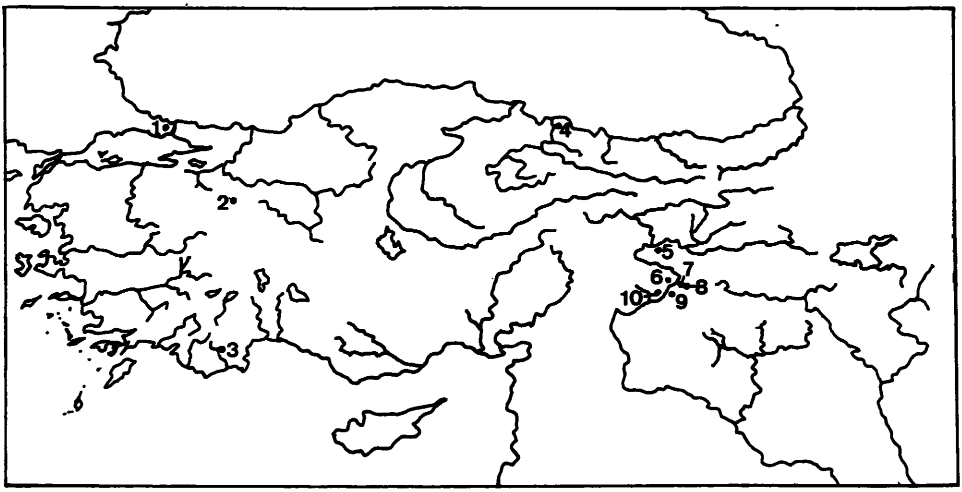


Figure 9a. Log Ratio Diagram of Breadth (N=76) and Length (N=64) Size Indices of *Bos* Specimens from Early Bronze Age Sos Höyük.

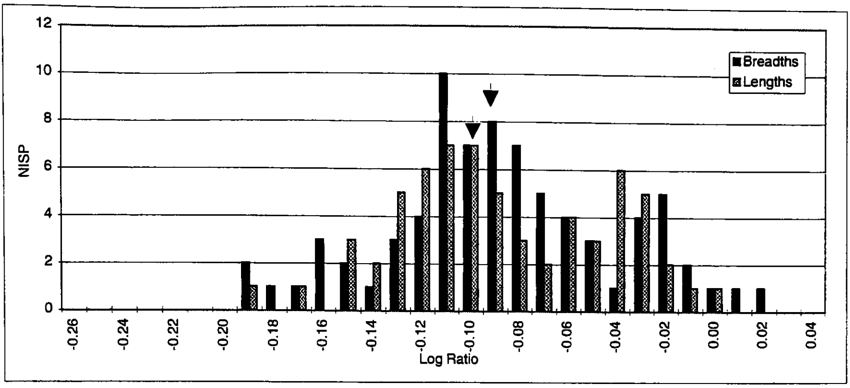


Figure 9b. Log Ratio Diagram of Breadth (N=41) and Length (N=23) Size Indices of *Bos* Specimens from Iron Age Sos Höyük.

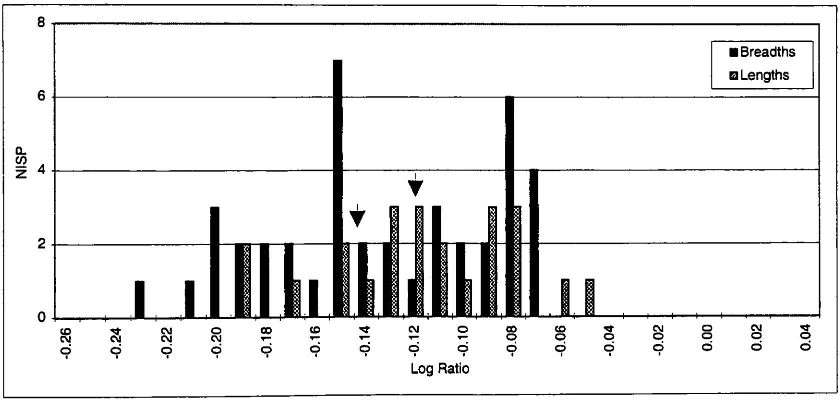


Figure 9c. Log Ratio Diagram of Breadth (N=19) and Length (N=10) Size Indices of *Bos* Specimens from Iron Age Büyüktepe Höyük.

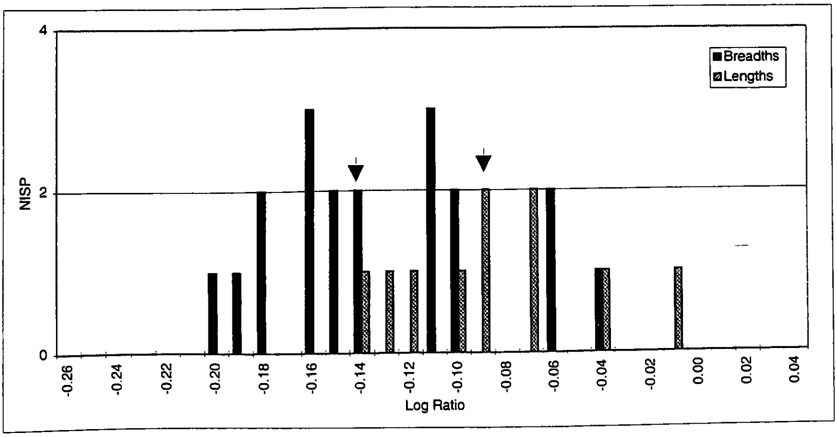


Figure 9di) Log Ratio Diagram of Breadth (N=26) and Length (N=11) Size Indices of *Bos* Specimens from Early Bronze Age Hassek Höyük.

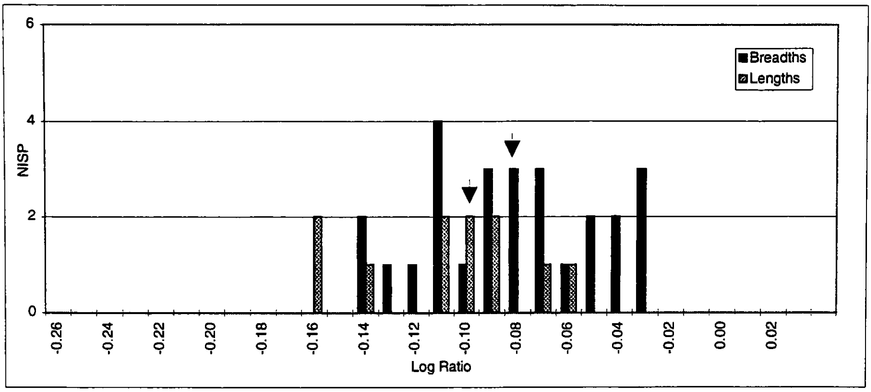


Figure 9dii) Log Ratio Diagram of Breadth Size Indices (N=9) of *Bos* Specimens from Early Bronze Age Lidar Höyük.

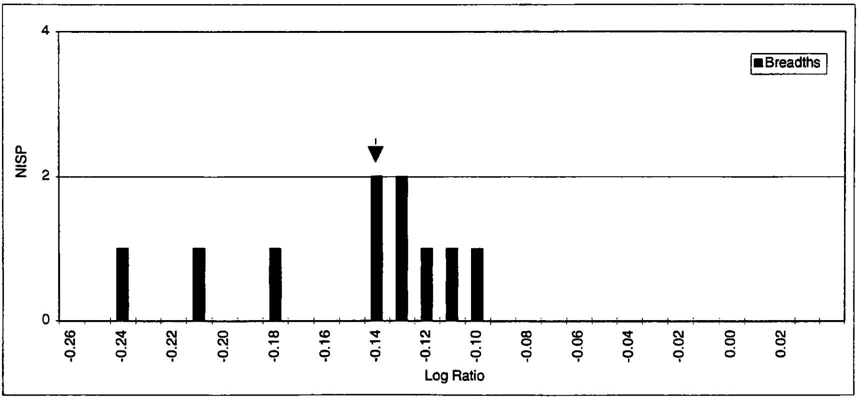


Figure 9diii) Log Ratio Diagram of Breadth (N=43) and Length (N=8) Size Indices of *Bos* Specimens from Middle Bronze Age Lidar Höyük.

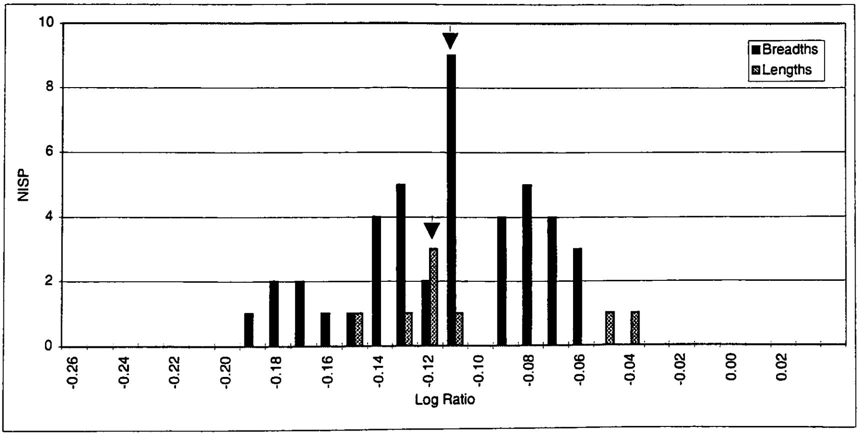


Figure 9div) Log Ratio Diagram of Breadth (N=20) and Length (N=27) Size Indices of *Bos* Specimens from Late Bronze Age Korucutepe.

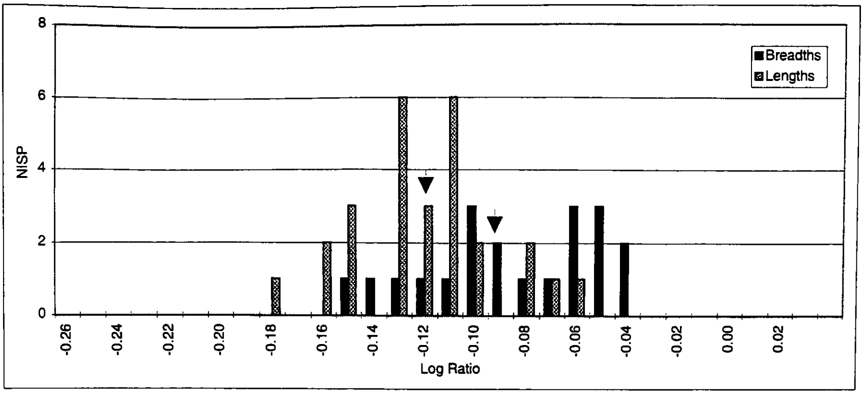


Figure 9dv) Log Ratio Diagram of Breadth Size Indices (N=43) of *Bos* Specimens from Late Bronze Age Lidar Höyük.

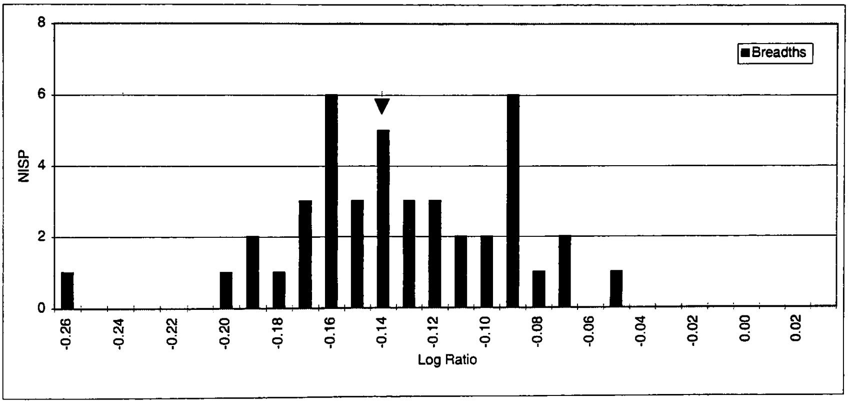


Figure 9dvi) Log Ratio Diagram of Breadth Size Indices (N=22) of *Bos* Specimens from Iron Age Lidar Höyük.

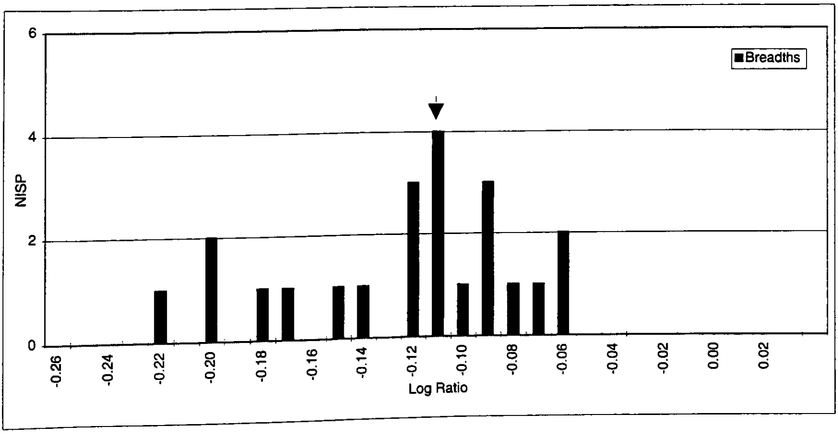


Figure 10. Greatest Length of the Lateral Half (GLl) by Greatest Breadth (Bd) of *Bos* Talus Bones from Early Bronze Age Sos Höyük (N=26)

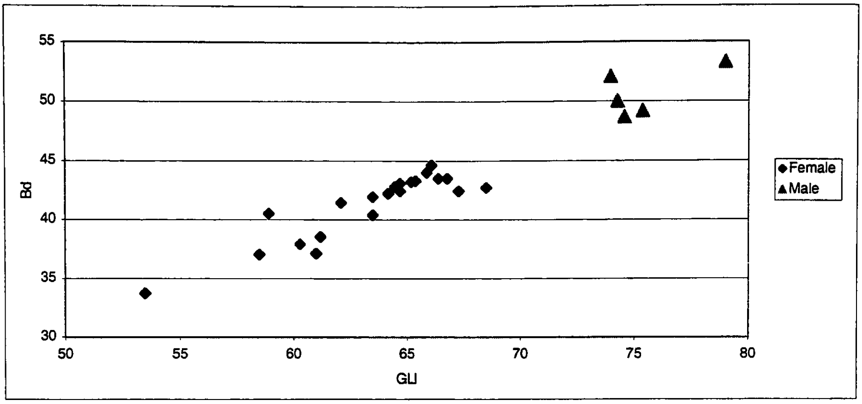


Figure 11a. Log Ratio Diagram of Breadth (N=120) and Length (N=34) Size Indices of *Ovis* Specimens from Early Bronze Age Sos Höyük.

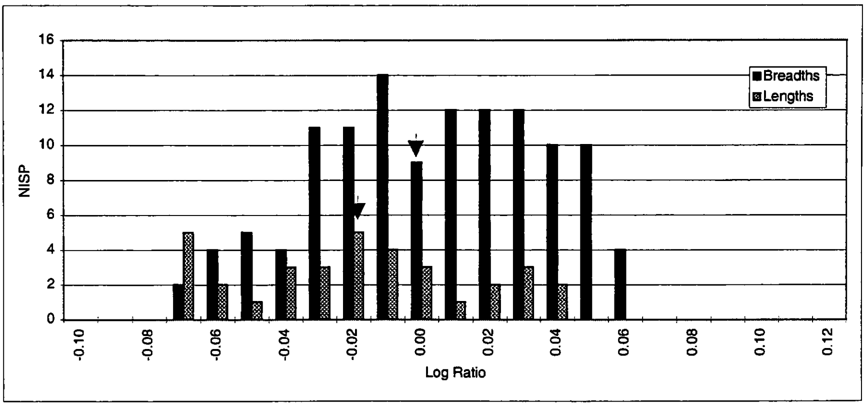


Figure 11b. Log Ratio Diagram of Breadth (N=120) and Length (N=34) Size Indices of *Ovis* Specimens from Iron Age Sos Höyük.

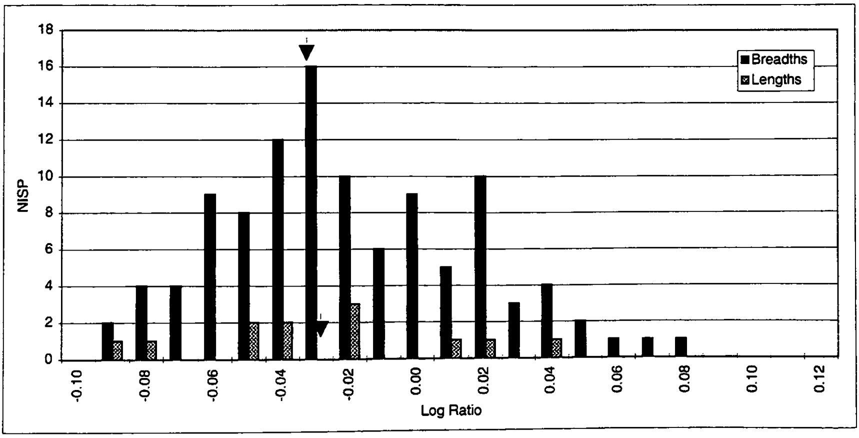


Figure 11c. Log Ratio Diagram of Breadth Size Indices (N=17) of *Ovis* Specimens from Iron Age Büyüktepe Höyük.

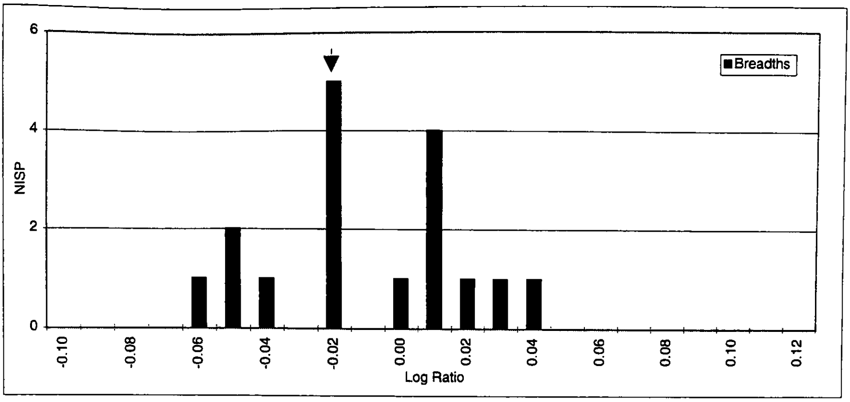


Figure 11di. Log Ratio Diagram of Breadth Size Indices (N=35) of *Ovis* Specimens from Chalcolithic Hassek Höyük.

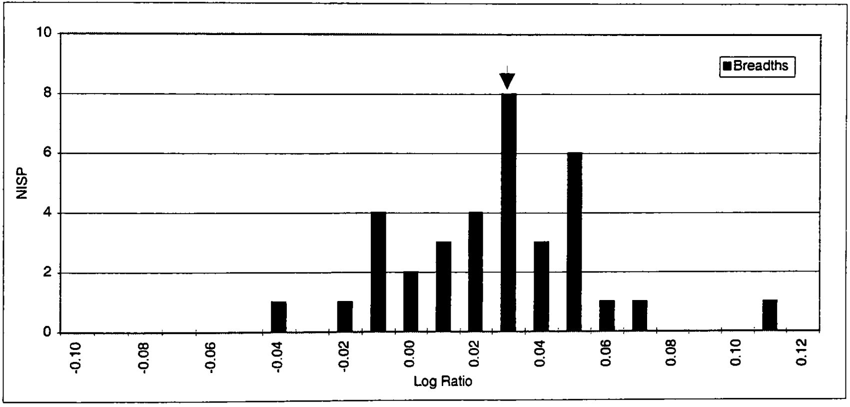


Figure 11dii. Log Ratio Diagram of Breadth (N=98) and Length (N=23) Size Indices of *Ovis* Specimens from Early Bronze Age Hassek Höyük.

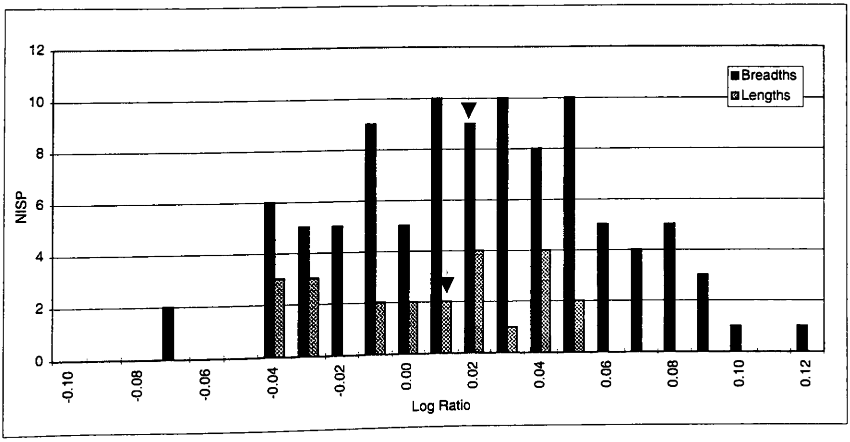


Figure 11diii. Log Ratio Diagram of Breadth Size Indices (N=18) of *Ovis* Specimens from Middle Bronze Age Korucutepe.

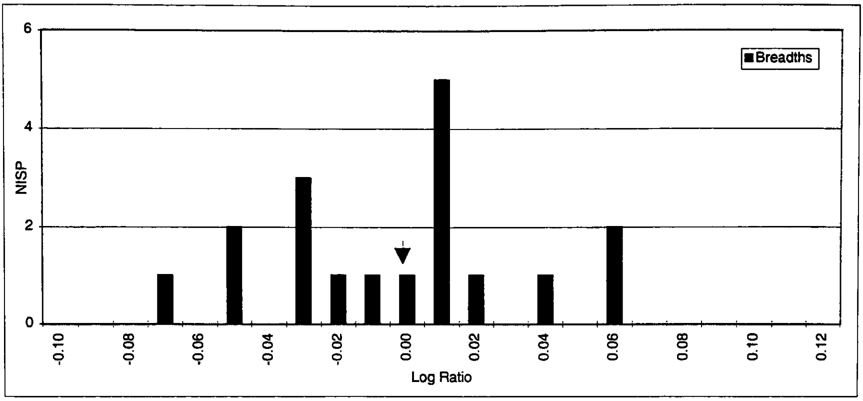


Figure 11div. Log Ratio Diagram of Breadth (N=60) and Length Size Indices (N=34) of *Ovis* Specimens from Late Bronze Age Korucutepe.

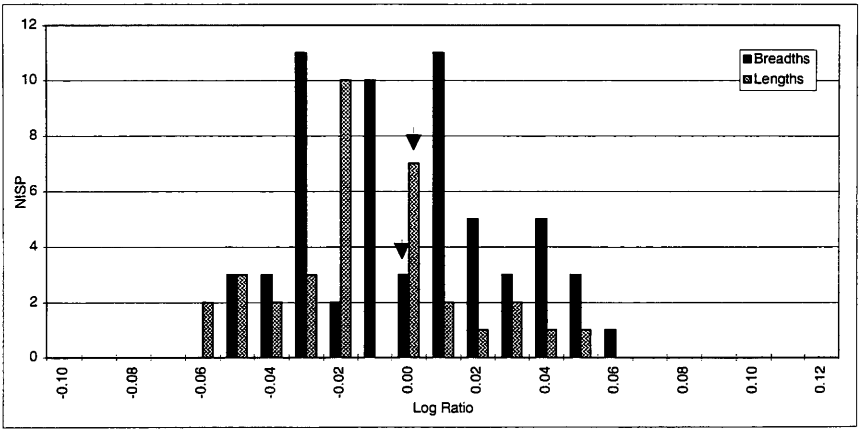


Figure 12a. Logarithm Ratio Diagram of Breadth (N=28) and Length (N=14) Size Indices of *Capra* Specimens from Early Bronze Age Sos Höyük.

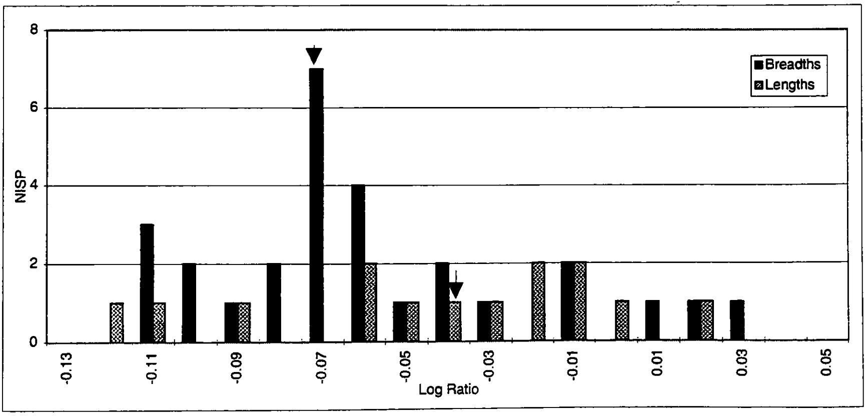


Figure 12b. Logarithm Ratio Diagram of Breadth Size Indices (N=11) of *Capra* Specimens from Iron Age Sos Höyük.

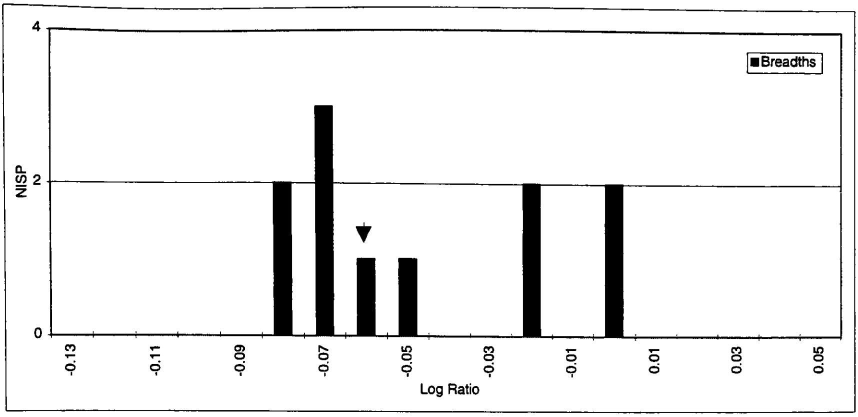


Figure 12ci. Logarithm Ratio Diagram of Breadth Size Indices (N=30) of *Capra* Specimens from Chalcolithic Hassek Höyük.

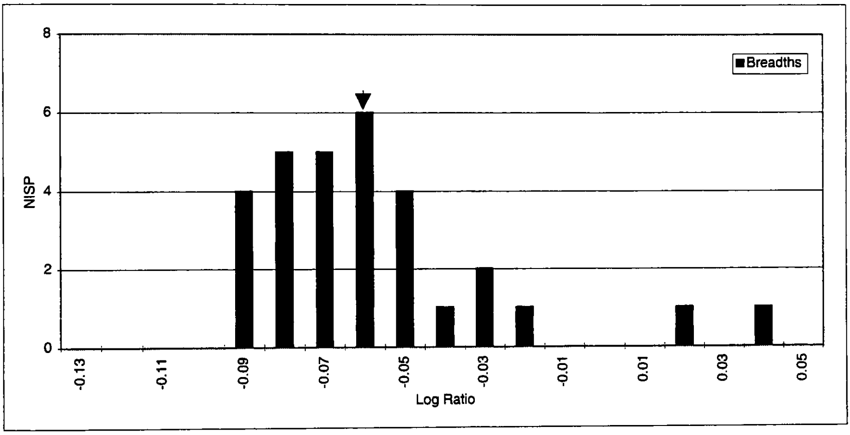


Figure 12cii. Logarithm Ratio Diagram of Breadth (N=119) and Length (N=21) Size Indices of *Capra* Specimens from Early Bronze Age Hassek Höyük.

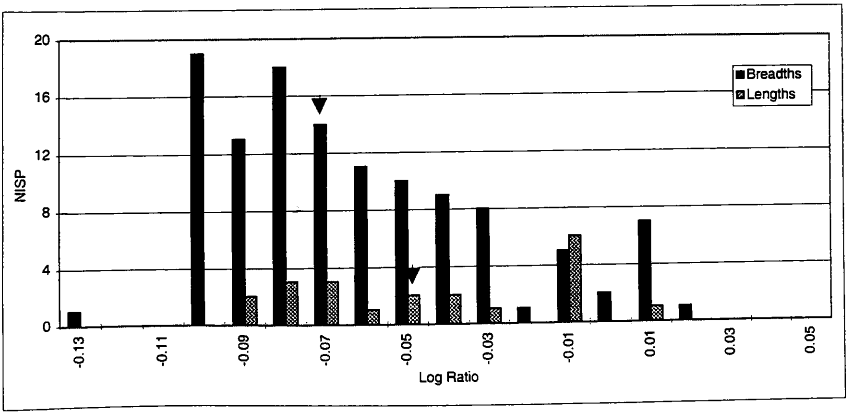


Figure 12ciii. Logarithm Ratio Diagram of Breadth Size Indices (N=11) of Domestic *Capra* Specimens from Middle Bronze Age Korucutepe.

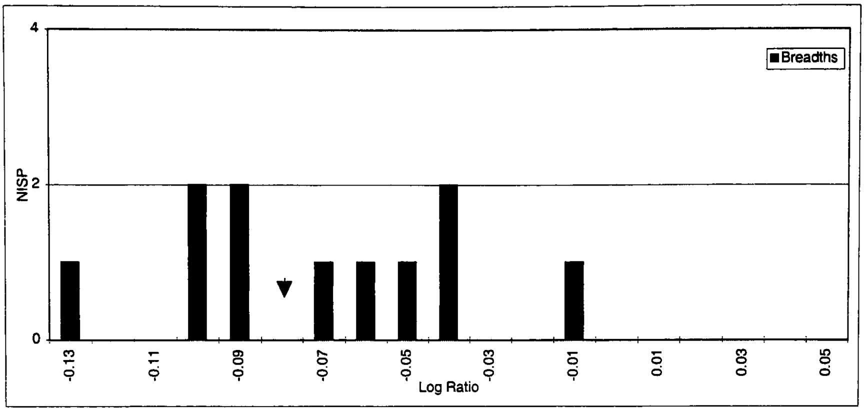


Figure 12civ. Logarithm Ratio Diagram of Breadth Size Indices (N=17) of Domestic *Capra* Specimens from Middle Bronze Age Lidar Höyük.

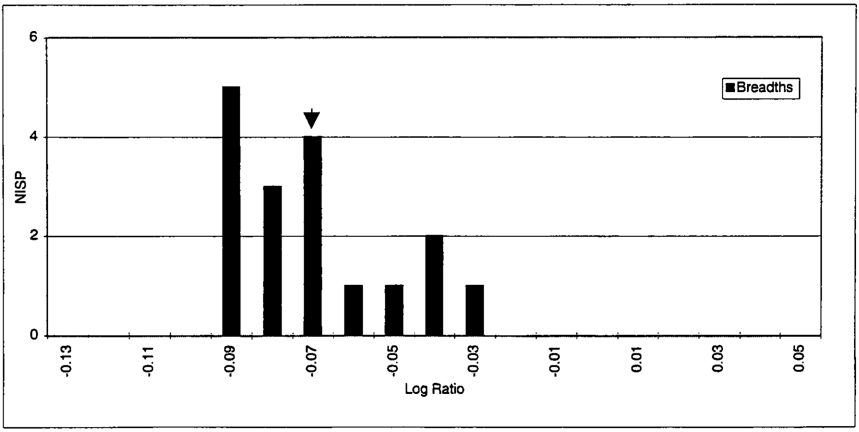


Figure 12cv. Logarithm Ratio Diagram of Breadth (N=42) and Length (N=19) Size Indices of Domestic *Capra* Specimens from Late Bronze Age Korucutepe.

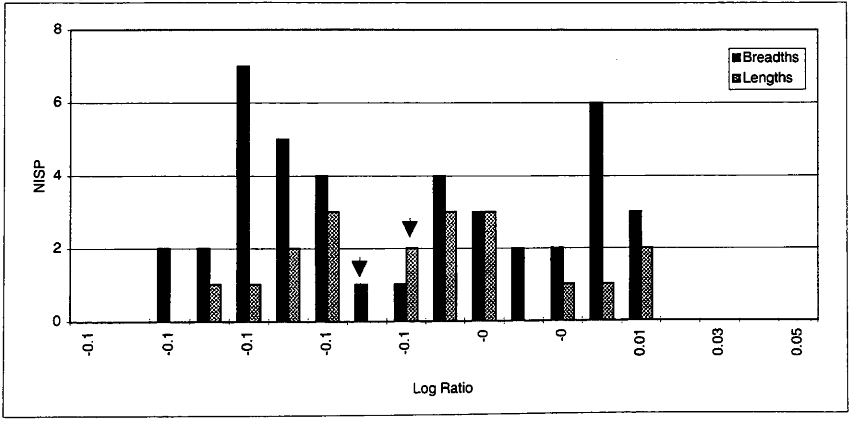


Figure 13. Relative Abundance of Domestic to Wild Taxa at Sos Höyük and Büyüktepe Höyük

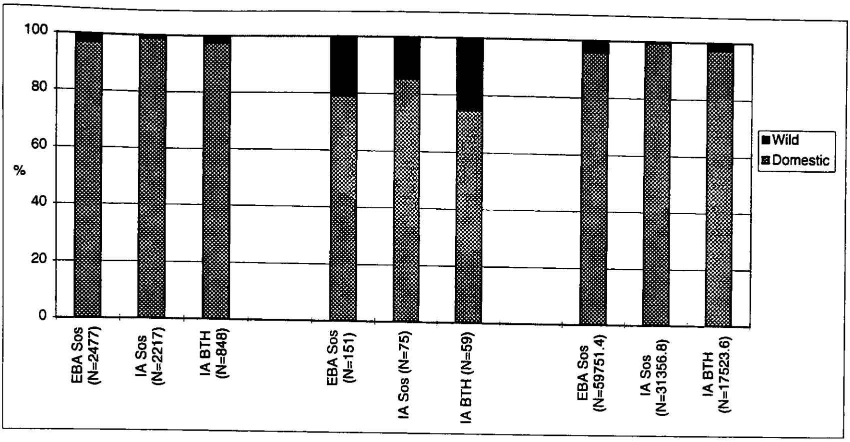


Figure 14a. Relative Abundance of the Main Domesticates from Sos Höyük and Büyüktepe Höyük (NISP)

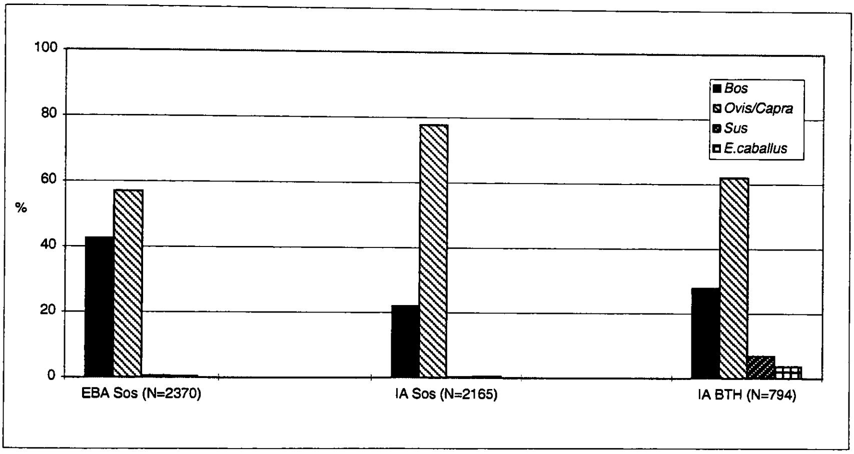


Figure 14b. Relative Abundance of the Main Domesticates from Sos Höyük and Büyüktepe Höyük (MNI)

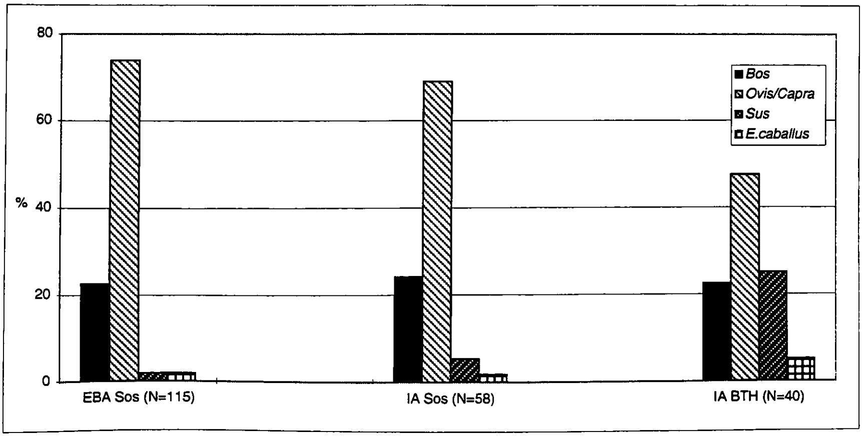


Figure 14c. Relative Abundance of the Main Domesticates from Sos Höyük and Büyüktepe Höyük (WEIGHT(g))

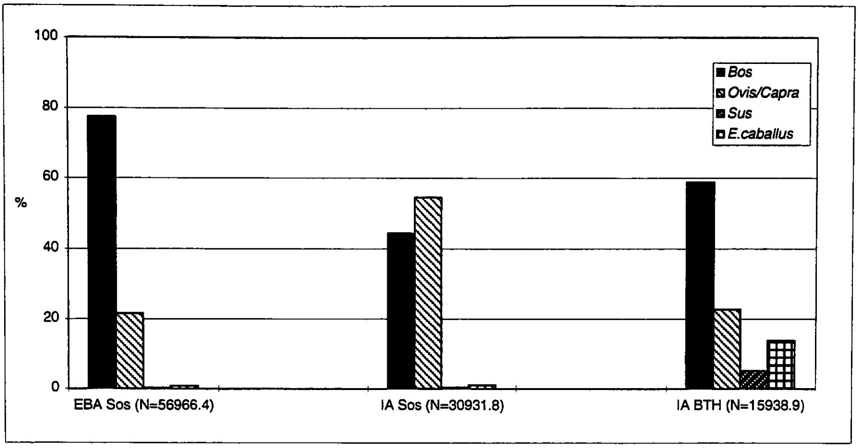


Figure 15. Triploar diagram of relative species abundance of cattle, pigs and ovicaprids from Early Bronze and Iron Age sites in the Near East (% NISP).

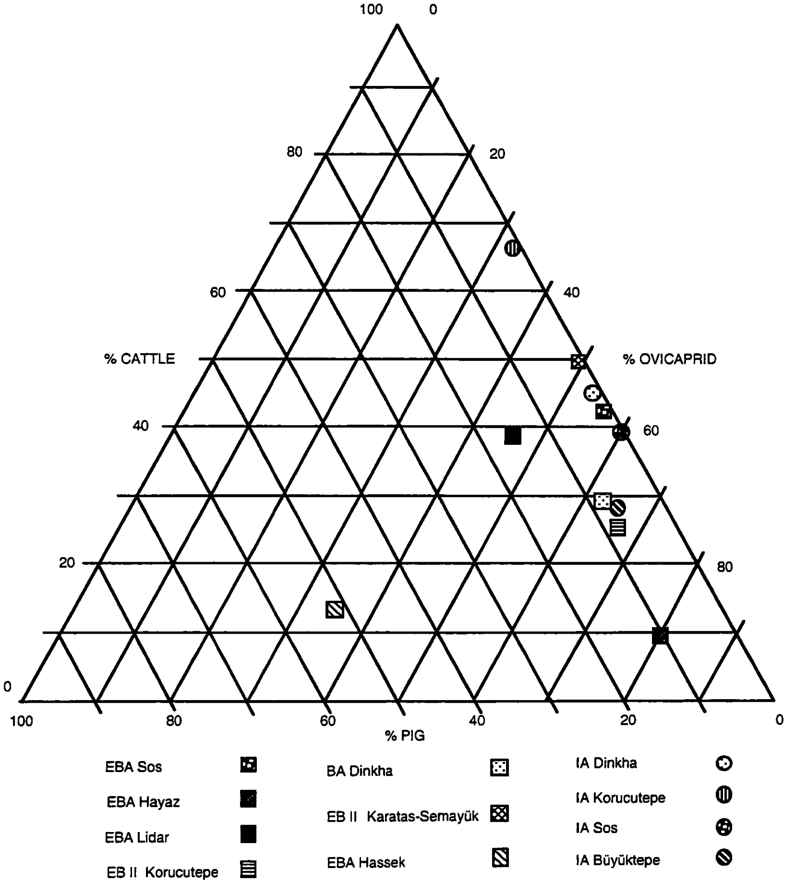


Figure 16a. Skeletal Part Representation of *Bos* Elements from Early Bronze Age Sos Höyük

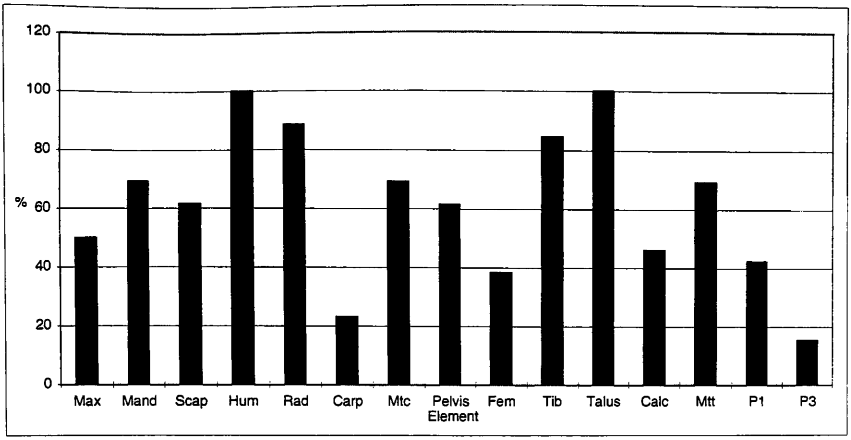


Figure 16b. Skeletal Part Representation of *Bos* Elements from Iron Age Sos Höyük

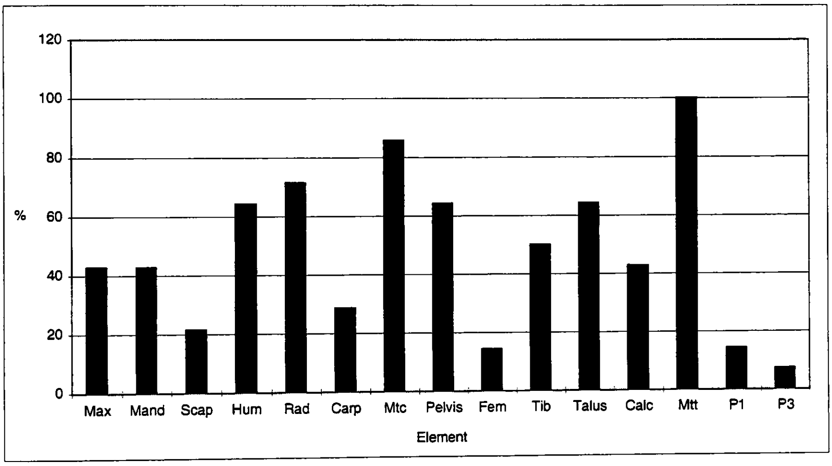


Figure 16c. Skeletal Part Representation of *Bos* Elements from Iron Age Büyüktepe Höyük

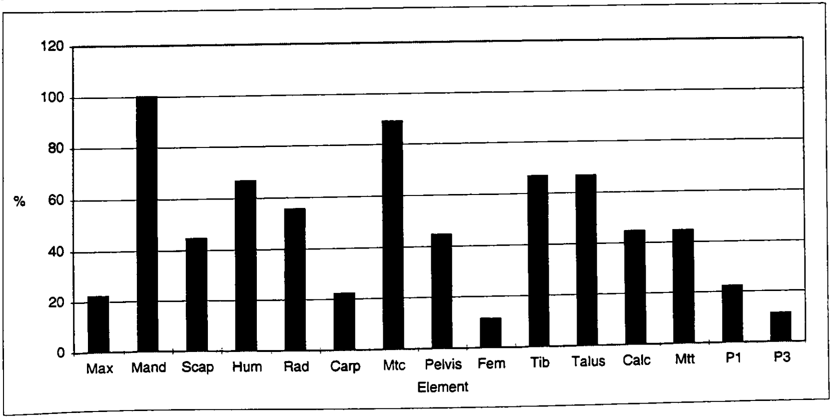


Figure 17a. Skeletal Part Representation of *Ovis/Capra* Elements from Early Bronze Age Sos Höyük

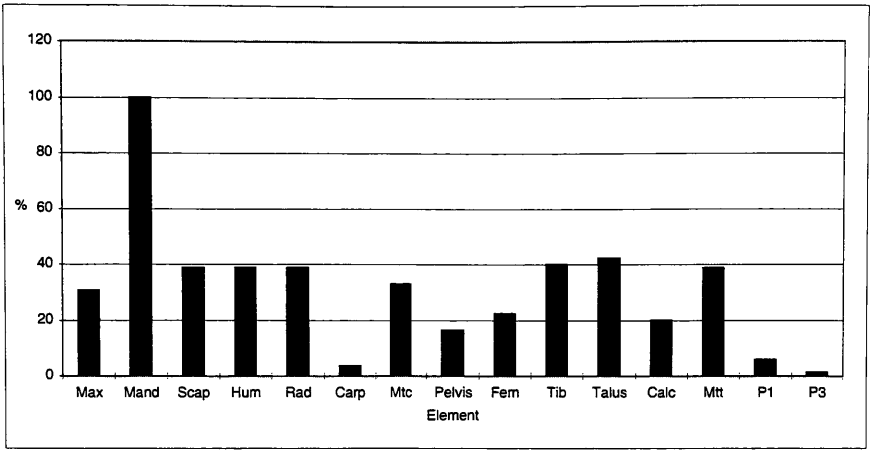


Figure 17b. Skeletal Part Representation of *Ovis/Capra* Elements from Iron Age Sos Höyük

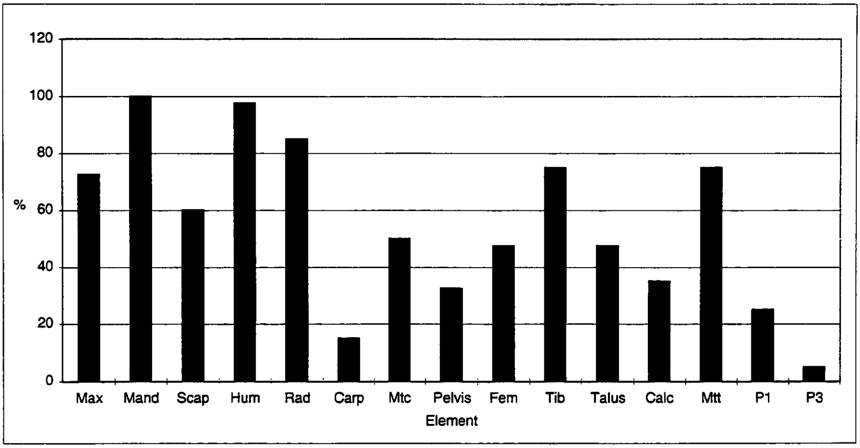


Figure 17c. Skeletal Part Representation of *Ovis/Capra* Elements from Iron Age Büyüktepe Höyük

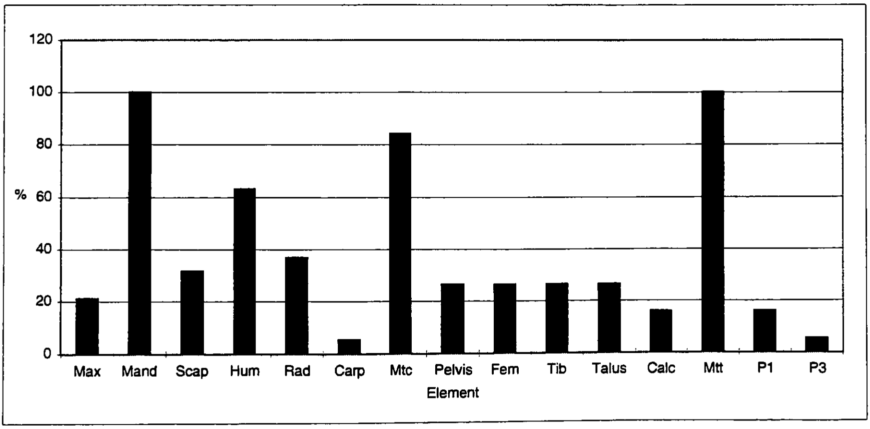


Figure 18a.

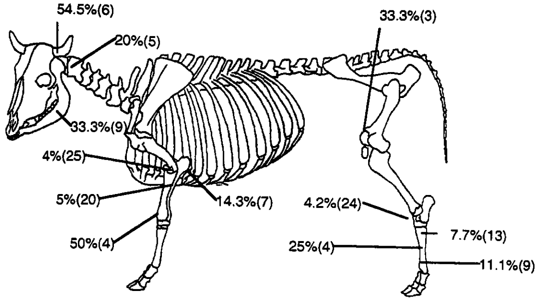


Figure 18b.

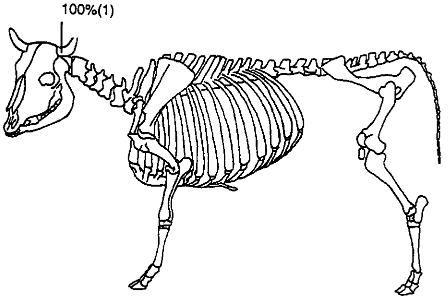


Figure 18c.

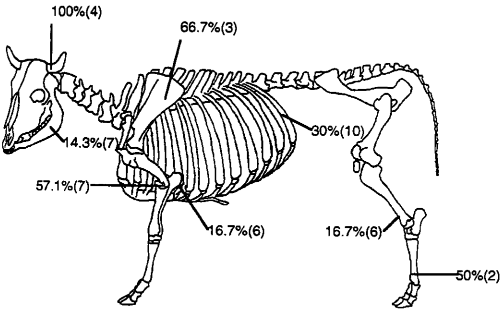


Figure 18d.

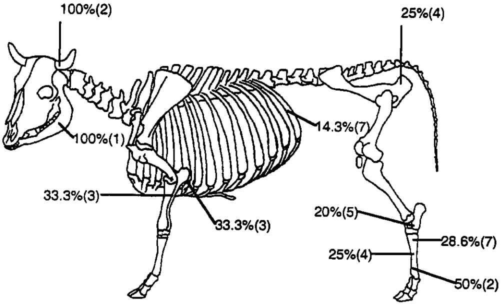


Figure 18a. Percentage of a Given Skeletal Element showing Butchery Marks from Early Bronze Age Sos Höyük *Bos* remains (Total Number of Specimens Recovered provided in Parentheses).

Figure 18b. Percentage of a Given Skeletal Element showing Butchery Marks from Early Bronze Age Büyüktepe Höyük *Bos* remains (Total Number of Specimens Recovered provided in Parentheses).

Figure 18c. Percentage of a Given Skeletal Element showing Butchery Marks from Iron Age Sos Höyük *Bos* remains (Total Number of Specimens Recovered provided in Parentheses).

Figure 18d. Percentage of a Given Skeletal Element showing Butchery Marks from Iron Age Büyüktepe Höyük *Bos* remains (Total Number of Specimens Recovered provided in Parentheses).

FIGURES

Figure 19a.

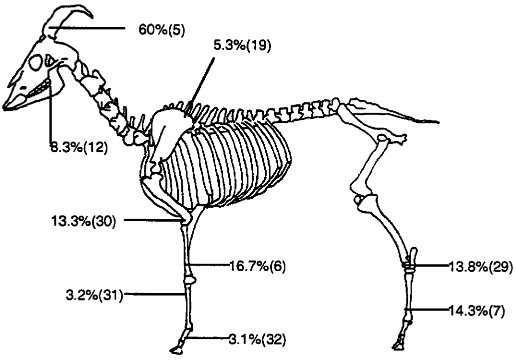


Figure 19b.

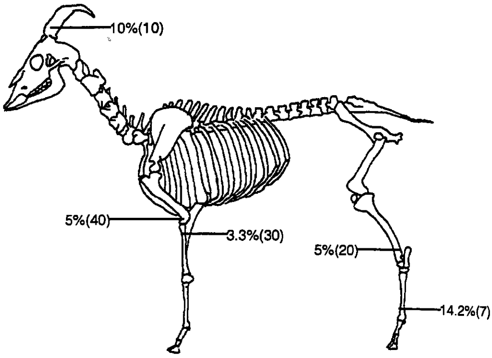


Figure 20a.

Figure 20b.

Figure 19c.

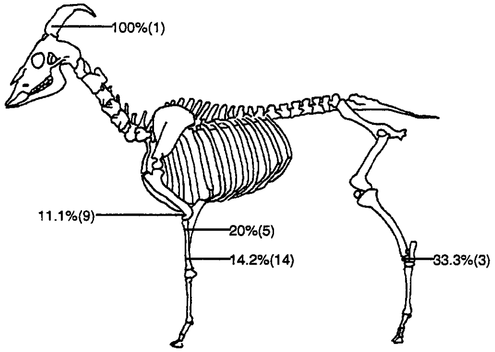


Figure 20c.

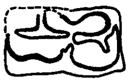


Figure 20d.

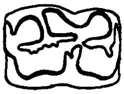


Figure 20e.

Figure 20f.

Figure 19a. Percentage of a Given Skeletal Element showing Butchery Marks from Early Bronze Age Sos Höyük *Ovis/Capra* remains (Total Number of Specimens Recovered provided in Parentheses).

Figure 19b. Percentage of a Given Skeletal Element showing Butchery Marks from Iron Age Sos Höyük *Ovis/Capra* remains (Total Number of Specimens Recovered provided in Parentheses).

Figure 19c. Percentage of a Given Skeletal Element showing Butchery Marks from Iron Age Büyüktepe Höyük *Ovis/Capra* remains (Total Number of Specimens Recovered provided in Parentheses).

Figure 20a. *Equus asinus/E.hemionus* M2, 6.1491, ooclusal aspect (Early Bronze Age Sos Höyük)

Figure 20b. *Equus caballus* M2, 6.0362, ooclusal aspect (Early Bronze Age Sos Höyük)

Figure 20c. *Equus asinus/E.hemionus* P3, 7.0442, occlusal aspect (Iron Age Sos Höyük)

Figure 20d. *Equus caballus* P4/M1, 7.1078, occlusal aspect (Iron Age Sos Höyük)

Figure 21e. *Equus asinus/E.hemionus* P4/M1, 4.0434, occlusal aspect (Iron Age Büyüktepe Höyük)

Figure 21f. *Equus hemionus* M3, 5.0008, occlusal aspect (Iron Age Büyüktepe Höyük)

FIGURES

Figure 21.

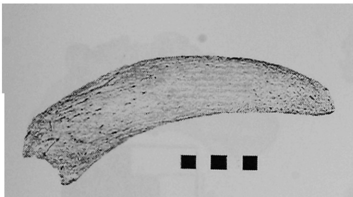


Figure 22.

Figure 23.

Figure 24.

Figure 25a.

Figure 25b.

Figure 26.

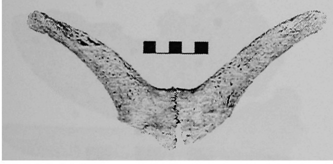


Figure 27a.

Figure 27b.

Figure 21. *Bos taurus* Horn Core, 6.0182, ventral aspect (Early Bronze Age Sos Höyük)

Figure 22. *Bos* Humerus Spindle Whorl, 5.3460, dorsal aspect (Early Bronze Age Sos Höyük)

Figure 23. *Bos* Tibia Awl, 6.1844, ventral aspect (Early Bronze Age Sos Höyük)

Figure 24. *Bos* Modified Phalanx 1, 5.3479, dorsal aspect (Early Bronze Age Sos Höyük)

Figure 25a. *Bos* Phalanx 1 with Extreme Osteoarthritis, 5.2057, lateral aspect (Early Bronze Age Sos Höyük)

Figure 25b. *Bos* Phalanx 1 with Extreme Osteoarthritis, 5.2057, proximal aspect (Early Bronze Age Sos Höyük)

Figure 26. *Ovis aries* Horn Core, 6.0514A-B, dorsal aspect (Early Bronze Age Sos Höyük)

Figure 27a. *Capra hircus* Horn Core. 6.0045, lateral aspect (Early Bronze Age Sos Höyük)

Figure 27a. *Capra hircus* Horn Core. 6.0045, dorsal aspect (Early Bronze Age Sos Höyük)

Figure 28.

Figure 29a-b.

Figure 30.

Figure 31.

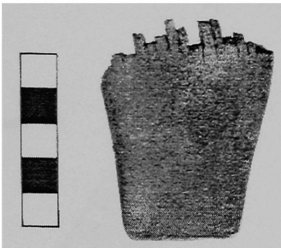
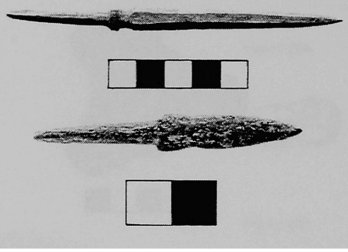


Figure 32a-b.



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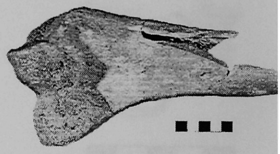

Figure 34.

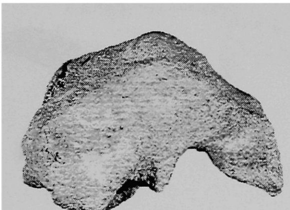

Figure 35.

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Figure 28. *Ovis* Modified Phalanx 1, 7.1403, dorsal aspect (Iron Age Sos Höyük)

Figure 29a. *Ovis* Radius with Healed Comminuted Fracture, 7.1671, ventral aspect (Iron Age Sos Höyük)

Figure 29a. *Ovis* Radius with Healed Comminuted Fracture, 7.1671, lateral aspect (Iron Age Sos Höyük)

Figure 30. *Ovis* Phalanx 2 with Periostitis, 7.1064, dorsal aspect (Iron Age Sos Höyük)

Figure 31, *Cervus elaphus* Comb, 5.3500, (Early Bronze Age Sos Höyük)

Figure 32a. Bone Point, 6.0075, (Early Bronze Age Sos Höyük)

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Figure 34. *Bison bison* Radius, 4.0128, distal aspect (Iron Age Büyüktepe Höyük)

Figure 35. *Canis familiaris* Mandible, 6.1884, lateral aspect (Early Bronze Age Sos Höyük)

Figure 36. *Ursus arctos* Mandible, 5.1971, lateral aspect (Early Bronze Age Sos Höyük)

Figure 37.

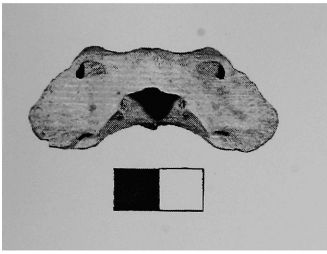

Figure 38.

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Figure 41a-b.

Figure 42i-ii.

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Figure 44i-ii

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Figure 37. *Meles meles* Atlas, 7.0813, dorsal aspect (Iron Age Sos Höyük)
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