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PATTERNS OF ANIMAL HUSBANDRY, ENVIRONMENT, AND ETHNICITY IN CENTRAL ANATOLIA IN THE OTTOMAN EMPIRE PERIOD: FAUNAL REMAINS FROM ISLAMIC LAYERS AT KAMAN-KALEHÖYÜK

HONGO, Hitomi

International Research Center for Japanese Studies, Kyoto, Japan

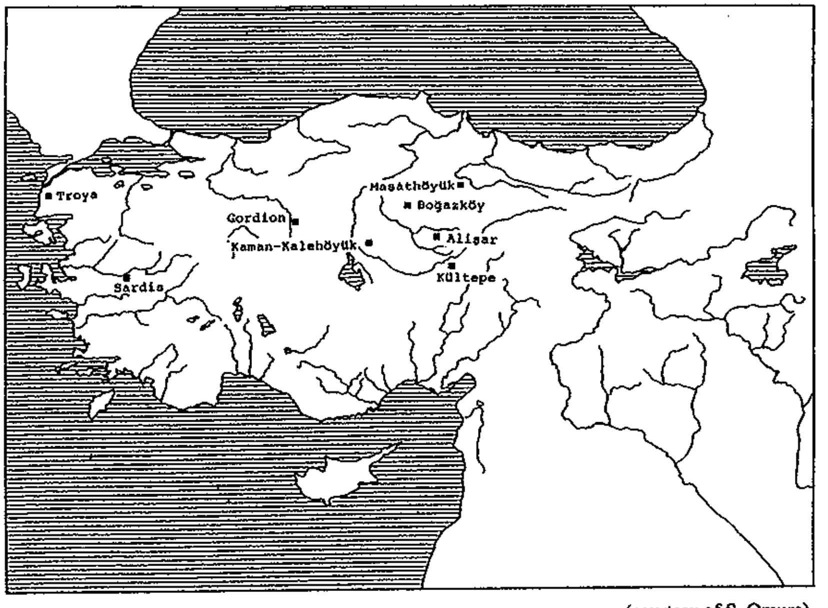
This paper is based on an analysis of faunal remains from the Ottoman Empire Period Layers at Kaman-Kalehöyük, a mound site located in Kırşehir province, Turkey. Anatolia, during the period after the Ottoman conquest in 1453, has usually been regarded as being under Turkish rule and its culture designated as "Islamic," which conceals the cultural variability and complex demography of the region. In spite of numerous ethnographic accounts of life during the Ottoman Empire Period, details of animal husbandry practices are virtually unknown. This study attempts to investigate the patterns of animal husbandry practice during the Ottoman Empire Period by examining relative proportions of taxa, kill-off patterns and body sizes of major domesticates, and the frequency and nature of bone modification. The results are compared to the result of faunal analysis of the Iron Age layers at the site, and also to reports from other contemporary sites in Anatolia. Aspects of pastoral economy in relation to the site's status and environment as well as the ethnicity of the residents of the site are discussed.

Key words: FAUNAL ANALYSIS, OTTOMAN EMPIRE PERIOD, CENTRAL TURKEY, BODY SIZE, KILL-OFF PATTERNS

INTRODUCTION

This paper is based on an analysis of faunal remains from Kaman-Kalehöyük in central Anatolia. Kaman-Kalehöyük is located about 100 kilometers southeast of Ankara, three kilometers east of the town of Kaman in the Kırşehir Province (Fig.1). The site is a rather small tell about 280 meters diameter at the base and about 16 meters high. The excavation, sponsored by the Middle Eastern Culture Center in Japan, started in 1986 after a season of survey (S. Omura, 1989, 1991a,b, 1992a,b, 1993a,b,c, 1994, 1995a,b; Mikami & S. Omura, 1987, 1988, 1991a,b, 1992; Mori & S. Omura, 1990, 1993). Layers of the 2nd and 1st millennia BC have been identified beneath layers of the Ottoman period (c. 16th-17th century AD) (Table 1). In this paper, only the faunal remains from the Ottoman period will be discussed.

The Turks had begun to migrate into Anatolia from Central Asia by the beginning of the 11th century AD. They adopted Islam as their religion when they passed through Persia on their way to Anatolia. By the end of the 11th century, many towns in central and western Anatolia had been captured and the Turks had reached the west coast of Anatolia. The Ottoman Turks started to penetrate into Anatolia by the end of the 13th century and established their state (Itzkowitz, 1976), and finally captured Constantinople in 1453. By the end of the 15th century, the entire region of Anatolia was unified under the rule of the Ottoman Empire. From this time on, Anatolia



(courtesy of S. Omura)

Fig. 1. Location of Kaman-Kalehöyük.

Table 1. Periodization of Kaman-Kalehöyük.

Phase	Architectural Levels	Date	
Phase I			
Ia	I-1,2	16-17th c. AD and later?	
			Ottoman period
Ib	I-3,4	16-17th c. AD (or earlier?)	
		Hiatus	
Iron Age			
Phase II			
IIa	II-1-7	mid. 7th-4th c. BC	Achaemenid?
IIb	II-8,9	mid. 7th c. BC	
IIc	II-10,11	8th-mid. 7th c. BC	
		Burning in upper levels of IId (II-12-16)	
IId	II-12-19	12th-early 8th (?) c. BC	"Dark Ages"
Phase III			
Late Bronze Age			
IIIa	III-1,2	c. 1450-1180 BC	Hittite Empire?
Middle Bronze Age			
IIIb	III-3,4	c. 1650-1500 BC	Old Hittite
			burning (destruction?)
IIIc	III-5-12	c. 1950-1780 BC	Assyrian Colony
(Early Bronze/Middle Bronze)			
IIId	III-13	c. 2000 BC	

became Islamic on the institutional level, and also an increasing portion of the population became Muslim through marriage or conversion and eventually became the majority. The designation of "Islamic" applied to the cultures of Anatolia, however, conceals the cultural variability and complex demography of the region. Although abundant historical sources from both Turkish and Christian sides enable us to trace the interaction between different ethnic groups to some extent, it is virtually unknown how persistent the Byzantine tradition was in Anatolia and to what extent the Islamic religion and culture were adopted by local populations in the Middle Ages.

THE OTTOMAN EMPIRE PERIOD AT KAMAN-KALEHÖYÜK

Layers of the Middle Ages/ Islamic period (Phase I) at Kaman are found directly over the late Iron Age levels (S. Omura, 1993c). No architecture of the Hellenistic or Roman period has been found at the site, although materials belonging to the Hellenistic and Byzantine periods have been collected during surface survey. This is probably because Hellenistic and later period sites in central Anatolia were usually built on the plain and not on mounds. In addition, many of the buildings of Phase I are semi-subterranean and these destroyed the upper portion of the Late Iron Age levels.

Most of the datable material from Phase I at Kaman, such as Polish coins, Ming Dynasty Chinese ceramics, and pipes, suggest that the site was inhabited in the 16th and 17th centuries during the Ottoman Empire period (Mikami & S. Omura, 1987, 1988, S. Omura, 1989, 1991 a,b, 1992a,b, 1993a,b,c 1994a, 1995a,b). There are at least four architectural levels in Phase I, which can be divided into earlier and later subphases. The finds listed above, however, all come from the upper (later) levels (Subphase Ia) of Phase I. Typical Islamic burials, oriented east-west with the head of the skeleton in the west facing south, were found close to the center of the mound beneath the latest architectural level of the mound.

The stratigraphy of Phase I is still largely tentative, and there is a possible hiatus between the earlier and later subphases. Also, there might be a considerable gap in time within the later subphase between the digging of the burials and the construction of houses in the uppermost level, as it seems unlikely that the houses would have been built over the graves if the residents had had knowledge of the burials (S. Omura, 1993b: 29; 1993c). It is also rather peculiar to dig burials in the center of the mound, if the mound was functioning as a town at that time. In addition there may be another temporal hiatus between the level of the typically Islamic burials and the earlier levels. Excavators also note that few ceramics from Phase I are complete, and indeed very few artifacts are found *in situ*. One possible interpretation is that the residents of the mound packed up their belongings and moved elsewhere in the 16th or 17th century (S. Omura, 1993b). The possibility of occupation of the site during the period earlier than the Ottoman conquest cannot yet be completely ruled out either, because a Seljuk coin of the beginning of the 13th century has also been found (S. Omura, 1989). Whether any pre-Islamic middle age levels or non-Islamic sections contemporary with the Ottoman period are present at the site is still an open question.

Although pastoralism has played an important role in the economy during the Middle Ages in Anatolia, little zooarchaeological study has been done on remains of this period (But see works by Boessneck and von den Driesch, 1975; Kussinger, 1988). The study of the archaeological remains from Kaman-Kalehöyük, a small site, has the potential of providing us with information about little known aspects of cultural, economic, and political history as documented by finds from a rural town in the Ottoman Empire Period. Furthermore, faunal remains are effective tools for documenting cultural practices in the past, because animal bones as the refuse of meals were discarded not only by the élite class but also by the commoners who are usually missing from the textual and artistic records.

FAUNAL ANALYSIS

1. Sampling of Faunal Remains

The study of faunal remains at Kaman-Kalehöyük began in 1989, and faunal remains for analysis were selected from the materials excavated between 1987 and 1992. The grouping of samples and interpretation of faunal remains in the present work is based on stratigraphic information current at the end of the 1994 season.

All the excavated soil was dry screened using one centimeter square mesh. Selection of faunal samples from Kaman-Kalehöyük involved two procedures. Samples for detailed documentation were taken from carefully selected areas of the site. Since the research questions were directly related to archaeological problems, the archaeological context of the faunal remains was the most important criterion in selecting the samples to be analyzed. Samples of Phase I have been taken from Area 0 and Areas XVIII and XIX, new areas that were opened next to the deep trench, where a well-preserved architectural configuration of the Islamic period was exposed. Samples were also taken from an iron smelting workshop excavated during the 1990 season in Area XXXI of the South Excavation Area, which belongs to Phase I. Faunal samples were taken from inside of rooms as well as from pits. Additional limb bones and mandibles of major species were documented at the site during the field seasons in order to provide additional measurement data and additional data on tooth eruption and wear. During this latter process, large quantities of excavated faunal remains were surveyed to check for rare or foreign species.

2. Range of Identified Taxa

The range of species identified at Phase I of Kaman, including those found during the survey of faunal remains during the field season, is listed in Table 2. The results of identifications by NISP (number of identified specimens) and by bone weight are presented in Table 3. A total of 1463 bone fragments weighing more than 9.7 kg have been analyzed. A total of 560 fragments, about 7.8 kg (7,789 grams), have been identified to the species, genus or family level. Figure 2 shows relative proportion of principle domesticates and total wild species including birds by NISP. The result of identifications of faunal remains from the late Iron Age layers (Phase IIa) is also shown in Figure 2 for comparison.

Bones of domestic animals are dominant throughout the occupation of the site and make up 96% of the total numbers of identified fragments in Phase I. Cattle, sheep, goats, and pigs are the most common species in the sample, with some dogs, donkeys, and horses. Hares and red foxes are relatively common among the wild taxa. Wild pigs might also occasionally have been hunted, although they are not included in the analyzed samples. Most of the red deer remains are antler fragments. The range of animal taxa at Kaman in Phase I is essentially the same as that during the 2nd and the 1st millennia BC, except for the introduction of a few foreign taxa, including water buffalo, camels, and perhaps chickens (Hongo, 1992, 1993, 1994, 1996; see below). The

Table 2. List of Taxa Identified at Kaman-Kalehöyük.
(including taxa identified during survey)

Domestic mammals	**Domestic birds**
Cattle	Chicken
(Bos taurus)	*(Gallus gallus)*
Water buffalo	
(Bubalus bubalis)	**Wild birds**
Sheep	Cukar
(Ovis aries)	*(Alectoris graeca)*
Goat	Flamingo
(Capra hircus)	*(Phoenicopterus ruber)*
Pig	other unidentified birds
(Sus domesticus)	
Horse	**Reptiles**
(Equus caballus)	Tortoise
Ass	*(Testudo graeca)*
(Equus asinus)	
Camel	**Fish**
(Camelus bactrianus & C. dromedarius)	
Dog	
(Canis familiaris)	
Wild mammals	
Red deer	
(Cervus elaphus)	
Wild sheep	
(Ovis orientalis)	
Wild pig	
(Sus scrofa)	
Red fox	
(Vulpes vulpes)	
Ground squirrel	
(Spermophilus citellus)	
Hare	
(Lepus capensis)	

ratio of sheep to goats is 2.2 to 1, a ratio doubled from that of the Late Iron Age (Subphase IIa).

The faunal assemblages in the Ottoman Period are characterized by more emphasis on cattle compared to the Iron Age (1st millennium BC). The proportion of cattle shows an increase to about 40% by NISP and about 60% by weight of identified specimens in Phase I. There are also concentrations of complete or almost complete cattle limb bones, especially in pits, which indicates that the butchery and cooking methods had changed by the Ottoman period. As will be discussed later, the use of cattle seems to have become more diversified in Phase I (see the section of kill-off patterns). Cattle probably became more important for traction and also the contribution of cattle meat to the diet became greater, and this is probably related to the higher cattle ratio.

The faunal assemblage of the Ottoman period is also characterized by a marked decrease of pigs. Pig bones, however, still account about 5% of the identified fragments and seem to be a little more common in the earlier phase of the Ottoman period than in the later. The ethnic and religious affiliations of the population in Kaman during the Ottoman period are still unknown, and the presence of pigs might indicate that the process of Islamization was a gradual one or that a Christian population was present at the site (see below).

Water buffalo *(Bubalus bubalis)* is one of the domestic animals that were introduced to Kaman by the Ottoman period. Although a few water buffalo bones have been found from Phase IIa

Table 3. Summary of Identified Fragments from Phase I.
(corrected for multiple specimens from a single individual)

	Phase I Total				R 69-Subphase Ib (lower)				Subphase Ia total			
	NISP	%	Wt. (g)	%	NISP	%	Wt. (g)	%	NISP	%	Wt. (g)	%
Bos	202	36.7	4588.5	58.9	95	34.8	1647.0	40.2	107	38.6	2941.5	79.8
Bubalus	10	1.8	1363.0	17.5	10	3.7	1363.0	33.2	0	0.0	0.0	0.0
Sus (domestic)	43	7.8	388.5	5.0	24	8.8	226.0	5.5	19	6.9	162.5	4.4
Ovis	31	5.6	237.0	3.0	17	6.2	112.0	2.7	14	5.1	125.0	3.4
Capra	14	2.5	122.5	1.6	9	3.3	93.0	2.3	5	1.8	29.5	0.8
Ovis/Capra	212	38.5	601.5	7.7	100	36.6	279.0	6.8	112	40.4	322.5	8.7
equids	6	1.1	410.0	5.3	3	1.1	338.0	8.2	3	1.1	72.0	2.0
Canis familiaris	5	0.9	25.0	0.3	3	1.1	22.0	0.5	2	0.7	3.0	0.1
Sus (wild)	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Ovis/Capra (wild)	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Cervus	5	0.9	23.0	0.3	3	1.1	10.0	0.2	2	0.7	13.0	0.4
carnivores	3	0.5	7.5	0.1	0	0.0	0.0	0.0	3	1.1	7.5	0.2
Lepus	7	1.3	5.5	0.1	1	0.4	1.0	0.0	6	2.2	4.5	0.1
Domestic birds	4	0.7	4.5	0.1	2	0.7	2.0	0.0	2	0.7	2.5	0.1
other	8	1.5	12.5	0.2	6	2.2	8.0	0.2	2	0.7	4.5	0.1
Identified Total	550	100.0	7789.0	100.0	273	100.0	4101.0	100.0	277	100.0	3688.0	100.0
Total at the site	1,463		9,748.0									

	R2-Subphase Ia (upper)				Pits-Subphase Ia (upper)				Workshop-Subphase Ia			
	NISP	%	Wt. (g)	%	NISP	%	Wt. (g)	%	NISP	%	Wt. (g)	%
Bos	12	30.8	205.0	55.3	76	43.2	2487.5	87.4	19	30.6	249.0	53.0
Bubalus	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Sus (domestic)	3	7.7	17.0	4.6	7	4.0	31.5	1.1	9	14.5	114.0	24.3
Ovis	3	7.7	5.5	1.5	10	5.7	109.5	3.8	1	1.6	10.0	2.1
Capra	1	2.6	14.5	3.9	4	2.3	15.0	0.5	0	0.0	0.0	0.0
Ovis/Capra	13	33.3	50.0	13.5	71	40.3	184.5	6.5	28	45.2	88.0	18.7
equids	3	7.7	72.0	19.4	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Canis familiaris	1	2.6	2.0	0.5	1	0.6	1.0	0.0	0	0.0	0.0	0.0
Sus (wild)	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Ovis/Capra (wild)	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Cervus	0	0.0	0.0	0.0	1	0.6	9.0	0.3	1	1.6	4.0	0.9
carnivores	0	0.0	0.0	0.0	2	1.1	5.0	0.2	1	1.6	2.5	0.5
Lepus	1	2.6	0.5	0.1	2	1.1	2.0	0.1	3	4.8	2.0	0.4
Domestic birds	0	0.0	0.0	0.0	2	1.1	2.5	0.1	0	0.0	0.0	0.0
other	2	5.1	4.5	1.2	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Identified Total	39	100.0	371.0	100.0	176	100.0	2847.5	100.0	62	100.0	469.5	100.0

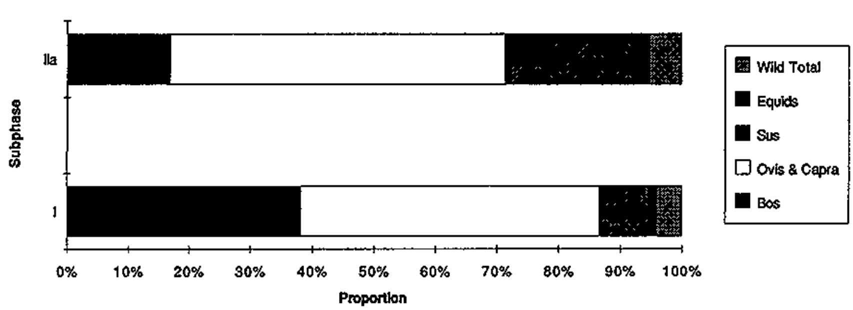


Fig. 2. Relative Proportion of principal domesticates and total wild taxa in NISP.

layers (Late Iron Age-- mid 7th-4th century BC) in Area III, they are all from the fill, and the degree of contamination from later deposits is unknown (Hongo, 1996). Much of the identification of specimens from Kaman was made with the help of Dr. R. Meadow of the Zooarchaeology Lab. of the Peabody Museum, Harvard University, together with published observations (Higham, 1975a, b; Higham et al., 1981).

Water buffalo were domesticated in South Asia before 2500BC (Clutton-Brock, 1981), and introduced to the Balkans by the 7th century AD (Bökönyi, 1974). Therefore, the first introduction of water buffalo to Anatolia could have been at some point between these dates. The earliest presence of water buffalo in Anatolia is reported from Layer II of Büyükkale at Boğazköy, which is dated between the 12th and 7th centuries BC (Vogel, 1952; von den Driesch & Boessneck, 1981). All other water buffalo bones reported from sites in Anatolia come from contexts of the Middle Ages. A water buffalo bone is reported from Lidar Höyük from the layer of the 4th to 13th century (Kussinger, 1988), and water buffalo bones are also reported at Korucutepe (Boessneck & von den Driesch, 1975).

Pollen analysis indicates that climatic conditions became wetter and swamps were formed in the vicinity of the site during the Ottoman period (pers. comm., Y. Yasuda, 1991), which may have facilitated the introduction of water buffalo. Water buffalo are still kept in some parts of central Anatolia, although the number of animals has declined sharply in recent years. For instance, the village of Kızılkaya near Aksaray, where the present author observed a herd of more than 30 water buffalo in 1990, saw its last water buffalo slaughtered in May 1994 (pers. comm. F. Ertug-Yaraş, 1994). The animal was also commonly seen in the vicinity of Kaman-Kalehöyük, but in 1995 only a couple were still left in the village near the site and several were kept in another village nearby.

A survey of faunal remains carried out in the field revealed that both the Bactrian camel *(Camelus bactrianus)* and dromedary camel *(C. dromedarius)* were introduced during Phase I (Hongo, 1994). Since the dromedary has slenderer bones than the Bactrian, identification of the two species can be made by calculating the ratio of breadth to length for the limb bones (Lesbre, 1903), but this method can not be applied to fragments from archaeological sites. Problems involved in the comparative osteological studies of the two species are described by Köhler-Rollfson (1989). The identification of camel bones from Kaman-Kalehöyük was based largely on the characteristics described by Wapnish (1984) and Steiger (1990), and also on comparison with the collection at the Archaeozoology Lab. of the University of Tübingen.

The Bactrian or two-humped camel was probably domesticated during the third millennium BC in Central Asia. The Dromedary or one-humped camel was domesticated by the end of the 3rd millennium BC in South Arabia (Bulliet, 1975; Köhler, 1981; Uerpmann, 1987). Although there is still much debate over the place and date of the first domestication of camels, the animals surely played an important role in trade and military campaigns by the 1st millennium BC in the Near East. Reliefs of camels on the bronze gates from Balawat, made during the reign of Shalmaneser III of Assyria and now housed in the British Museum, show that both species of camels were known in northern Mesopotamia by the beginning of the 1st millennium BC (King, 1915; Bulliet, 1975; Köhler, 1981). The Bactrian camels depicted on the relief are said to be gifts from countries in eastern Anatolia, which is the first reference to camels in Anatolia. The first historical reference to camels in western Anatolia was made by Herodotus ("History" Book I: 80) in his depiction of the battle of Sardis (546BC), where Cyrus II of Persia, using camels, defeated the cavalry of Lydian King Croesus. It is not clear whether the camels used by the Persians were Bactrian or dromedary. Even though Bactrian camels were probably more common in Persia proper, dromedary camels and Arab riders were often incorporated into the Persian military in Egypt.

These historical records suggest that camels may have been present in central Anatolia as early as the end of the 1st millennium BC, even though there are no reports of camel bones in Anatolia dated earlier than the Medieval period. Therefore the presence of camels in Subphase IIa at Kaman-Kalehöyük is quite possible, given the fact that during this period Kaman might have been under the rule of the Achaemenids (S. Omura, 1995a,b, M. Omura, 1994). One camel bone was found from the layer under a hearth, and another from a layer under a wall, both structures probably belonging to Subphase IIa. In both cases, however, the structures belong to the very end of Subphase IIa, the level considerably disturbed by the construction activities of Phase I (the Ottoman period), and some artifacts of the Islamic period were also mixed in the contexts where the camel bones were found. Thus the introduction of camels earlier than Phase I cannot be securely established until more camel bones in good context from Phase II are found.

The climate of central Anatolia, with hot summers and harsh winters, is not favorable for either species of camel. This problem was solved by producing a hybrid of Bactrian and dromedary, which is physically superior to either of the parents and makes an ideal beast of burden in non-desert regions of the Near East (Bulliet, 1975; Gauthier-Pilters & Dagg, 1981). Historical records mention that Anatolia was a major center of hybrid camel production until the beginning of this century (Bulliet, 1975). These "Turkmen" camels played important roles in the Ottoman military as well as in the caravan trade. An old trade route passes at the foot of Kaman-Kalehöyük on the south side, connecting Kaman and Kırşehir. This road, referred to locally by various names including Göç Yolu (migration route), Ipek Yolu (silk route), or Kervan Yolu (caravan route), was certainly used during the Ottoman Period and possibly dates back to a much earlier period. It seems highly likely that the camels found at the site were being used in trade along this route.

Out of 18 camel bones, from at least 14 individuals, 9 bones (from 8 animals) show morphological characteristics of the dromedary, while at least one, and possibly two, seem to have come from Bactrians (Hongo, 1994). There are phalanxes from one individual that are exceptionally large (Hongo, 1996: Appendix 3) and comparable in size to hybrid camels reported from the 8th century AD temple remains at Pella in Jordan (Köhler-Rollefson, 1989).

The chicken *(Gallus gallus)* is another domestic taxon that became important in the Ottoman Period, although it might have already been introduced to Anatolia in the Iron Age. Chickens were probably domesticated in East Asia before the 6th millennium BC and are believed to have spread to the Near East and Europe as early as the late Neolithic and early Bronze Age, although the Iron Age seems to be the main period of dispersal (West & Zhou, 1988). The oldest domestic chicken bone is reported from an Early Bronze Age (3rd millennium BC) context at Yarıkkaya of Boğazköy (Boessneck and Wiedemann, 1977), but whether domestic chickens had been introduced to Anatolia as early as the end of the 3rd millennium BC is still debatable. Another domestic chicken bone has been reported from the Old Hittite layers at Korucutepe (Boessneck and von den Driesch, 1975). Introduction of domestic fowl in the Late Phrygian Phase at Gordion is suggested by the sudden increase of bird bones in this period (Zeder & Arter, 1994). Although

Phasianidae bones are present as early as Subphase IIIa (Hittite Empire period) at Kaman-Kalehöyük, the ones found in the 2nd and 1st millennium BC layers are a little smaller and might be pheasant bones. Fragments of eggshell were recovered by flotation only from samples of the Ottoman Period (pers. comm., M. Nesbitt, 1993). The present author identified them as chicken egg shells by microscopic observation. This suggests that the use of chicken eggs became common by the Ottoman Period, and it may also suggest that domestic chicken had not yet been introduced to Central Anatolia in large numbers in the Iron Age.

3. Kill-off Patterns of Principal Domesticates

Domestic animals are slaughtered either when it is no longer economical to keep them alive (i.e., when the production does not match the investment) or when the maximum yield is expected by killing the animal and selling the products. The ideal slaughter schedule varies depending on the animal taxa and the animal products being exploited. Models of ideal kill-off of domestic animals, based on the hypothesis that the principle use of the animal will dictate the schedule of slaughter, have been suggested (Wapnish and Hesse, 1988; Redding, 1984; Sherratt, 1981, 1983; Payne, 1973). When meat is the primary goal of animal keeping, individuals may be slaughtered relatively young as soon as growth has begun to slow significantly, for as the animals approach their adult size weight is not being added as quickly. Animals primarily used for traction and labor may be kept well into adulthood--indeed until they are quite old. Animals used for their wool and hair may also be kept until an old age. If milk is important as a product, male animals may be killed quite young. Domestic animals are, however, kept for multiple purposes in most small-scale pastoral economies, and kill-off schedules are not as simple as these models. Also, animals of a certain age group might have been exported and thus contributed to the site's economy in a different form than primary or secondary animal products. Even with these problems, analyses of kill-off patterns can still help us to investigate what were the primary functions of each domestic species.

Table 4. Stages of epiphyseal fusion and estimated of fusion.
(after Silver 1969, Habermehl 1975, & Bökönyi 1972)

(p): proximal; (d): distal

Ovis & Capra

I	II	III	IV
(6-12 months)	(12-28 months)	(30-36 months)	(36-42 months)
Scapula (d), Humerus (d), Radius (p) Pelvis (acetabulum),	1st & 2nd phalanges (p), Metapodial (d), Tibia (d)	Ulna (p), Femur. (p), Calcaneum (p)	Humerus (p), Radius (d), Femur. (d), Tibia (p)

Sus

I	II	III
(c.12 months)	(24-30 months)	(36-42 months)
Scapula (d), Humerus (d), Radius (p), 2nd phalanx (p) Pelvis (acetabulum),	1st phalanx (p), Metapodial (d), Tibia (d), Fibula(d),	Humerus (p), Radius (d), Ulna (p&d), Femur. (p&d), Tibia (p), Fibula(p)

Bos

I	II	III	IV
(6-12 months)	(12-18 months)	(24-42 months)	(42-48 months)
Scapula (d), Radius (p) Pelvis (acetabulum),	Humerus (d), 1st & 2nd phalanges	Metapodial (d), Tibia (d), Calcaneum	Humerus (p), Radius (d), Ulna (p), Femur. (p&d), Tibia (p)

Table 5. Tooth Wear Stages for *Bos*, *Ovis* and *Capra*, and *Sus*.

Bos **Age Stage**	**Teeth & Wear Stages**	***Ovis & Capra*** **Age Stage**	**Teeth & Wear Stages**	***Sus*** **Age Stage**	**Teeth & Wear Stages**
I-Newborn	dp4 (a-c)	**I-Newborn**	dp4 (DU-D3)	**I- Newborn**	dp4 (a-c)
			n.d. dp (er-sl)		dp er/sl
II	dp4 (d-g)		di (er-sl)		I er/sl
M1 erupting	n.d. dp (mod)		M1 (ue)		
(c. 6 months)	M1 (a-c)			**II**	dp4 (d)
	M2 (ue)	**II**	dp4 (D4-D5)	**M1 erupting**	n.d. dp (mod)
		M1 erupting	n.d. dp (mod)	**(up to 6 months)**	M1 (er, a-b)
III	dp4 (h-n)	**(up to 6 months)**	M1 (er-S2/3)		P1 er
M2 erupting	n.d. dp (hv)				
(1 to 1.5 years)	M1 (d-g)	**III**	dp4 (D6-DV)	**III**	dp4 (e-i)
	M2 (a-c)	**M2 erupting**	M1 (S3-S6)	**M2 erupting**	n.d. dp mod/hv
	M3 (ue)	**(6 to12 months)**	M2 (er-S2/S3)	**(6-12 months)**	i mod/hv
	n.d. P (ue)		M3 (ue)		M1 (c-e)
					M2 (er, a-b)
IV	M1 (h-k)	**IV**	dp4 (DX)		M3 (ue)
M3, P4 erupting	M2 (d-g)	**M3, P4 erupting**	n.d. dp (hv)		I3, C er.
(2 to 3 years)	M3 (a-d)	**(1 to 2 years)**	M1 (S8-M1)		
	P4 (a-c)		M2 (S5-S8)	**IV**	P4 (a-c)
	n.d. P (er-sl)		M3 (er-S3)	**P4 erupting**	P2,3, & unid er/sl
			P4 (er-S4)	**(1-1.5 years)**	I1 er
V	M1 (l-n)		n.d. P (er-sl)		
(over 3 years)	M2 (h-k)			**V**	M1(f-h)
	M3 (e-j)	**V**	M1 (M2-H1)	**M3 erupting**	M2 (c-e)
	P4 (d-h)	**(2 to 4 years)**	M2 (M1)	**(1.5-2 years)**	M3 (a-b)
	n.d. P (mod)		M3 (S4-S8)		P4 (d-e)
			P4 (M1-M2)		P mod
VI	M1 (o-p)		n.d. P (mod)		I2 er
(old)	M2 (l-p)				
	M3 (k-n)	**VI**	M1 (H2-H3)	**VI**	M1 (j-k)
	P4 (j)	**(4 to 7 years)**	M2 (M2-H1)	**(over 2 years)**	M2 (f-h)
	n.d. P (hv)		M3 (M1-M3)		M3 (c-e)
			P4 (H+)		P4 (f)
			n.d. P (H, V)		P hv
					I hv
		VII	M1 (V1)		
		(old)	M2 (H2-V1)	**VII**	M1 (l-n)
			M3 (H1-V1)	**(old)**	M2 (j-k)
			P4 (V+)		M3 (f-j)
					P4 (g-h)

i: deciduous incisor
dp: deciduous premolar
I: incisor
P: premolar
M: molar
n.d.: unidentified

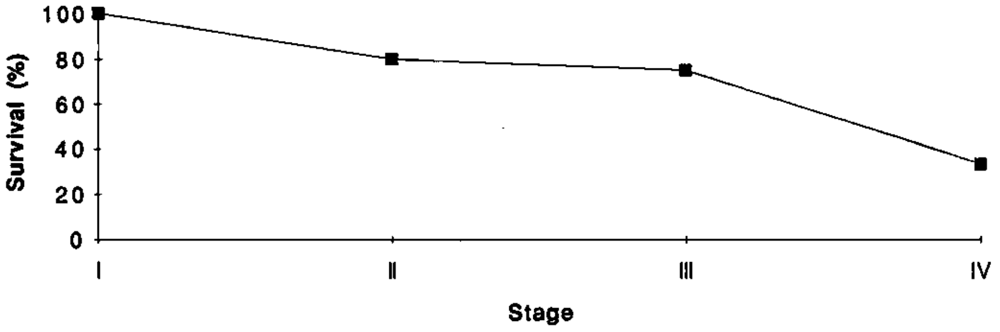


Fig. 3. Survivorship curves for *Bos* based on epiphyseal fusion.

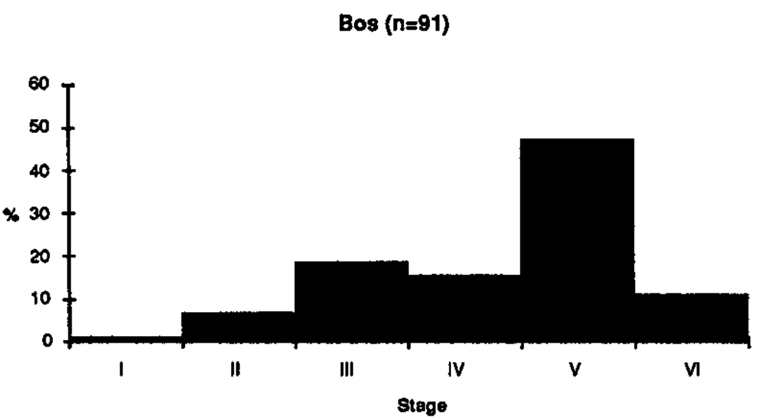


Fig. 4. Kill-off patterns for *Bos* based on tooth eruption and wear.

Kill-off patterns of cattle, sheep, goats, and pigs are investigated based on epiphyseal fusion of long bores and tooth eruption and wear. Post-cranial parts are grouped according to the sequence of epiphyseal fusion based on the ages presented by Silver (1969), Bökönyi (1972), and Habermehl (1975) (Table 4). Teeth are seriated according to the wear stage sequence based on the protocols presented by Grant (1975, 1982) for cattle and pigs, and by Deniz and Payne (1982) and Payne (1987) for sheep and goats (Table 5). The animals approach their adult size at Stage IV, marked by the eruption of M3 and P4. Since teeth continue to wear until an animal dies, kill-off patterns based on tooth wear, unlike in the case of epiphyseal fusion sequence, cover the years after the animal attains its maximum size. Stages V, VI, and VII are defined on the basis of wear stage combinations of the molars. The estimated age range for each stage is shown in parentheses in both Tables 4 and 5, but it should be noted that these age ranges may vary according to breed or population in each taxon (Bull & Payne, 1982; Noddle, 1974).

In both methods, the same designation for a stage in different taxa does not mean the same number of years from birth, nor the same level of maturity in an animal's life cycle. Also, tooth eruption and wear stages are not equivalent to epiphyseal union stages. It should be noted that the results of aging based on epiphyseal fusion and on tooth eruption and wear are not directly comparable. The former shows the "survival rate" of animals beyond the beginning of the given age stage. The latter refers to the proportion of animals that died within a given age stage. Also, various factors can move the actual age corresponding to each age stage in either direction. For example, the timing of epiphyseal fusion may be slower than that found in literature among the breed of animals at Kaman, but the attrition of teeth may be faster due to lower quality of pasture.

Survivorship curves for cattle based on epiphyseal fusion (Fig. 3) suggest that cattle were kept until sub-adulthood. The survival rate at the beginning of Stage IV is only 33%, which is in contrast to c.75% survival rate throughout the 2nd and 1st millenium BC at the site (Hongo, 1996). The low survival rate at Stage IV, together with an increase in the proportion of cattle in NISP, suggests that the cattle's role as a source of meat became more important in the Ottoman period.

Although distribution of tooth wear stages for cattle show peaks in the Stage V age group (Fig. 4), quite a few young cattle teeth were also found in samples, with 27% of teeth belonging to animals of Stage III and younger. Thus the tooth wear data also suggest that the use of cattle was not solely for traction but also for meat and milk.

The introduction of water buffalo as a milk animal might have contributed to the change in the use of cattle. This hypothesis is not yet supported by faunal data since morphological differences between cattle and water buffalo are not well established for younger animals. Some of the bones from very young bovines, therefore, may have come from male water buffalo that were culled.

A study of kill-off patterns for cattle is available from Lidar Höyük in southeastern Anatolia (Kussinger, 1988). There it is reported that the kill-off pattern of cattle changed after the Hellenistic and Roman period: most cattle were kept to over 3 years of age until the Hellenistic period. After the Hellenistic and Roman period, half of the cattle were slaughtered before reaching 3 years. Thus the change in the kill-off pattern of cattle might be a universal phenomenon in Anatolia after the Iron Age, and cattle meat became at least as important as traction.

Kill-off patterns for sheep based on tooth eruption and wear shows two peaks, one at Stage III, and another at Stage V (Figure 5). The proportion of Stages I-III teeth is relatively small, and 65

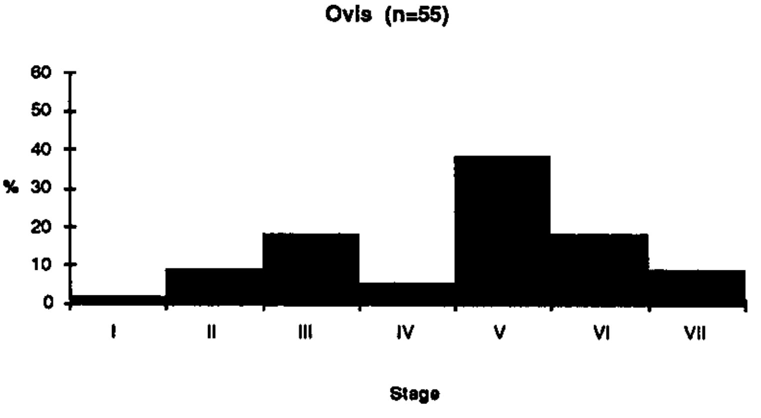


Fig. 5. Kill-off patterns for *Ovis* based on tooth eruption and wear.

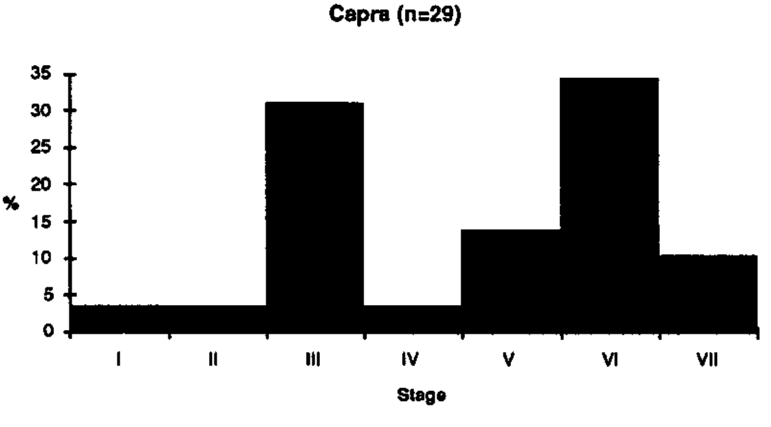


Fig. 6. Kill-off patterns for *Capra* based on tooth eruption and wear.

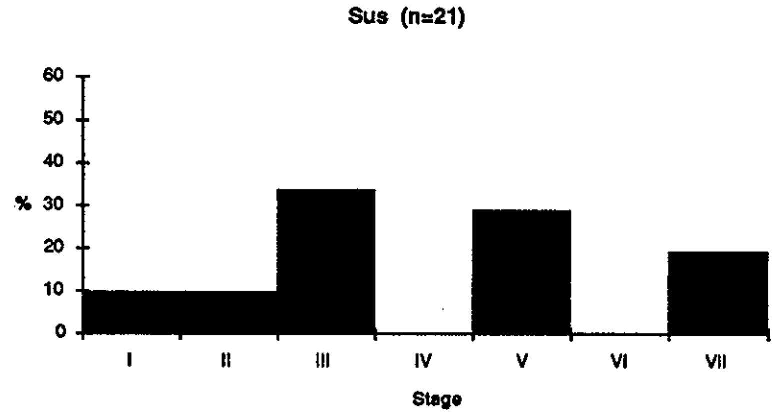


Fig. 7. Kill-off Patterns for *Sus* based on tooth eruption and wear.

% of the teeth come from animals of Stage V and older. This pattern is probably close to a strategy to maximize production in small scale herding by obtaining a mix of products--milk, wool, and meat. More emphasis, however, seems to have been put on wool production. The same schedule of slaughter for sheep is found today in the villages around the site where each household practices small scale herding of sheep. Females, except for infertile ones, are kept until an older age. Some males are killed very young, but usually they are also kept until the first harvest of wool the next year. By that time the young sheep have put on weight and have become more profitable to be sold as meat. Such export of sub-adult sheep probably resulted in the small proportion of Stage IV animals. Some castrated males may be kept for a little longer until they have put on maximum weight.

Goat teeth also show a distribution with two peaks, one at Stage III and another at Stage VI (Fig. 6). This schedule of slaughter was established as early as the Middle Bronze Age (Hongo, 1996: 129). This pattern might suggest optimization for milk production, as almost all males were killed quite young while most females were kept until they were old.

Due to a very small sample size, survivorship curves for pigs from Phase I could not be calculated. Figure 7 shows the distribution of tooth wear stages for pigs from Kaman. Pigs were slaughtered quite young during the Ottoman Empire period as in previous periods at the site (Hongo, 1996). In previous periods, teeth of Stages I, II, and III account for up to 80% of the sample. In Phase I, teeth are more evenly distributed across the age stages. Indeed, the kill-off pattern of pigs in the Ottoman Empire period shows an unusual pattern, as the proportion of older pigs of Stages V and VII is relatively high, while fewer animals seem to have died or been killed in Stages I and II compared to other periods at the site. High proportions of older pigs in Phase I may indicate that pigs were not kept primarily for meat in this period and survived until old age, which may be related to the beginning of avoidance of pig meat.

3.4. Size of Principal Domesticates

In order to compare the size of animals in different periods at the site, each measurement of limb bones was compared to the corresponding dimensions of a "standard" animal using the "Index Method" developed by Uerpmann (1979, 1982) or the "difference of logs" method

Table 6. Standard Measurements for *Bos*.
Based on measurement data from Lidar Höyük (Kussinger, 1988)
Mean and standard diviation were calculated based on measurement data.
For Ulna, Matacarpal Fomur, Astragalus, Metatarsal, Ph1, and Ph2, published mean and SD were used.

Scapula	mea. d.	SLC	GLP	LG	BG	
	n	49	54	57	58	
	Mean	48.7	65.3	55.1	45.2	
	SD	6.6	6.7	5.8	4.9	
Humerus (n=84)	mea. d.	BT				
	Mean	68.6				
	SD	5.4				
Radius	mea. d.	Bp	SD	Bd	GL	BFp
	n	65	4	59	4	69
	Mean	75.0	33.1	67.2	264.1	69.2
	SD	7.3	3.3	5.7	19.4	6.5
Metacarpal	mea. d.	Bp	Bd			
	n	135	115			
	Mean	55.2	56.9			
	SD	4.7	5.2			
Pelvis (n=28)	mea. d.	LA				
	Mean	63.0				
	SD	5.7				
Femur (n=1)	mea. d.	Bd				
	Mean	72.0				
	SD	2.9				
Tibia	mea. d.	Bp	Bd			
	n	4	143			
	Mean	94.1	58.0			
	SD	5.0	4.9			
Astragalus	mea. d.	GLl	GLm	Dl	Bd	
	n	188	183	184	180	
	Mean	62.1	57.5	34.3	40.1	
	SD	4.0	4.0	2.1	3.5	
Calcaneum (n=64)	mea. d.	GB				
	Mean	42.2				
	SD	4.1				
Metatarsal	mea. d.	Bp	Bd			
	n	113	124			
	Mean	45.2	52.8			
	SD	4.0	4.9			
Ph1 (anterior)	mea. d.	Bp	SD	Bd	GL	
	n	215	219	216	222	
	Mean	29.1	24.3	27.5	55.6	
	SD	2.8	2.8	2.8	3.7	
Ph1 (posterior)	n	199	201	198	203	
	Mean	26.6	22.5	25.6	57.6	
	SD	3.1	2.9	2.7	4.3	
Ph2 (anterior)	mea. d.	Bp	SD	Bd	GL	
	n	173	173	168	175	
	Mean	28.9	23.2	25.2	36.9	
	SD	2.7	2.8	2.5	2.9	
Ph2 (posterior)	n	155	153	149	158	
	Mean	26.8	21.6	22.8	38.0	
	SD	2.3	2.0	2.0	2.8	
Ph3 (n=14)	mea. d.	GL	Ld			
	Mean	65.8	51.3			
	SD	8.1	4.3			

developed by Meadow (1981, 1983). Length measurements and breadth measurements are dealt with separately, because the length of a bone is related to the height of the animal whereas the breadth is related to the weight (Meadow, 1991: 90).

For cattle, measurements from Lidar Höyük dating from the Early Bronze Age to the Middle Ages was used as the standard (Kussinger, 1988) (Table 6), and the size was compared using the "Size-Index Method" (See Uerpmann, 1982). Size-indices of sheep and goats from Kaman were calculated in the same way as described by Uerpmann (1979: Table A3) (Tables 7.1. and 7.2.). For pigs, the "Difference of Logarithms Method" (Simpson, 1941; Meadow, 1983) was employed to compare the size of pigs from Kaman-Kalehöyük to a modern female European wild pig at the University of Tübingen (catalogue number Su 12 of the Archaeozoology Lab, Institute für Vor-und-Frühgeschichte at the University of Tübingen, Table 8).

Table 7.1. Standard Measurements for *Ovis*. (Uerpmann 1979)

Scapula	SLC	19.5	BG	22.0
Humerus	BT	29.5		
Radius	Bp	33.5	Bd	31.0
Ulna	BPC	19.0	DPA	27.5
Metacarpal	Bp	25.0	Bd	26.5
Femur	DC	21.1		
Tibia	Bd	26.5		
Astragalus	GLl	31.3	Bd	19.6
Calcaneum	GL	64.0		
Metatarsal	Bp	22.5	Bd	26.0

Table 7.2. Standard Measurements for *Capra*. (Uerpmann 1979)

Scapula	BG	24.7		
Humerus	BT	34.2		
Radius	Bp	35.5	Bd	33.2
Ulna	BPC	25.9	DPA	29.5
Metacarpal	Bp	27.3	Bd	30.5
Femur	DC	23.0		
Tibia	Dd	21.7		
Astragalus	GLl	32.0	Bd	20.8
Calcaneum	GL	65.5		
Metatarsal	Bp	23.0	Bd	28.5
Ph1	GLpe	40.4		

Size indices for cattle in Phase I (Ottoman Empire period) are spread out over a much wider range compared with those in Subphase IIa (Late Iron Age) (Fig. 8). In both phases, there are a few large animals and many small animals, which suggests differentiation in the use of cattle. The few large individuals possibly represent oxen for traction and bulls for breeding, and small animals represent cows for milking. There may also have been more than one breed of cattle, but this is difficult to confirm from the measurement data because of a possible overlap in the size of males and females even within a breed. The very large specimen in Phase I with size index value between 90 and 100 might be from water buffalo.

Measurements of cattle astragali from phase I and phase II are plotted in scatter diagrams in an attempt to examine the bone size proportions (Fig. 9). Observation of patterns is difficult due to the small number of samples in each Phase, and the following interpretation should be accepted only with caution. The distribution in Phase I can be interpreted as a large number of small milking cows and a few very large males for ploughing. When the scatter plot distribution of Phase I is compared with that of Phase II, the two smaller clusters in Phase II fall on the smaller side of the "female" cluster in Phase I. Animals that fall in the size range of the larger two clusters of Phase II disappear in Phase I, while there are a few much larger animals in Phase I. Thus, there was an overall increase in the size of females in Phase I while very small animals still exist. The size of males also increased in Phase I. The changes in both male and female size result in much larger size variability in Phase I, which also can be seen in the size index distributions. At the same time, there are fewer large males represented in the sample of Phase I. Thus there seems to be an overall shift towards smaller size in Phase I, shown both by the distribution of scatter plots and by the median values, which in fact may be partly due to the change in sex ratio of cattle.

Table 8. Standard Measurements for *Sus*.
(Measurements of "Su 12" at Archaeozoology Lab, University of Tübingen)

Scapula	mea. d.	SLC	GLP	LG	BG	HS	DHA	Ld			
	meas.	26.0	36.5	32.5	25.5	217.0	205.0	122.0			
	Log	1.415	1.562	1.512	1.407	2.336	2.312	2.086			
Humerus	mea. d.	Bd	BT	SD	Bp	GLC	GL	Dd	GLT	LT (med)	LT (lat)
	meas.	42.5	30.5	18.0	65.0	182.5	209.5	40.5	29.0	20.0	23.0
	Log	1.628	1.484	1.255	1.813	2.261	2.321	1.607	1.462	1.301	1.362
Radius	mea. d.	Bp	SD	Bd	GL	BFd	Dp	DFd			
	meas.	29.0	18.0	34.0	157.0	31.0	22.0	17.0			
	Log	1.462	1.255	1.531	2.196	1.491	1.342	1.230			
Ulna	mea. d.	BPC	DPA	SDO	GL	LO					
	meas.	23.5	39.0	30.5	209.0	62.5					
	Log	1.371	1.591	1.484	2.320	1.796					
Metacarpal III	mea. d.	Bp	Dp	SD	Bd	Dd	GL	D.verticillus			
	meas.	20.0	19.5	14.0	17.0	18.0	74.5	11.0			
	Log	1.301	1.290	1.146	1.230	1.255	1.872	1.041			
Metacarpal IV	mea. d.	Bp	Dp	SD	Bd	Dd	GL	D.verticillus			
	meas.	16.5	16.5	12.0	17.5	17.5	76.0	10.5			
	Log	1.217	1.217	1.079	1.243	1.243	1.881	1.021			
Pelvis	mea. d.	LA	GL	LFo	BFo	SH	LAR	SB			
	meas.	37.5	235.0	45.0	32.0	24.5	31.5	13.5			
	Log	1.574	2.371	1.653	1.505	1.389	1.498	1.130			
Femur	mea. d.	Bp	DC	SD	Bd	B. troc	GLC	Dd			
	meas.	58.0	26.0	20.5	50.0	23.0	221.0	60.5			
	Log	1.763	1.415	1.312	1.699	1.362	2.344	1.782			
Tibia	mea. d.	Bp	SD	Bd	Dd	GL					
	meas.	54.0	21.0	30.5	26.5	205.0					
	Log	1.732	1.322	1.484	1.423	2.312					
Astragalus	mea. d.	GLl	GLm	Dl	Dm	Bd	BFp/ Bp				
	meas.	40.5	39.0	21.0	24.5	26.5	21.0				
	Log	1.607	1.591	1.322	1.389	1.423	1.322				
Calcaneum	mea. d.	GL	GB	Gdl	sm.D.T	L.Tub.					
	meas.	82.5	23.5	31.0	20.5	52.0					
	Log	1.916	1.371	1.491	1.312	1.716					
Metatarsal III	mea. d.	Bp	Dp	SD	Bd	Dd	GL				
	meas.	15.5	22.5	12.5	16.5	17.5	82.5				
	Log	1.190	1.352	1.097	1.217	1.243	1.916				
Metatarsal IV	mea. d.	Bp	Dp	SD	Bd	Dd	GL				
	meas.	16.0	24.5	12.5	16.0	18.5	91.5				
	Log	1.204	1.389	1.097	1.204	1.267	1.961				
Ph1	mea. d.	Bp	SD	Bd	GL/GL	Dp	min.D	Dd			
	meas.	16.8	13.5	15.2	36.5	16.7	9.5	10.7			
	Log	1.225	1.130	1.182	1.562	1.223	0.978	1.029			
Ph2	mea. d.	Bp	SD	Bd	GL/GL	Dp	min.D	Dd			
	meas.	16.3	13.5	14.5	24.3	16.5	10.5	13.8			
	Log	1.211	1.130	1.161	1.385	1.217	1.021	1.140			
Ph3	mea. d.	GL	Ld	MBS							
	meas.	32.5	31.5	13.0							
	Log	1.512	1.498	1.114							

note: Standards for Ph1, Ph2, and Ph3 are the average of anterior and posterior III and IV

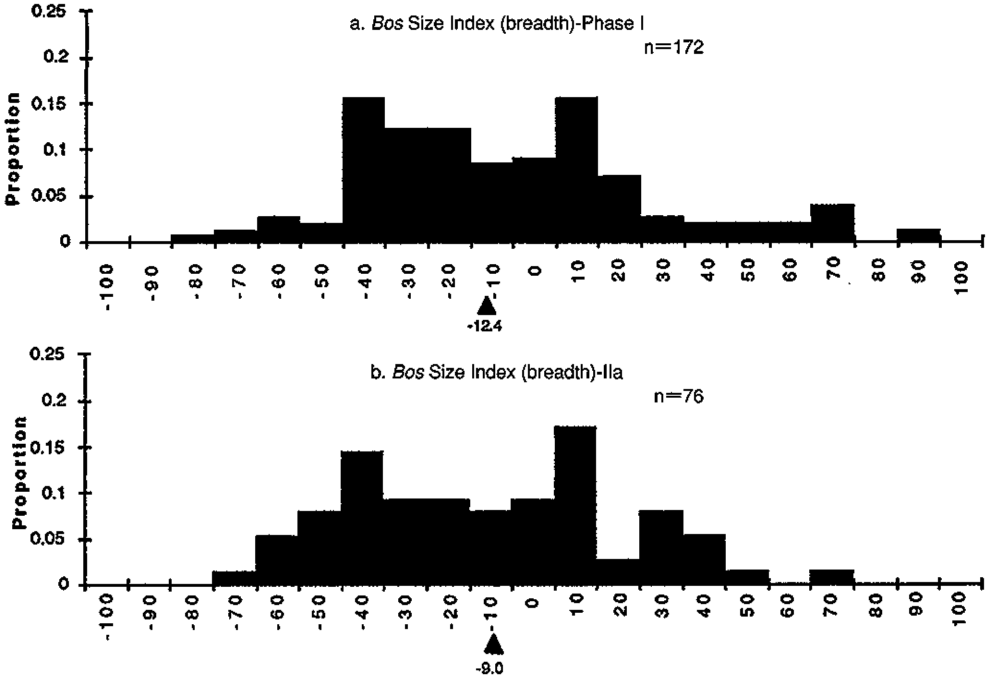


Fig. 8.1. Size Index Disributions for *Bos* (Breadth).

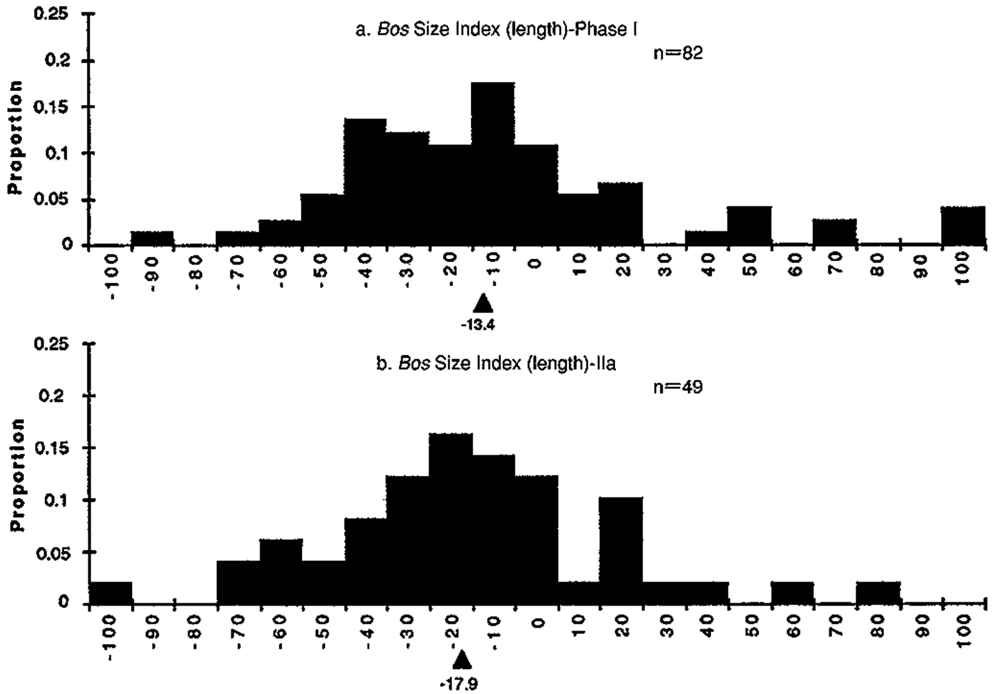


Fig. 8.2. Size Index Disributions for *Bos* (Length).

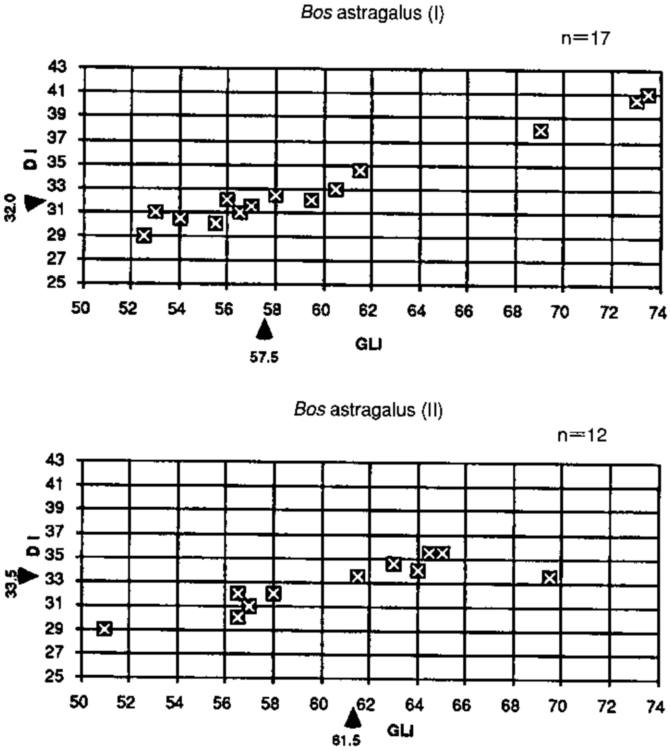


Fig. 9. Measurements of *Bos* Astragali (DI against GLl).

There is a considerable increase in the size of sheep in Phase I compared to that in Phase IIa, which is more clearly observed in length than in breadth measurements (Fig. 10.1 and 2). The same observation can be made by looking at scatter plots of astragali measurements for sheep (Fig. 11.1 and 2). Increases in both length and breadth/depth are observed in Phase I.

The size index distribution for goats also shows a shift toward much larger animals in Phase I (Fig. 12.1 and 2). The scatter plots of astragali measurements of goats also show that there is an overall size increase in goats in Phase I, although the result should be interpreted with caution because of very small sample sizes (Fig. 13.1 and 2). The shift of median values toward larger animals is the result of the disappearance of smaller animals, with the upper end of the size range remaining the same as in the previous periods.

The size of pigs remains almost the same throughout the occupation of the site, although pigs in Phase I seem to be slightly smaller (Fig. 14.1 and 2). The large individuals present in the samples probably came from wild pigs that were occasionally hunted at the site.

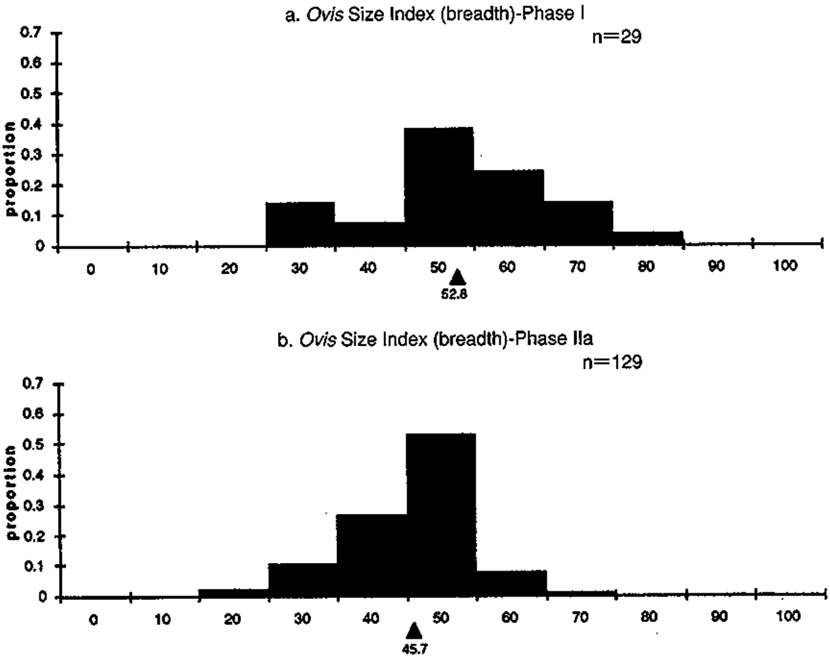


Fig. 10.1. Size Index Disributions for *Ovis* (Breadth).

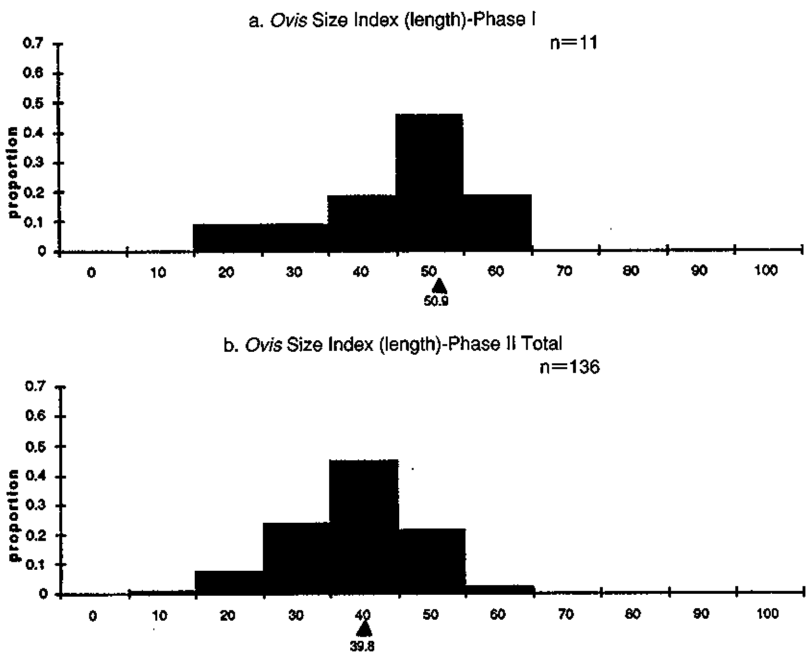


Fig. 10.2. Size Index Disributions for *Ovis* (Length).

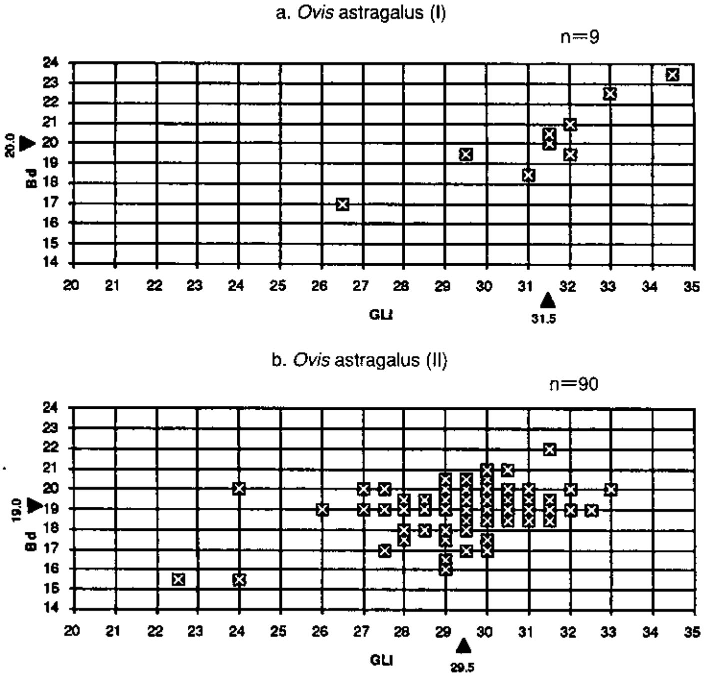


Fig. 11.1. Measurements of *Ovis* Astragali (Bd against GLI).

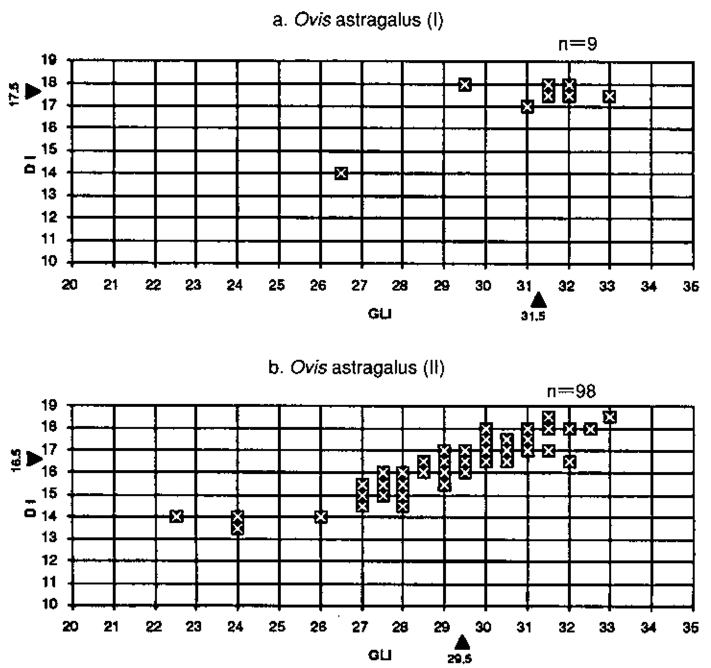


Fig. 11.2. Measurements of *Ovis* Astragali (DI against GLI).

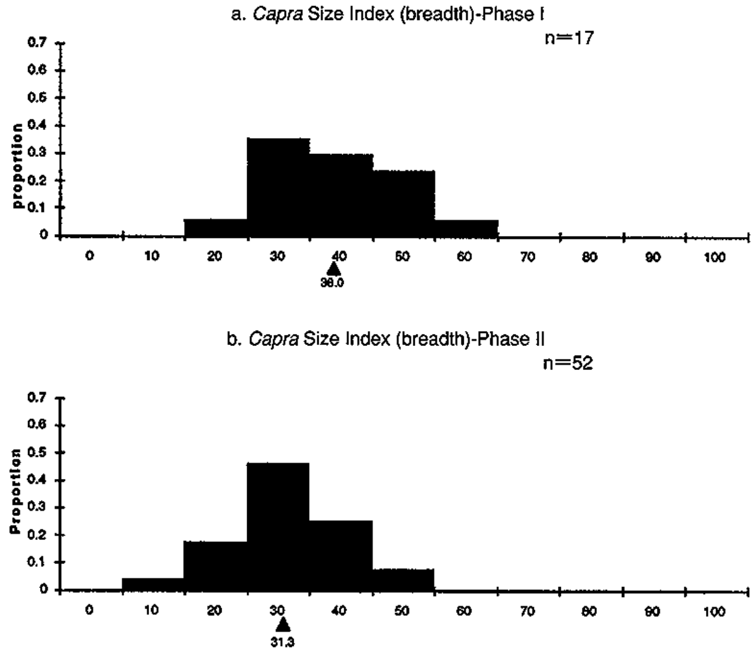


Fig. 12.1. Size Index Disributions for *Capra* (Breadth).

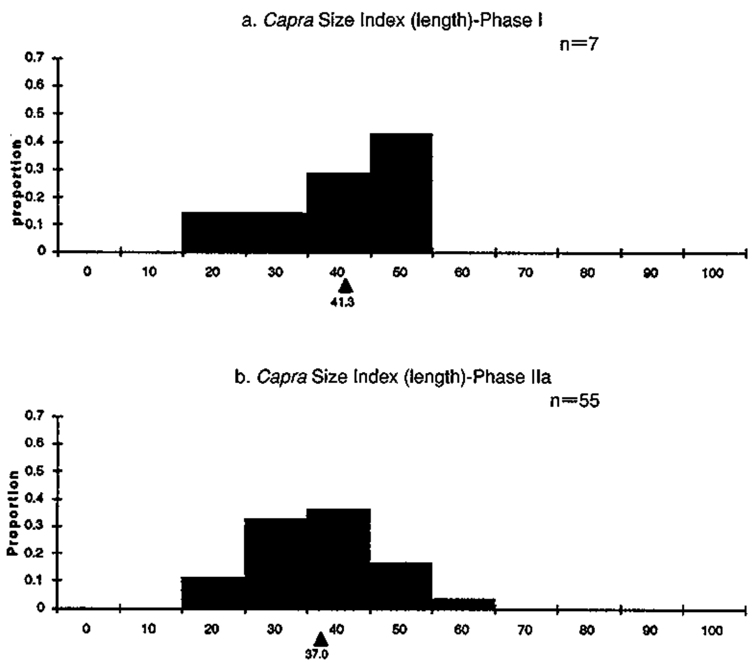


Fig. 12.2. Size Index Disributions for *Cspra* (Length).

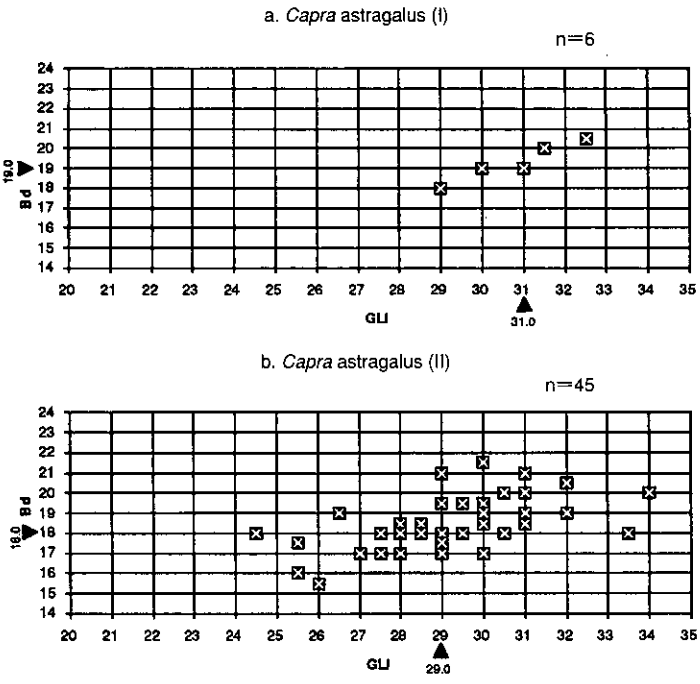


Fig. 13.1. Measurements of *Capra* Astragali (Bd against GLI).

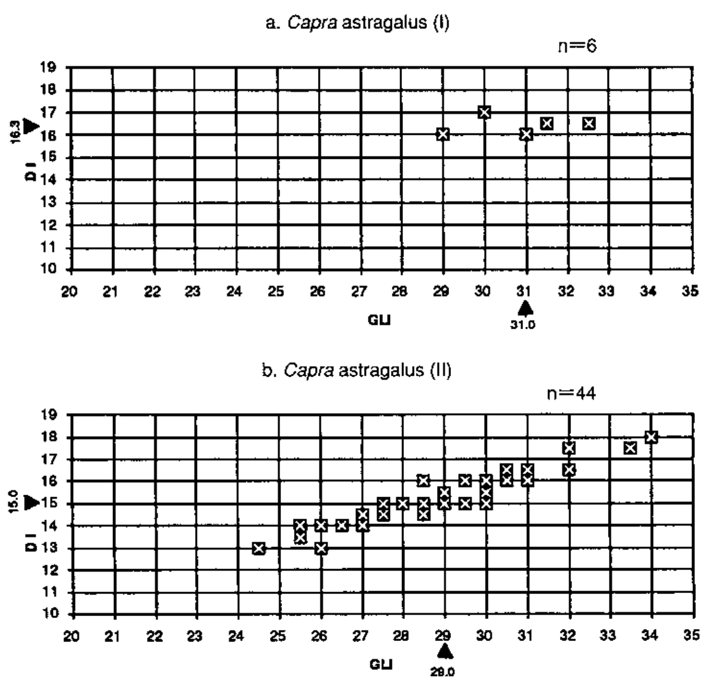


Fig. 13.2. Measurements of *Capra* Astragali (DI against GLI).

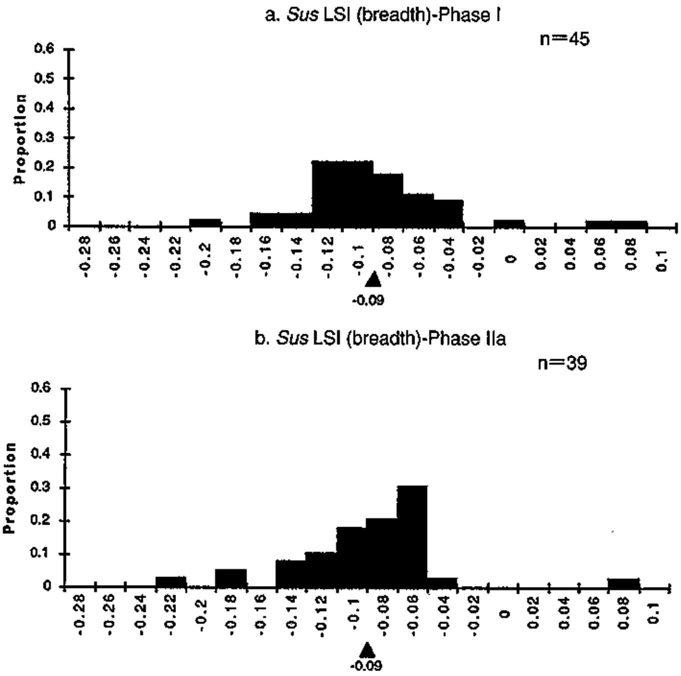


Fig. 14.1. Long Size Index Disributions for *Sus* (Breadth).

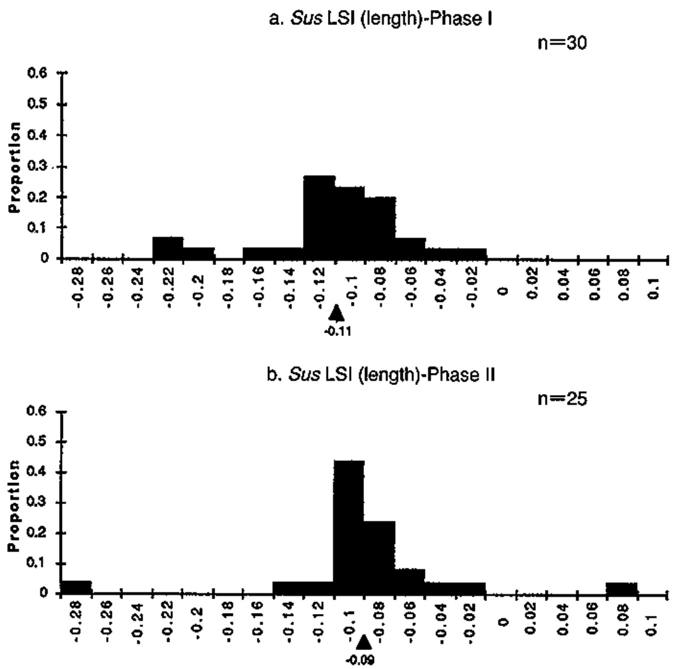


Fig. 14.2. Long Size Index Disributions for *Sus* (Length).

5. Modification of Bones

5.1. Cut marks

Compared to the previous phases at the site, cut marks are more frequently found on bones from Phase I. The increase in heavy chop marks in this phase indicates both an increase of heavy duty cutting tools and a change in butchery practices. The proportion of cattle bones among the total identified cut bones is higher than the taxon's proportion in total NISP in all periods at the site (Hongo, 1996). In Phase I, the proportion of cut cattle bones is particularly high, and is more than twice that of the proportion of cattle in total NISP.

5.2. Pathology

In Phase I, the frequency of pathological bones increases to c. 0.7% of total fragments from 0.2% or less in Bronze and Iron Ages. Among the pathological specimens from Phase I, all but one large bird bone come from cattle or water buffalo. Seven out of ten pathological specimens are cattle or water buffalo lower leg bones (distal tibia, carpal, tarsal, and phalanges including two specimens belonging to a water buffalo) with exostoses. These pathological cattle and water buffalo bones suggest that these animals were used for traction, probably in agricultural fields. Bone exostosis on lower leg bones was rare in cattle bones from the Bronze Age, and was only occasionally found in those from the Iron Age.

Thus, the increase in cut marks on cattle bones and the increase in pathological cattle bones suggest that while cattle's use as a source of meat became increasingly important, the demand for agricultural labor from large bovids also increased and there was more intensive use of these animals in agricultural fields in Phase I than before.

DISCUSSION AND CONCLUSION

The significantly larger size of sheep and goats as well as cattle compared to previous periods at the site indicate a mature and stable agro-pastoral economy in the Ottoman period with the introduction or development of improved breeds. Camels and water buffalo were introduced, the former for use in long-distance trade and the latter for the use in agricultural fields. Chickens were also introduced by the Ottoman period, and their eggs were used.

Kill-off patterns of both sheep and goats show two peaks, one at the infantile/juvenile stage and another at the adult stage. The kill-off patterns suggest that the use of sheep and goat was more diversified, and larger animals were preferred because the emphasis was also put on meat (and also milk, probably). The high proportion of adult and old sheep suggests that wool production was important. Also, subadult (male) sheep might have been exported.

An increase in pathological cattle bones, mostly foot bones with exostoses, suggests that there was a greater demand for cattle as traction animals in agricultural fields. Most pathological specimens seem to come from large old animals, which suggests that there were large oxen specifically kept for cultivation. At the same time, the increase in representation of cattle and the change in kill-off patterns suggest that the use of cattle was not confined to a traction animal in agriculture and cattle were also important as a major source of meat.

Pigs decreased drastically probably because of the avoidance mandated by Islam, but the presence of a small number of pigs at the site suggests that the site probably remained multi-ethnic well into the Ottoman period.

Although there are no reliable statistics concerning the numbers of Turks and Christians in

Anatolia in the Middle Ages, it seems that the Christian population outnumbered the Muslims at least until the 13th century (Vryonis, 1969-70). One account maintains that by the late 15th century, more than 90 percent of the Anatolian population was Muslim (Barkan, 1958: 30). There were, however, regional differences in the degree of impact from Turkish advances, with cities on the Black Sea and Mediterranean coasts holding out longer under Christian rule. In the central and western Anatolian plateau, many towns were captured and regained time and again by both sides. Even at the end of 19th century, however, Christians (Armenians and Greeks) outnumbered Turks in some provinces along the southern coast, and there was also a significant concentration of Greeks in Cappadocia (Birken, 1976).

The Turks were nomadic pastoralists who also benefited from warfare and raiding when they first came to Anatolia. The Turkish "conquest" of Anatolia was, in short, characterized by a retention of local sedentary cultural elements. In the process of the conquest, the Turks exerted a direct control over the vassal states in Anatolia through the *timar* system which was based on official registration of the population and resources. This method of ruling was in fact a conservative one which aimed at gradual assimilation in the sense that local conditions and classes were preserved and reconciled with Ottoman institutions (Inalcık, 1954). Under Turkish rule, Orthodox churches and their lands were often officially recognized by the sultans (Vryonis, 1969/70). Byzantine influences are especially visible in aspects of the agriculture, crafts, and commerce as well as in the administrative system (Inalcık, 1954; Vryonis, 1969/70). Although there was considerable displacement, and the majority were converted after the 13th century, Christians dominated in the agricultural sector. Christian craftsmen continued to work in weaving, metalworking, and pottery manufacture. Persian, Arab, and Jewish craftsmen were also numerous in Anatolia. The lives of Muslims and Christians were not completely segregated, and mixed marriages of Muslims and Christians were common.

Also, the conquest of a city by one group did not necessarily mean a total replacement of the population by the conquerors. Although there is no doubt that the Turkish invasions were destructive in many cases (see Vryonis, 1969/70), when there was a stable period under a centralized Turkish state, the community could recover and thrive again. Inalcık (1954: 103-129) discusses an Ottoman policy concerning the population of conquered towns by quoting from an early Ottoman chronicle and a chronicle by Bertrandon de La Broquiére who traveled between Constantinople and Adrianople in 1432. The towns that surrendered without fighting were left undisturbed and the residents' lives, property, and religious rights were fully protected, providing that the Christian population agreed to pay an additional tax. Towns that surrendered after some resistance were repopulated by both Turks and Greeks. Only the towns that fought hard against the Turks were destroyed and looted, and repopulated only by Turks.

Thus one can see significant influences of Greeks and other ethnic groups in every aspect of political institutions and culture. The presence of Turkish speaking Greek Christian communities in Anatolia, who use Greek alphabets for writing (Vryonis, 1969/70; Dawkins, 1916) shows how the language of the dominant political group was quickly adopted by the native population. Nevertheless, the Greek or Christian tradition was carried on especially at the level of folk culture. Some of material manifestations of the mixture of Christian and Muslim traditions listed by Vryonis (1969/70) show how misleading such hybridization can be from an archaeological point of view: Some Seljuk sultans used Byzantine style clothing and produced coins bearing a sultan wearing Byzantine imperial garb or with Christian iconography and Greek inscriptions;

Some Turkish seals employ Christian iconography of saints and the Virgin; The cross was believed to have healing or protective powers and was often carved on buildings. In one case, a cross was attached to the crescent on a mosque.

Another factor that should be considered in terms of ethnic diversity in Anatolia is the nomadic Türkmen tribes. During the period of 400 years following the Ottoman conquest of Constantinople there were almost constant waves of various nomadic Turkish groups migrating into Anatolia. While some of these Türkmen tribes became sedentary, some remained as nomadic groups. These Türkmen groups, together with other nomadic groups such as Kurds and Arabs, were called Yürüks and played a significant economic and military role during the Ottoman period. There is a record from the 16th century mentioning pasture near Ankara given to the nomadic groups (Inalcık, 1986). Although the extent of interaction between these nomadic Türks in the area and the sedentary population at Kaman is unknown, the existence of these nomads must be noted when the pastoral economy in the region is discussed.

The existence of unorthodox Muslim sects in central Anatolia further complicates the question of ethnicity at Kaman-Kalehöyük. These Kızılbaş and Bektaş sects belong to the Shia order, while the mainstream Muslims in Anatolia belong to the Sunni order. The distribution of these Anatolian Shia sects, Kızılbaş in eastern Anatolia and Bektaş in the district of Cappadocia, suggest that they had been in close contact with Armenian or Greek Christians and were considerably influenced by their religion. The beliefs of these sects have much in common with Christian theology, such as the idea of a holy trinity. The veiling of women, circumcision, and the five prayers are not practiced and they tend to deny polygamy. They drink wine in their rituals and, what is important for this discussion is that they are said to eat pork, although this account might have come from a prejudice against the members of the unorthodox sects. Although whether the members of these Anatolian sects were local Christian converts is still an open question, as Hasluk (1929: 157-8) warns, these unorthodox sects were probably more attractive to local Christians when the latter considered conversion. The center of the Bektaş sect was located in Kırşehir, and it is possible that the residents of Kaman in the Ottoman period belonged to this sect, although no evidence to prove this theory has been found at the site.

In the present analysis, assemblages from the upper and lower levels of Phase I were not studied separately, because the presence of these two levels and the possible existence of a temporal hiatus between them had not yet been clearly established when the samples for analysis were chosen. As far as taxonomic abundance is concerned, however, temporal and spatial variation exist in the proportion of pigs among the different archaeological contexts of Phase I (Table 3). The assemblage from the workshop contained as high a proportion of pigs as in the Iron Age assemblage, but caution must be taken in interpreting the result because of the small sample size. The sampled assemblage from the earlier building levels (R 69 in Subphase Ib) does not show particularly higher proportion of pigs in comparison to those in upper levels (Subphase Ia), although observations from the results of a more superficial survey of faunal remains from many Phase I contexts suggest that pig bones might be more abundant in the earlier building levels than in the upper levels.

Given the fact that the buildings of Subphase IIa were extensively destroyed by construction activities in Phase I, the possibility that more Iron Age materials were mixed in Subphase Ib than in Ia can not be ruled out. With this reservation in mind, considering the presence or absence of pig bones as an indicator of the religious affiliation of the residents of the site, variation in the proportion of pigs in different contexts suggests two things (which are not mutually exclusive). First, the presence of pigs indicates that not all the residents of the site were practicing Muslims. If indeed fewer pigs are found in Subphases Ia than in Ib, that would indicate a gradual process of Islamization, not a "conquest" followed by total replacement of the population or a forced conversion. Islamization progressed either by the Turks moving into the site over a long period of time, or by the gradual conversion of predominantly Christian residents to Islam, or by a combination of both. Secondly, the composition of the population remained multi-ethnic during the Ottoman period, but different sections of the site were occupied by different ethnic groups. The high proportion of pig bones in the workshop area may suggest that Christians were involved in craft manufacturing activities. Various ethnographies suggest that the Greeks and the Armenians were active in craft manufacturing, including mining and metalworking (Vryonis, 1969/70: 283; Mayer, 1959: 16). At present, the analyzed sample is too small to support or negate these possibilities. Comparison of assemblages from earlier and later phases and also of assemblages from different kinds of contexts is necessary in the future and could make a significant contribution to the study of the process of Islamization in central Anatolia.

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オスマン朝時代の中央アナトリアにおける家畜飼養形態、環境、民族：カマン・カレホユック遺跡イスラム時代層出土の動物遺存体

本郷一美

要旨：オスマン・トルコによるコンスタンチノープル征服（1453年）以降のアナトリアは、トルコ民族統治下の「イスラム時代」と称されることが多い。しかし、この呼称は、オスマン朝時代のアナトリアにおける民族的、文化的多様性を無視したものである。本論文は、トルコ共和国クルシェヒル県にあるカマン・カレホユック遺跡のオスマン朝時代の文化層から出土した動物遺存体の分析結果をもとに、オスマン朝時代の中央アナトリアにおける牧畜経済を考察したものである。オスマン朝時代の人々の日常生活に関する、主にヨーロッパ人によって書かれた民族誌は多く残っているが、家畜飼養に関する記録はほとんどないといってよい。本論文では、家畜種の相対的な割合、屠殺パターン、家畜のサイズ、骨に残る解体痕や病変の痕などのデータにもとづき、オスマン朝時代の家畜飼養形態、遺跡の政治経済的地位、環境を、同じ遺跡の鉄器時代の資料とも比較しながら論じた。

オスマン朝時代には、アナトリア地域にもともと存在しなかったラクダとスイギュウが飼育されるようになった。全体的に安定した農村経済における小規模な家畜飼育が行われていたと考えられ、家畜のサイズも、鉄器時代と比較して大型化した。また、ブタを食べることが宗教的なタブーとなっているはずの時代であったにもかかわらずブタの骨が相当量出土していることから、カマン・カレホユックの住民の中に、キリスト教またはイスラム教の異端派に属する者がいた可能性がある。