Çukuriçi Höyük – Animal exploitation from early Ceramic Neolithic settling to early Bronze Age proto-urban life at the western coast of Anatolia

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Abstract / Zusammenfassung

Çukuriçi Höyük is located in the vicinity of Ephesos, the ancient „*metropolis Asiae*" at the Turkish west coast. Archaeological research at this site indicates habitational sequences over a long period, lasting from the Early Ceramic Neolithic, the Early Chalcolithic to the Early Bronze Age. In this region, it is one of the rare and outstanding examples for long lasting settlement activities. The setting of Çukuriçi Höyük near the coast and the quality of the material excavated certainly will provide proof for the existence of maritime and inland exchange routes and thus, help to understand the expansion of the Neolithic. In addition to the exploitation of livestock and natural resources, this topic will of course also be a focus of this paper. Domesticates generally provided the main supply of animal protein for the inhabitants of the site, especially in the earlier phases. This is when the keeping of domestic pigs gained importance, although it was exactly during this period that pigs and other domestics exhibited characteristics shared by both wild and domestic animals. Differences in the frequency and age class distribution of the major domesticates indicate a shift in livestock management from the Late Neolithic to the Early Bronze Age. Furthermore, an increase in the exploitation of small and big game and notably the exploitation of marine resources during the Early Bronze Age all evidence a clear shift in diet. Either environmental or cultural changes may be responsible for this development. The vast amount of material from Çukuriçi Höyük provides the opportunity to document these developments over a time span of about three thousand years.

Çukuriçi Höyük liegt nahe Ephesos, der antiken „*metropolis Asiae*", an der Westküste der Türkei. Archäologische Ausgrabungen an diesem Fundplatz haben eine Besiedlungssequenz erbracht, die vom frühen Keramischen Neolithikum über das frühe Chalcolithikum bis zur frühen Bronzezeit reicht. Regional ist dies eines der seltenen und herausragenden Beispiele für lang andauernde prähistorische Besiedlungsaktivitäten. Die Lage von Çukuriçi Höyük an der Küste und die Qualität der ausgegrabenen Funde können dazu beitragen, die Existenz von Gütertauschrouten über das Meer und ins Hinterland aufzudecken und gleichzeitig zum Verständnis der Ausbreitung des Neolithikums beitragen. Neben der Nutzung von Haustieren und natürlichen Ressourcen steht auch diese Frage im Zentrum des vorliegenden Beitrags. Generell lieferten Haustiere den wesentlichen Proteinanteil für die Ernährung der Siedlungsbewohner, vor allem in den ältesten Phasen. Eben dann ist auch die Schweinehaltung von ökonomischer Bedeutung, obwohl beim Schwein und anderen Haustieren gerade in dieser Phase vermehrt Individuen mit intermediärem Charakter zwischen Wild- und Haustier in Erscheinung traten. Vom späten Neolithikum zur späten Bronzezeit können bei den Mengen und in der Altersverteilung der wichtigen Haustiere Unterschiede festgestellt werden, die mit einem wechselnden Tiermanagement zusammenhängen. Daneben zeigt auch das Ausmaß der Jagd auf Hoch- und Niederwild und die generell an diesem Platz umfangreiche Nutzung mariner Ressourcen in der frühen Bronzezeit eine ansteigende Tendenz und bestätigt, dass Veränderungen in der Nahrungsversorgung tatsächlich stattgefunden haben. Hierfür können neben Umweltveränderungen auch soziokultureller Wandel verantwortlich sein. Das Fundmaterial vom Çukuriçi Höyük bietet aufgrund seiner Fülle die Möglichkeit, solche Entwicklungen über eine Zeitspanne von rund 3000 Jahren nachzuzeichnen.

Keywords: Çukuriçi Höyük, northwest Anatolia, Neolithic, Bronze Age, maritime society, changing economy
Çukuriçi Höyük, Nordwest-Anatolien, Neolithikum, Bronzezeit, maritime Gesellschaft, variable Ökonomie

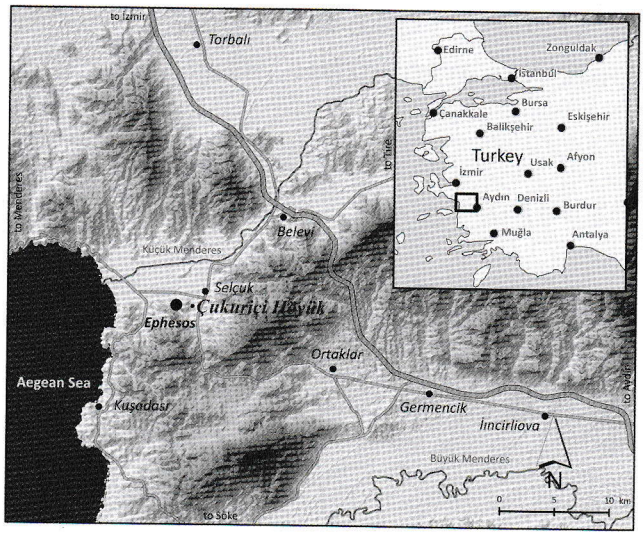

Fig. 1: Geographical position of Çukuriçi Höyük south east of the town of Ephesos (Austrian Archaeological Institute, map Chr. Kurtze).

Introduction

The prehistoric and interdisciplinary archaeological project on Çukuriçi Höyük initially was established a decade ago at a time when Neolithic investigation were scarcely documented in western Anatolia (Lichter 2005; Horejs et al. 2015), contrary to the much better documented early prehistoric history of southern and eastern Anatolia, the Aegean and southeastern Europe. Until today the situation substantially improved for the archaeozoological knowledge in western Anatolia (Çilingiroglu et al. 2012; Çakırlar 2012a, 2012b; Çevik 2016; Gerritsen et al. 2013a, 2013b; Çakırlar & Atici 2017, Atici et al 2017).

Çukuriçi Höyük lies about one kilometer southeast of the ancient "*metropolis Ephesos*" at the Northwestern Aegean coast of Anatolia (Horejs 2012c, Fig. 1), where, unsurprisingly, archaeozoological investigations mainly focused on classical and antique faunal material (Forstenpointner et al. 2008, 2010; Galik et al. 2010a, 2010b, 2014, 2016). The prehistoric site was originally located close to the seashore and was surrounded by mountains and plains.[1] Because some parts of the excavated Neolithic material have yet to be analyzed, the results presented here should be considered preliminary. Nonetheless, it is important that the data available from Neolithic and early Bronze Age Çukuriçi Höyük will be published.

The Neolithic material is subdivided into two groups in order to avoid incommensurability according to the stages of research between the phases. The chronological earlier group starts with the beginning of the settlement and can be set at 6684 ± 28 cal. BC. (Horejs et al. 2015, Horejs 2017). The Neolithic stages are divided into two groups. It includes the phases ÇuHö XIII-XI in a time range from 6680 cal BC to 6400 cal. BC. (ibid.). The subsequent Neolithic group covers phase ÇuHö X-VIII (6400 - 5970 cal. BC.; ibid.). After a hiatus, the settlement continues with the late Chalcolithc phases ÇuHö VII, VI and Vb (Schwall 2016; Horejs 2010, 2014). The Early Bronze Age I is represented by the phases ÇuHö Va, IV and III (Horejs & Weninger 2016, Horejs 2017). Unfortunately, most of the late Chalcolithic faunal material has not been examined yet (Galik 2014) and none of the material from EBA I ÇuHö Va has been studied. In terms of quantity, the Chalcolithic material is not comparable to the Neolithic and Bronze Age faunal material, therefore, it was not included in the analysis. The other archaeozoological remains are less represented in phase IV but better represented in phase III and are therefore, according to its chronological stage, included into the analyses as EBA I faunal material. The archaeozoological results present an intra-site study covering a time span from the 7th to the 3rd millennium BC. The Neolithic fauna is partly related to excavated house contexts including surrounding yards in Neolithic architecture (Horejs et al. 2015, Horejs 2017). The settlement structure changed completely in the EBA1, where the living areas were densely covered by houses with multiple rooms (Horejs 2009, 2012, 2017; Grasböck 2013). Nevertheless, the excavations directly took place in the areas of daily living in the settlement, which are documented by the excavation of cultural layers alternating with re-intrusive covering sediment layers (Fig. 2, 3).

1 https://defc.acdh.oeaw.ac.at/cukurici-movie/

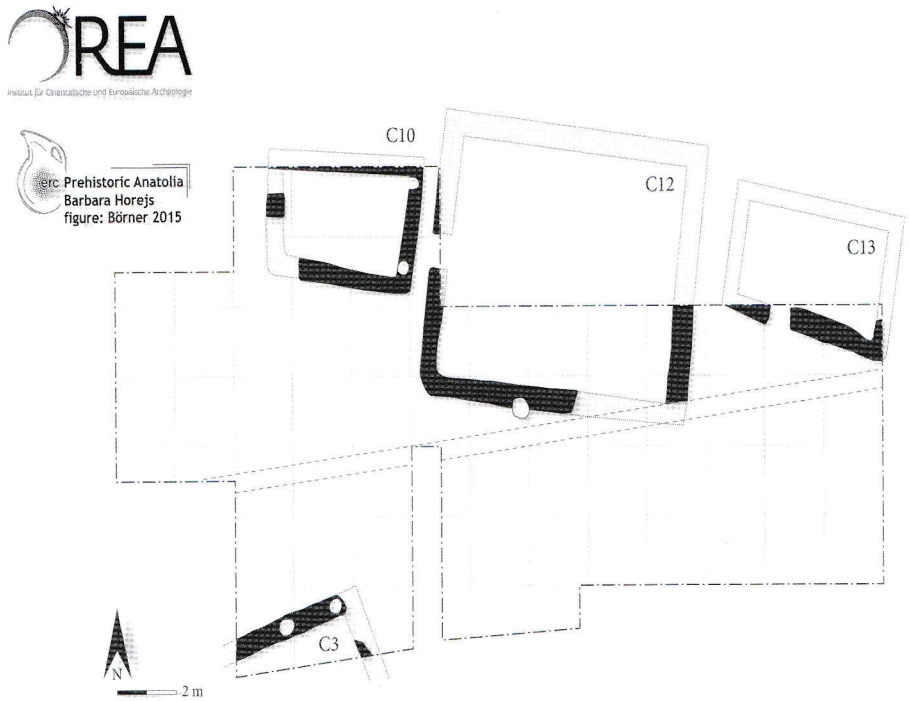

Fig. 2: Excavation in the Neolithic settlement in phase X (Horejs et al. 2015).

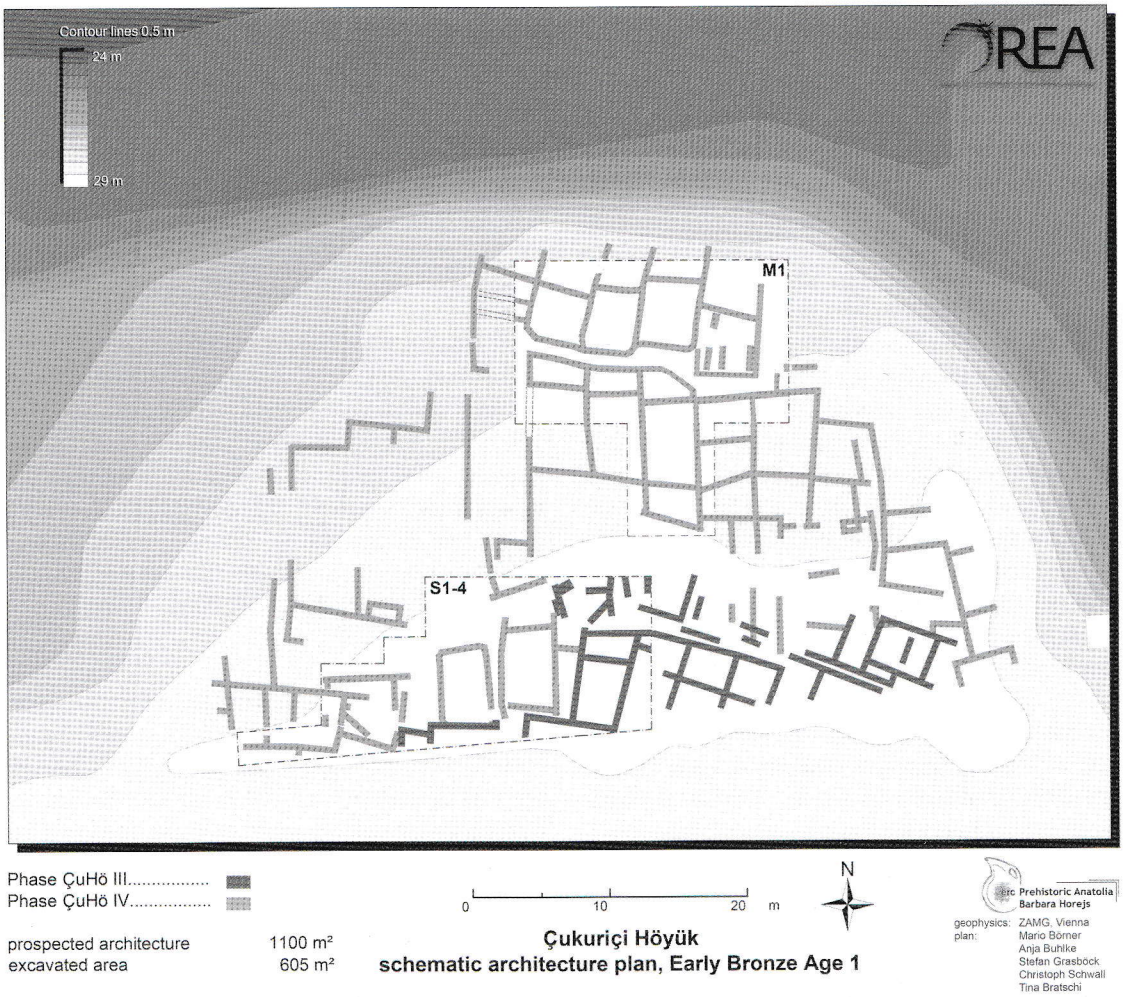

Fig. 3: Phase III and phase IV in the Early Bronze Age 1 settlement (Horejs et al. forthcoming).

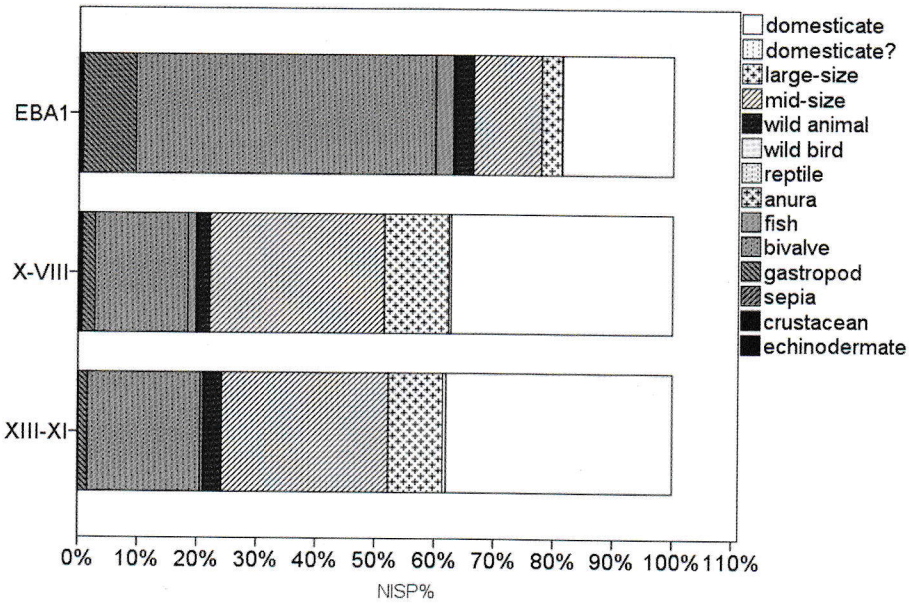

Fig. 4: Numerical quantification of archaeozoological finds.

Material and Methods

As a part of a research project, the excavation campaigns followed very high standards. Besides hand collecting, all excavated sediment was dry-sieved and sediment samples were taken from all sediment layers. After flotation and wet sieving of the sediment, sieve residues were screened for archaeobotanical and -zoological "micro-finds". The very well documented architectural and archaeological structures form the basis for further investigations about the consistency of prehistoric households. The intra-site results presented remain preliminary at a certain stage because certain parts, especially from the early Neolithic phases, must still be analyzed in the future. A bias certainly will be caused by the fact, that for some of the layers most of the sediment samples are analyzed and for others they are not, which results in an over- and underrepresentation of "micro finds". Careful skeletal examination was carried out with the support of the reference collection at the excavation house of the Austrian Archaeological Institute in Selçuk, Turkey. Whenever possible, species, bone element and anatomical side were identified and recorded.

Species identification of sheep and goat mandibular teeth as well as ageing was conducted according to Payne (1973), Halstead and Collins (2002) or Zeder (2006). The dental age distribution is calculated according to the principles presented by Payne (1973). The age at death values are expressed according to their relative frequency density and the unequal proportion of months in the diagram is expressed by its bin width (0-2 m=1/6; for example; Brochier 2013). The age classes derived from postcranial elements (i.e. elements of the limbs) are mainly categorized following Habermehl (1975) and Zeder (2006). The culling profiles received from mandibular dentition as well as the status of the epiphyseal fusion of limb bones are depicted in two ways: One is calculated using all available information, the other shows the distribution of culling stages calculated on the basis of MNI calculated per element. The NISP values of the dental ageing are indicated by framed bins while the values calculated from the MNIs are marked only by grey background colour. In case of postcranial ageing, both of the bins for the NISP as well as for the MNI values for each element are shown.

The reconstructions of the size distribution of the major domesticate populations as well as potential wild progenitors are run by using the LSI-method (Meadow 1999). The measurements of wild standard individuals, aurochs, wild sheep, wild goat and wild boar are obtained from Degerbøl and Fredskild (1970), Uerpmann (1979) and Hongo (1998). Sexing is based on remains reflecting sexual dimorphism like canines, horn cores, atlantes and coxae (Ruscillo 2006).

Results

1. Domesticates:

Categories of animal remains show similar distributions within the Neolithic phases and fragments of mid-sized and large-sized animals, in that order, dominate. The bones are heavily fragmented and bone splinters from large- and especially mid-sized animals drastically decrease in a comparison of weight (Fig. 4; Tab. 1 and Fig. 5; Tab. 2).

	EBA1		X-VIII		XIII-XI	
	NISP	WIS	NISP	WIS	NISP	WIS
domesticate	3769	33813.7	9478	94041.5	5853	40144.1
domesticate?	9	255.1	88	2777.5	82	2110.2
large-sized	693	4574.8	2758	12958.4	1405	4883.7
mid-sized	2297	5383.1	7461	10851.1	4313	4903.3
wild animal	645	13932	532	5834.1	458	3855.6
wild bird	34	38.4	34	20.8	14	4.5
reptile	11	14.3	21	17.1	3	3.3
anura	5	1	3	0.1	1	1
fish	613	140.8	345	117.8	77	126.7
sepia	7	6.8	1	0.5	1	12.5
bivalves	10162	39849.7	3970	22033.3	2912	10759.3
gastropods	1802	2104.8	554	1372.5	236	882.2
crustacea	17	7.7	3	4		
echinodermate	99	7.3	152	8.1	7	0.6
total	20163	100129.5	25400	150036.8	15362	67687

Table 1: Numerical and weight distribution of domesticates and wild animals.

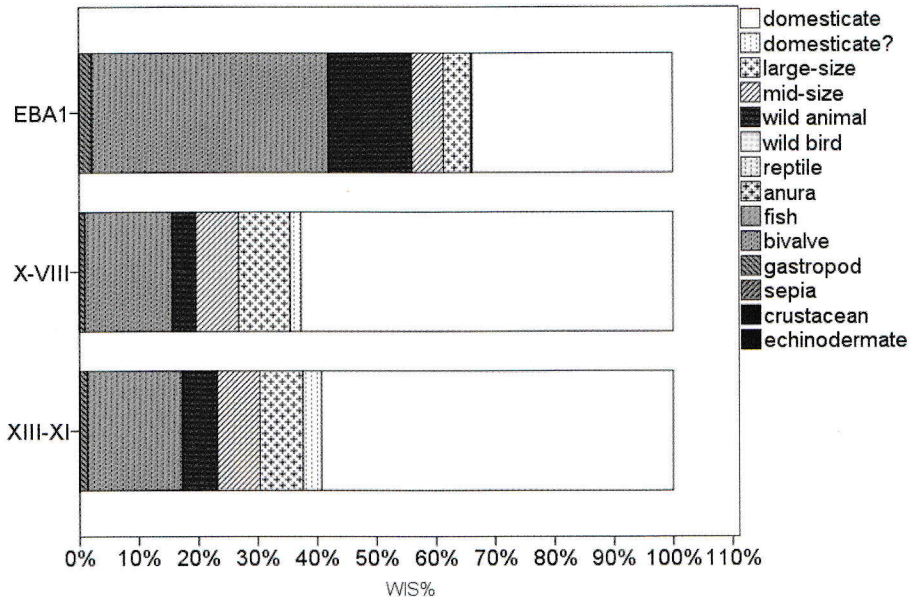

Fig. 5: Weight quantification of archaeozoological finds.

In addition to a few dog finds and some coprolites, ovicaprines numerically dominate the major domesticates with 62-66% followed by cattle at 20-27%. Pig is weakly represented with about 1% in the earliest phases and up to 6% in the subsequent periods. Bone weights indicate a similar distribution, but cattle totals about 60% in the Neolithic, however, weight distribution shows a decrease of cattle and an increase of ovicaprines in the EBA1 (Fig. 6).

1.1 Sheep/goat

The earliest Neolithic phases contain a higher proportion of sheep than goats (ratio sheep/goat 1,64), while in phase ÇuHö X-VIII the ratio of sheep to goat appears quite balanced (ratio sheep/goat 0,97; Fig. 6). In the EBA1 more goats are present than sheep (ratio sheep/goat 0,68). The major part of LSI-values clearly position sheep and goat in the size range of domesticated animals (Fig. 7, 8). However, both species show very large outliers in the size range of wild sheep and wild goat in all phases. Especially phase ÇuHö X-VIII shows

	EBA1		X-VIII		XIII-XI	
	n	weight	n	weight	n	weight
Sus sp.			52	654.8	67	271.9
Sus dom./pig	221	1672.5	561	5211.3	35	172.2
Bos primigenius?/aurochs	4	199.8	10	1676.1	10	1091.1
Bos taurus/cattle	757	16323.2	2481	59355.9	1594	25640.1
Ovis orientalis?/wild sheep?	1	12	1	35.4	3	698
O.orie?/C.aeg?/wild ovicaprine?			7	89.5	22	161.1
Ovis/Capra/ovicaprine	2486	12140.4	5904	23361.1	3828	10679.6
Ovis aries/sheep	122	1157.8	265	3026.2	232	1964.7
Capra hircus/goat	175	2358.6	254	3025.6	141	1422.6
Capra aegagrus?/Bezoar goat?	4	43.3	18	321.7	2	143.5
total	2787	15700.1	6441	29734.6	4203	14210.4

Table 2: Numerical and weight distribution of domesticates.

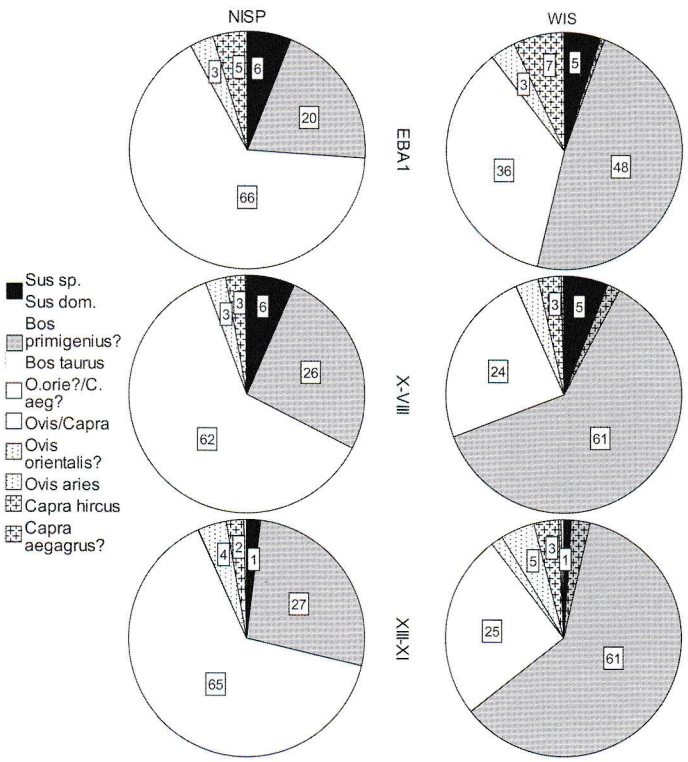

Fig. 6: Numerical and weight quantification of the three major domesticates.

a wide size distribution of very large- but also very minute adult sheep and goats, which appear in the size of "*dwarf*" forms. The size distribution of sheep and goat seems to be more homogeneous in the EBA1. The average size of sheep and goat appears quite similar in the Neolithic phases but indicates slightly larger individuals in the EBA1 (Fig. 7, 8).

In general, the MNI values seem to increase the rare finds such as erupting or unworn pd4s at the costs of the more dominant teeths. However, it appears that the main trends are not heavily changed. From the MNI-perspective, the mandibular dental culling pattern in phase ÇuHö XIII-XI at about 29% indicates a high percentage of neonate/infantile slaughtered ovicaprines. 38% of the stock was killed up to one year and about 26% up to two years. Only about 5% falls in the stage EF and older individuals are rarely present (Fig. 9). The dental age distribution clearly suggests the exploitation systems of "Milk A" and "Meat A" according to Vigne and Helmer (2007). However, the postcranial kill-off pattern is similar with a high abundance of slaughtered

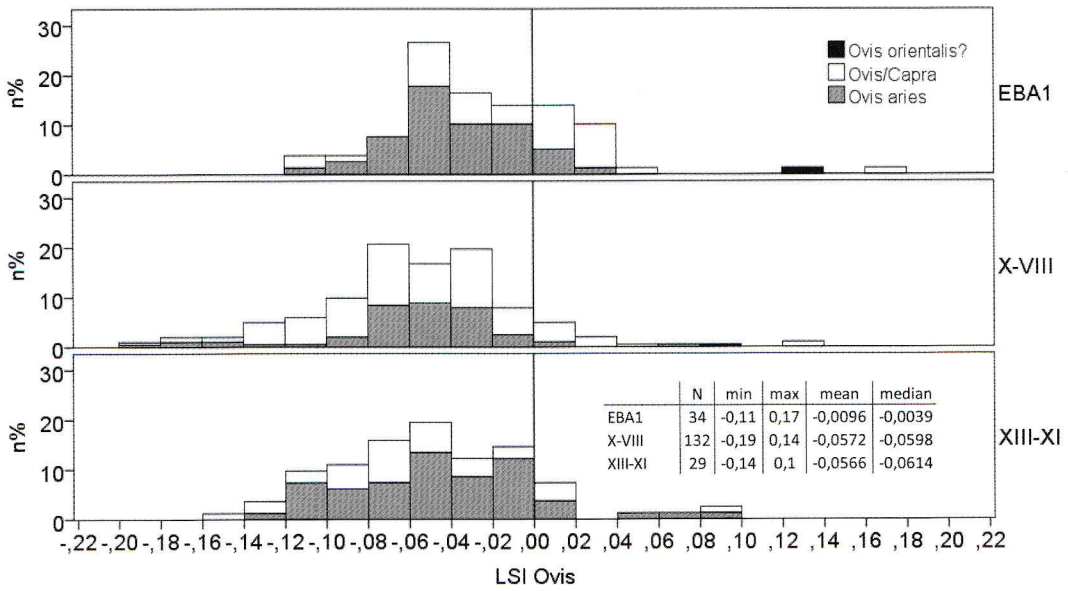

Fig. 7: LSI distribution of sheep.

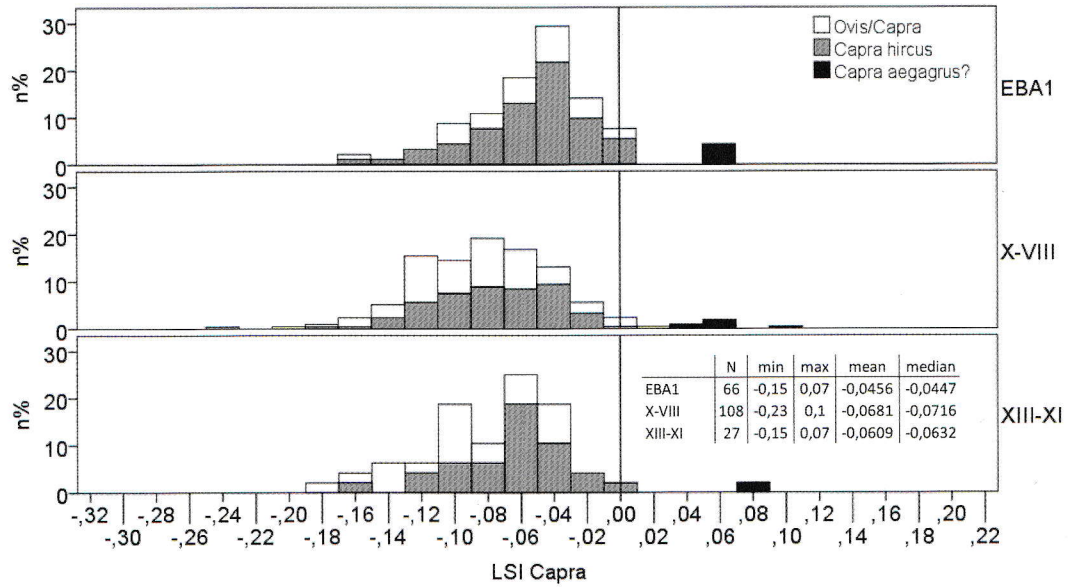

Fig. 8: LSI distribution of goat.

lambs and kids in phase ÇuHö XIII-XI (Fig. 10). It seems that a part of the individuals survived stage C and to one year and were slaughtered in the stage "12-18 months". The stage "18-30 months" contains few data but exhibits a more or less balanced distribution of unfused and fused epiphyses. Up to stage EF, a higher proportion was killed and only a minor part survived the fourth year. Individuals older than four years were obviously of less importance. The postcranial slaughter profile indicates exploitation of milk and meat in phase ÇuHö XIII-XI.

In phase ÇuHö X-VIII dental age pattern changes in slaughtered kids and lambs are less numerous, but still about 30% of the stock was killed at an age younger than half a year and a slightly less than 30% were slaughtered up to one year (Fig. 11). The stages EF and G comprise about 5%. The profile probably specifies a mixed exploitation of „Meat A and Milk A". However, the quantities of stages EF and G may also indicate the use of „Milk B". The postcranial bones in phase ÇuHö X-VIII again show a pattern of intense culling of kids and lambs up to half a year (Fig.10). The majority of livestock survived the first year and a higher proportion was killed during stage 18-30 months. Ovicaprines were mainly slaughtered at an age less than four years, although about 10% indicate surviving stage EF. Similar to the dental ages, this profile specifies a mixed exploitation of meat and milk in phase ÇuHö X-VIII.

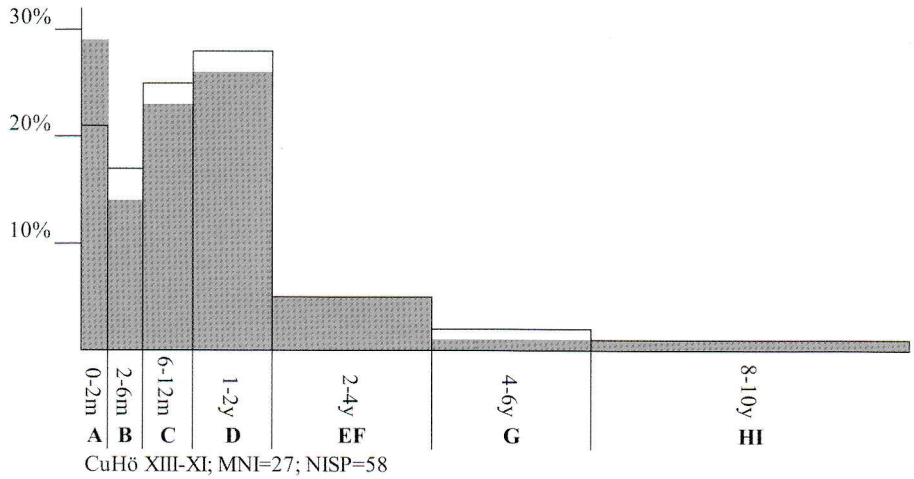

Fig. 9: Dental culling profile of sheep and goat in phase XIII-X.

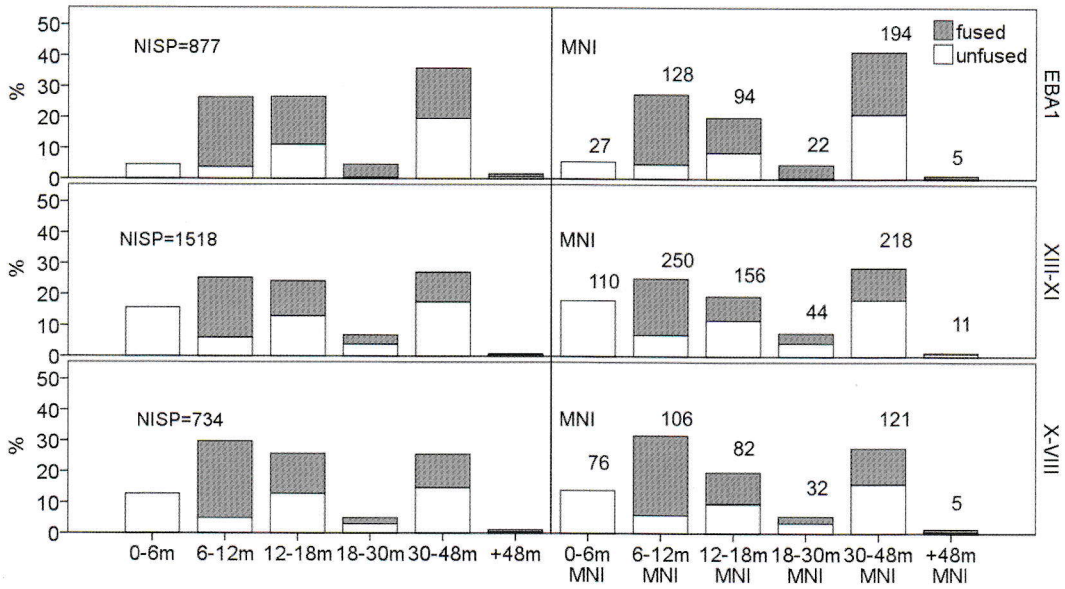

Fig. 10: Postcranial culling profile of sheep and goat.

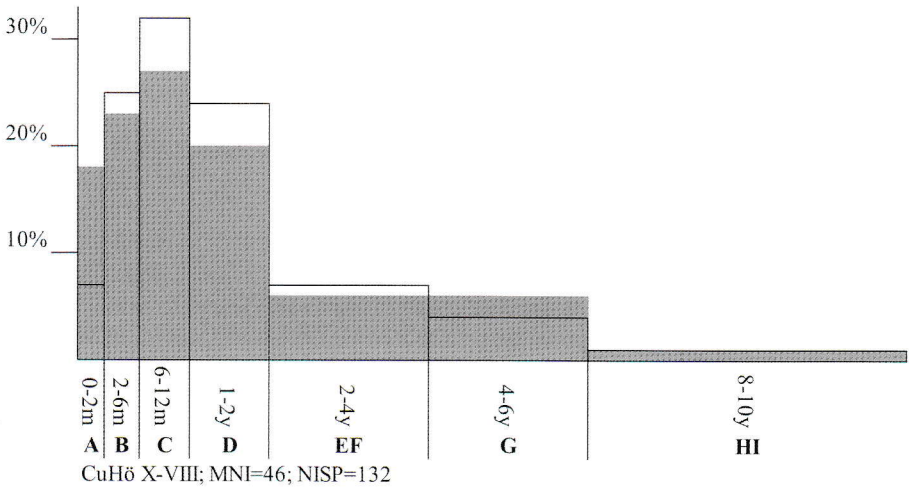

Fig. 11: Dental culling profile of sheep and goat in phase X-VIII.

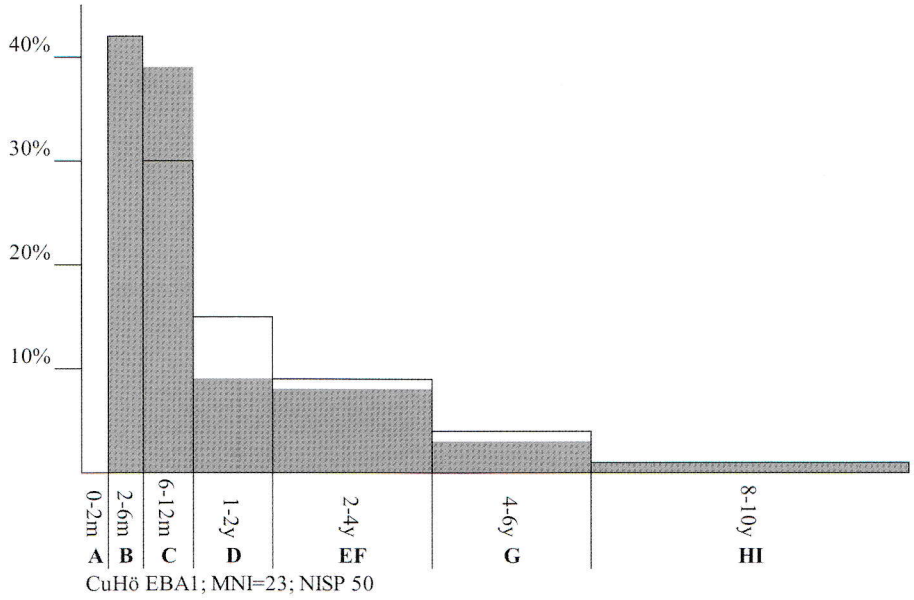

Fig. 12: Dental culling profile of sheep and goat in EBA1.

		masc	castrate?	fem	total
EBA1	Ovis/Capra	6		13	19
	sheep	3			3
	goat	2			2
total		**11**		**13**	**24**
X-VIII	Ovis/Capra	21	3	27	51
	sheep	4	1	11	16
	goat	4		3	7
total		**29**	**4**	**41**	**74**
XIII-XI	w.sheep/w.goat?	1			1
	Ovis/Capra	6		9	15
	sheep	18		6	24
total		**25**		**15**	**40**

Table 3: Sex ratios of sheep and goat coxae.

The EBA1 dental assemblage does not show evidence for culling group A, but about 40% were slaughtered at approximately half a year and another 40% up to 12 months of age (Fig. 12). Only 8% survived up to two years and 7% up to 6 years. The profile definitely indicates the exploitation of "Meat A" and stage EF might give a hint for the exploitation of "Milk B". Similar to the pattern observed with dentition, a decrease in the slaughtering of milk lambs and milk kids is visible in the EBA1 assemblages is noticeable by postcranial elements (Fig. 10). However, a higher proportion of fused epiphyses appear in the stages up to a year and up to two years. And a higher amount of individuals survived stage EF. Like the dental age culling profile, the postcranial EBA1 material indicates ovicaprines reached higher ages than in the Neolithic. The exploitation of meat shifted towards older individuals and the exploitation of Milk A is obviously less intense.

Tab. 3 contains all sexed coxae, the earliest phase ÇuHö XIII-XI reveals a surplus of male ovicaprine coxae with a ratio of 1,6. Phase ÇuHö X-VIII as well as EBA1 both indicate more female individuals with a ratio of 0.7 and 0.8 (Tab. 1). CuHö X-VIII indicated four specimens showing characteristics of castrated individuals.

1.2 Cattle:

In all phases, cattle appear to be smaller than the female Ur-reference individual, indicating the presence of domesticated animals (Fig. 13). The distribution of most measurements taken from the earliest phase ÇuHö XIII-XI is quite narrow and along a Gauß-normal distribution, with only a few small and large individuals. However, the

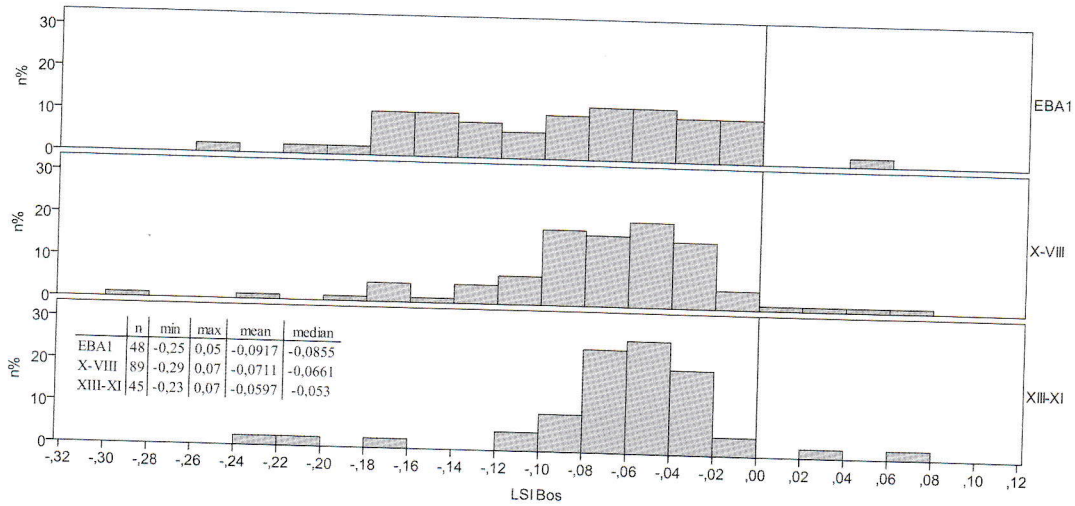

Fig. 13: LSI distribution of cattle.

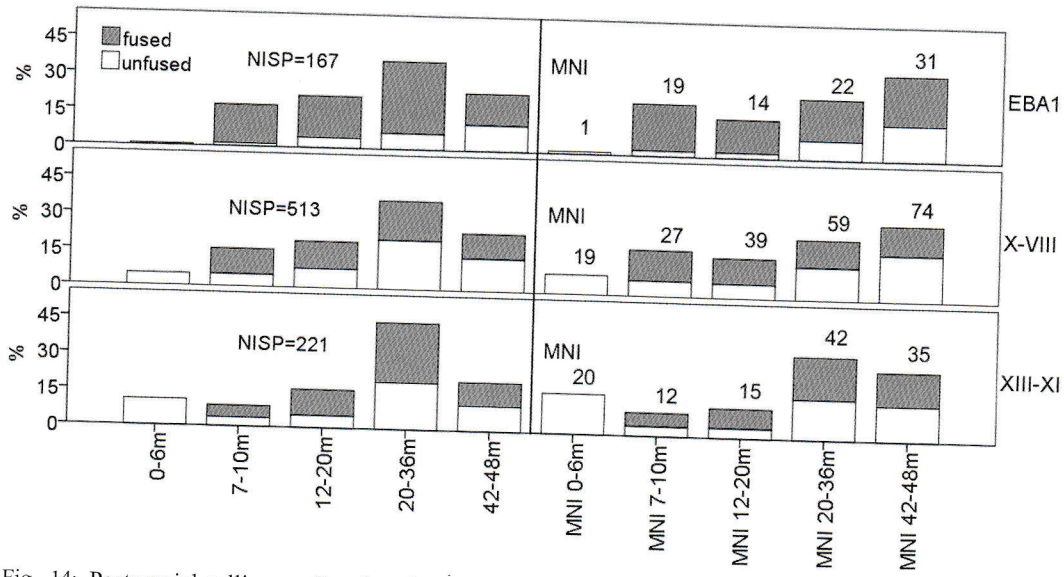

Fig. 14: Postcranial culling profile of cattle.

size distribution of cattle is quite large and indicates an increase in extreme outliers, especially with regard to very small individuals in phase ÇuHö X-VIII. Some of the unmeasurable fragments must be described as "*Bovini*". They show the anatomical characteristics of cattle, but their size range at this site is within that of very large sheep and goats, probably mirroring the complete size potential of cattle breeds, especially with respect to very small individuals. A small decrease in size is observed in phase ÇuHö X-VIII. The distribution in the EBA1 shows a flat bimodal distribution with a higher proportion of smaller individuals, and a reduction in size is clearly visible from the Neolithic up to the EBA1. This bimodality probably suggests a more or less even exploitation of bulls and cows, with sexual dimorphism, but a quite uniformly shaped breed in the EBA1 (Fig. 13).

The postcranial remains indicate a high percentage slaughter of neonate and infant individuals in the Neolithic (Fig. 14). Nevertheless, a certain proportion of individuals younger than 10 months and younger than 20 months were culled, while the proportion of animals killed increases in the stages up to three and up to four years. The postcranial pattern in the EBA1 indicates a changed system. Cattle definitely were killed at older ages than in the Neolithic. The proportion of unfused early- and mid- but also late fusing epiphyses is much lower (Fig. 14). Culling profiles based on teeth reduced to the MNI result in signals too weak for reliable results.

Only a few cattle bones could be sexed. Horn cores are also taken into account, although they do not necessarily reflect culling strategies. However, the earliest phase ÇuHö XIII-XI yielded more bull horn cores then cows, but also two cow axes and a female coxa (Tab. 4). In addition to remarkably large bone remains, most probably from aurochs, a male and five female coxae were documented in phase ÇuHö X-VIII. The situation

			masc	fem	total
EBA1	cattle	cran. fragm.		1	1
		Coxa	1	4	5
total			**1**	**5**	**6**
X-VIII	aurochs	Coxa		1	1
	aurochs?	cran. fragm.	1		1
	cattle	Coxa	1	5	6
total			**2**	**6**	**8**
XIII-XI	cattle	cran. Fragm.	7	2	9
		Vert. cerv.		2	2
		Coxa		1	1
total			**7**	**5**	**12**

Table 4: Sex ratios in cattle.

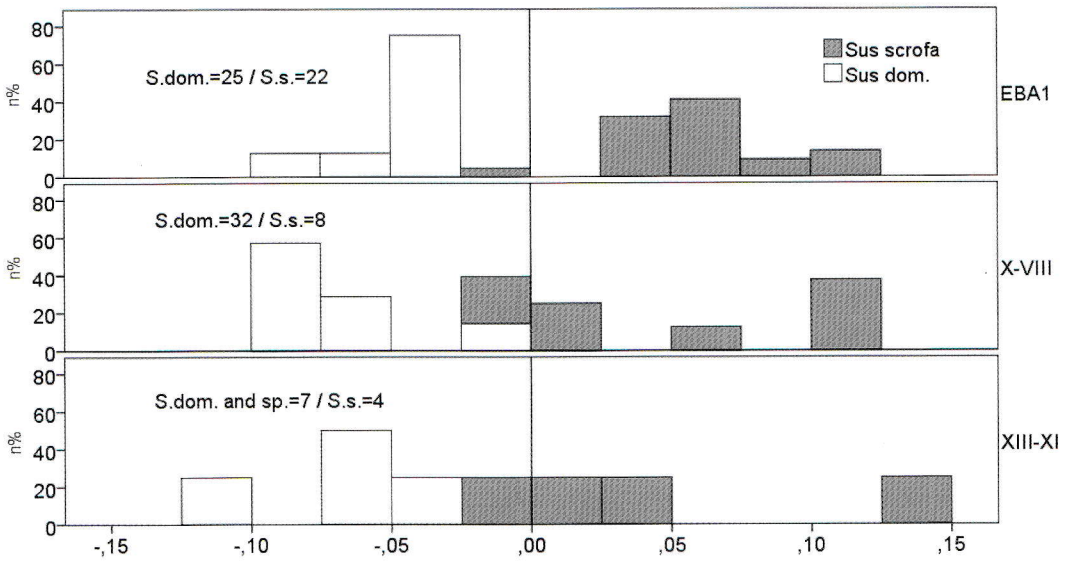

Fig. 15: LSI distribution of pig and wild boar.

in the EBA1 is quite similar with one bull coxa and four cow coxae. Based on the postcranial skeleton, it is apparent that more female individuals were slaughtered in comparison to the bulls.

Surprisingly, considering the quantities of cattle remains examined, very few pathologies were diagnosed on the bones: six in phase ÇuHö XIII-XI, 9 in phase ÇuHö X-VIII and five in the EBA1. A mandible indicates inflammation of the gum with osteologically visible structures buccal of the M2 and the M3 (phase ÇuHö XIII-XI). In one instance, a part of the *cochlea radii* appears reduced after a potential fracture of the joint surface. Another local bone fracture caused callus production on a metacarpus disto-cranial of the proximal joint. A rib shows strange circular impressions in cranio-caudal orientation and a metatarsus is pathologically widened plantar-medial at the shaft. Finally, a primary phalanx indicates development of small osteophytes in the axial ligament groove. Periostitic bone growth on a zygomatic bone and a molar deformed at its crown basis, come from phase ÇuHö X-VIII. A lumbar vertebra has *Foramina intervertebralia* of differing diameter and size. The ventral end of a *Costa vera* shows periostitic bone growth and another rib indicates an unalined healed fracture. A metatarsus exhibits deformation of the medial condyle but without traces of inflammation. A *Phalanx media* displays bone growth around the distal ligament eminences due to microtraumata and the joint of a distal phalanx shows a structure similar to a *Fossa synovialis*. However, the EBA1 contains a healed rib fracture and the other arthropathologies affected four different toe bones.

1.3 Pig/Wildboar:

The few metrical data collected from adult individuals indicates exploitation of wild boar and domesticated pigs in all the phases (Fig. 15). Not enough teeth are

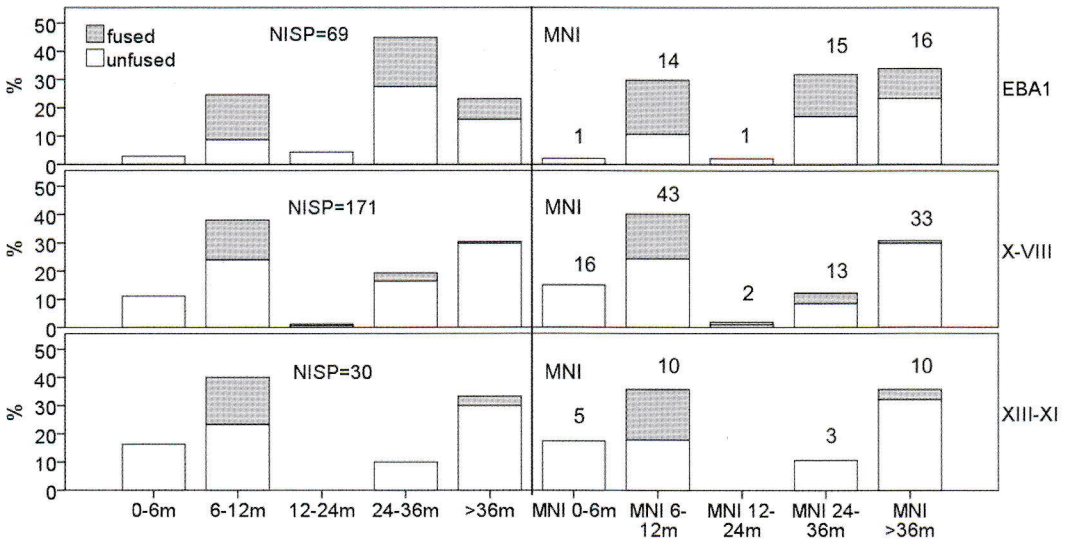

Fig. 16: Postcranial culling profile of pig.

		masc	fem
EBA1	wild boar		1
	pig	1	
	total	**1**	**1**
X-VIII	wild boar		13
	pig?		2
	pig	2	6
	total	**2**	**21**
XIII-XI	wild boar	3	
	total	**3**	

Table 5: Sex ratios in pig.

available for the reconstruction of slaughter patterns. The postcranial data indicates early killing up to one year, though a certain part survived this age in both Neolithic phases. Individuals older than a year were generally culled and very few reached fan age more than 36 months in both Neolithic phases (Fig. 16). The pattern differs in the EBA1 where more pigs survived the first year and more got older than 36 months. The few jaws and teeth recovered do not indicate a clear pattern of a preference to slaughter boars or sows in the EBA1 and only wild boar is presented in the earliest Noelithic phase. However, more remains of sow than boar (wild and domestic) are clearly represented in phase ÇuHö X-VIII (Tab. 5).

1.4 Wild mammals:

Game animals are present to a certain extent in all phases (Tab. 6). A weight comparison indicates a higher proportion in the EBA1 as in the Neolithic. It has to be stated that the amount of animal remains, which are not identifiable as domesticated animals with certainty, is definitely higher in the Neolithic than in the EBA1. On one hand this depends on the high proportion of infant pigs, which hardly can be differentiated into wild boar and domesticated pigs. On the other hand, it depends on the size and shape of bones, which are in an intermediate position between clearly wild and clearly domestic animals, like for aurochs and cattle, but also in sheep and goat. Nevertheless, a wide range of wild animals is present that also includes small rodents, which however, will not be discussed in this paper. Hunting played a stable part in the provision of food through time and the game targeted did not change very much (Tab. 6).

Small animals include hedgehog from the earliest phase and two squirrel remains from the EBA1. Hare was the most important small, non-carnivorous game species, especially in the Neolithic, but is less frequent in the EBA1. A large group of carnivores is present in all phases. In phase ÇuHö X-VIII these remains indicate exploitation of large sometimes juvenile carnivores. Small carnivores comprise mustelids, like stoat or badger, and wild cat. The most important small carnivore was definitely fox. Some of the bones are extremely small and can probably be considered smaller species like *Vulpes cana* or *V. rueppelli*, for example. Larger carnivores comprise brown bear, which is missing up to now in phase ÇuHö XIII-XI, and leopard, which occurs in all phases as well as hyena, which probably represented by a fragmented vertebra in phase ÇuHö XIII-XI.

Hunting of wild boar was of importance in all phases (Tab. 6). Several remains believed to be Aurochs are present in the material, and the proportion of "questionable wild cattle *Bos sp.*" is also in the EAB1. However, few remains from the earliest phases probably mark the occurrence and hunting of the European Bison. Very

		EBA1	X-VIII	XIII-XI
Erinaceus sp.	hedgehog			1
Lepus europaeus	hare	11	75	89
Sciurus vulgaris	squirrel	2		
Carnivora	carnivore	1	6	1
Canis lupus	wolf	1		
Vulpes vulpes	red fox	14	19	21
Vulpes sp.	fox	1	4	6
Panthera pardus	leopard	3	2	1
Hyaena hyaena?	hyena?			1
Ursus arctos	brown bear	8	3	
Martes foina	stone marten	1		
Marters sp.	marten	1	1	1
Mustela erminea	stoat	1		
Mustelidae	mustelid		2	
Meles meles	badger		1	
Felis silvestris	wild cat	1	4	3
Sus scrofa	wild boar	58	81	53
Sus sp.	pig?		52	67
Bos primigenius	aurochs	2	3	4
Bos primigenius?	aurochs?	4	10	10
Bison bonasus?	europ. bison?			2
Ovis orientalis?	wild sheep?	1	1	2
O.orie?/C.aeg?	wild ovicaprine?		7	1
Capra aegagrus?	bezoar goat?	4	18	2
Capreolus capreolus	roe deer	1	2	
Cervus elaphus	red deer	5	18	4
Dama dama	fallow deer	478	305	261
Dama_Antler	fallow deer antler	40	4	4
Cervidae	cervid	15	1	4
Delphinidae	dolphin	1	1	
total		654	620	540

Table 6: Wild mammals from Çukuriçi Höyük.

few roe deer- and some red deer remains can be found in all phases. But the major portion of hunted animals is fallow deer, with only a few pieces of antler. Two sea mammal remains are present in the material as well (Tab. 6). A rib fragment from the EBA1 and an unfused *Extremitas cranialis/caudalis* of a caudal vertebra out of ÇuHö X-VIII verify the exploitation of *Delphinidae*. The *Extremitas* indicates a rather large dolphin or small whale. The breadth of the *Extremitas* is approximately 60 mm and an estimated dorso-ventral height of ~68 mm. The bone is a little larger than comparative values of *Lagenorhynchus acutus* (Buchholtz & Schur 2004). The individual was most probably about the size of a large common bottlenose dolphin (*Tursiops truncatus*), but smaller than the orca (*Orcinus orca*; Buchholtz & Schur 2004), and perhaps represents a juvenile individual of 3 m in length.

1.5 Reptiles and Amphibians:

Reptiles and amphibians are scarcely represented with less than 0.1% in all phases. Nevertheless, all phases evidenced the presence of blind worms and some of the osteoderms are burnt. Tortoises and terrapins more likely served as food. However, amphibian remains come from all phases. Determinable remains from the EBA1 indicate the presence of the common spadefoot. Such animals are usually considered secondary deposits or recent intrusions. However, some bones are covered with sinter and therefore indicate a prehistoric origin.

		EBA1	X-VIII	XIII-XI
Aves ind.		1	2	
Aves large		4		3
Aves mid-size		11	19	6
Aves small		7	4	3
Anserinae	geese	3		
Anser anser	goose	2		
Anatinae	duck	4	2	
Coturnix coturnix	quail	1		
Accipiter gentilis	goshawk		1	
Buteo sp.	buzzard			1
Lyrurus tetrix	black grouse		1	
Larus sp.	sea gull		1	
Columba sp.	dove		3	
Corvus monedula	Euras. Jackdaw		1	
Corvus (corone)	crow			1
Pelicanus sp.	pelican	1		
total		34	34	14

Table 7: Birds from the Çukuriçi Höyük.

1.6 Birds:
Quantities of screened sediment samples reveal the exploitation of large-, middle-, and small-sized birds, while eggshells are completely absent at the Çukuriçi Höyük up to now. The total quantity of bird remains obviously is very low considering the fine recovery technique. Non-aquatic birds like hawk and buzzard, black grouse, dove, jackdaw and raven dominate the Neolithic. Ducks and seagull are water birds found in the Neolithic assemblages (Tab.7). Besides quail, the EBA1 revealed only waterfowl like geese, ducks and pelican (Tab.7).

1.7 Seafood:
Seafood of all kinds obviously had a certain importance in the Neolithic. The EBA1 exhibits a different pattern, with a clear dominance in the frequency as well as weight distribution of molluscs/bivalves. Marine crustacean and sea urchin remains are present mainly in the sediment samples and some show traces of burning.

Most of the fish bones are unidentifiable fragments or pieces of fin ray and are mainly picked from the sediment samples (Tab. 8). However, the most important fish species through time were certainly sparids, with gilthead seabream, dentex and striped seabream. Groupers, large blue fish, tuna, was well as horse mackerels and mackerels appear in the Neolithic. The EBA1 exhibits a whole range of costal fish species including parrotfish, red mullets, lip fishes, sea bass, Serranidae, sardines, hake and meagre, with sparids and grey mullets being most abundant, while mackerel and tuna are missing in the EBA1 up to now (Tab. 8).

Remains of elasmobranchs appear in the Neolithic as well as in the EBA1 (Tab. 8). Apart from the tooth of an angle shark, they are mainly ossified vertebral centers of sometimes rather large individuals. Stings of stingrays are quite well represented, though sometimes poorly preserved. The EBA1 revealed three stingers; phase ÇuHö X-VIII contained four and phase ÇuHö XIII-XI two more spines. However, three spines from phase ÇuHö X-VIII and one from ÇuHö XIII-XI are artificially modified with polished surfaces and the laterally serrated edges are partly removed or smoothened.

Marine snails like limpets, ceriths and mainly purple snail as well as the terrestrial large garden snail can be interpreted as exploited animals (Helix sp., Tab. 9). In addition to these, a range of edible snails is present including giant tun or triton snail. Smaller quite abundant snails are top snails like Gibbula and Phorcus with various species. Other species like *Bittium reticulatum, Columbella rustica, Conus ventricosus, Cyclope neritea, Euthria cornea, Galeodea echinophora, Mitromorpha olivoidea, Turritella sp.*, Vermetidae or Tenagodus sp. appear among the shells but may not represent consumption refuse. The aforementioned species are scarcely present, while *Melanopsis praemorsa* is quite abundant in the EBA1 and in phase ÇuHö X-VIII, a small fresh water snail. Though rare, another small freshwater snail Theodoxus sp. is present in all phases, sometimes with burnt shells (Tab. 9).

		EBA1	X-VIII	XIII-XI
Pisces	fish	487	278	51
Sparidae	sparid	42	29	1
Sparus aurata	gilthead seabream	5	7	2
Dentex sp.	dentex	2	1	
Lithognatus mormyrus	sand steenbras		2	
Spariosoma cretense	parrot fish	2		
Mugilidae	grey mullet	31		
Scorpena	scorpion fish	2		
Mullidae	red mullet	6		
Labridae	wrasse	1		
Dicentrachus	seabass	1	2	
Epinephelidae	grouper		1	3
Serranidae	comber	5		
Clupeidae	sardine	1		
~~*Merlangius merlangus*~~ corr. Merluccius merluccius 1	European hake	1		
Scienidae	drums	2		
Argyrosomus regius	meagre	1		
Pomatomus saltatrix	blue fish			3
Thynnus sp.	tuna		14	9
Caranx sp.	jacks		1	
Scomberidae	mackerel		2	
Chondrichthyes	cartilaginous fish	17	3	6
Rajidae/Dasyatis	sting ray	3	5	2
Squatina sp.	angel shark	1		
Anguilla anguilla	European eel	3		
total	total	613	345	77

Table 8: Fishes from Çukuriçi Höyük.

The valves also indicate exploitation of various kinds of marine bivalves like burrowing species, hard substrate species as well as tunneling species, both in the Neolithic and the EBA1 (Tab. 10). Lagoon cockles are most abundant, followed by the small corneous wedge clam, carpet shell and razor shell, especially in the EBA1. Other species rarely evidenced are the warty Venus shell, the noble pen shell, the spiny cockle, Dosinia lupina, Donax sp., Glycimeris sp., striped Venus shell and Mactra in the Neolithic and the EBA1. Hard substrate encrusting species are blue mussel, oyster, Noah's Ark shell, spondylus and bearded ark shell as well as a few saddle oysters. Tunneling bivalves are rarely found in the Neolithic and the EBA1 layers. Only a few remains of the common paddock are present in the Neolithic, while a hoard find in phase XIII-X and few other remains prove the presence of date mussels in all phases. The few Unio sp. shells date only to the Neolithic and are absent in the EBA1. Besides this edible species, a few shells of the very small freshwater bivalve Sphaeridae are present in the sediment samples of the EBA1 and the ÇuHö X-VIII phase. Remains of cuttlefish are also rare and usually heavily fragmented but appear in the Neolithic as well as in the EBA1.

A conspicuous change in the faunal composition becomes obvious comparing the Neolithic with the EBA1. Neglecting the high amount of corneous wedge clam in phase ÇuHö X-VIII coming from sediment samples, the Neolithic assemblages mirror a higher proportion of hard substrate bivalves and less lagoon cockles (Tab. 10). The EBA1 ensemble still is rich in mollusc species but is completely dominated by lagoon cockles.

The greatest valve height of the most common lagoon cockle does not indicate a clear tendency or change in size pattern from the Neolithic to the EBA1. The size of the shells slightly decreases from phase ÇuHö XIII-XI to phase ÇuHö X-VIII but increases towards the EBA1. However, the size differences are only in the range of a few millimeters, while the largest cockle shell with a height of 57 mm comes from phase ÇuHö X-VIII (Fig. 17).

1 corr. A. Galik 30.10.2020

		XIII-XI		X-VIII		EBA1	
		MNI	NISP	MNI	NISP	MNI	NISP
Gastropoda	snail		5		8		5
Hexaplex trunculus	purple snail	35	69	82	137	71	173
Bolinus brandaris	murex	1	2	2	6	2	6
Ocenebra sp.	sting winkle			1	1		
Muricidae	murex		1		9		
Cerithium vulgatum	cerith	8	32	26	221	119	731
P.caerulea	limpet	56	83	61	71	151	210
Patella sp.	limpet	6	14	8	32	80	525
Charonia variegata	triton snail						1
Charonia sp.	triton snail		1				
Tonna galea	tun				2		1
Gibbula divaricata	top snail			1	1		
Gibbula sp.	top snail			1	10	13	28
Phorcus sp.	top snail				2	3	9
Phorcus articulatus	top snail					1	2
Phorcus richardi	top snail			2	2		
Phorcus turbinatus	top snail	1	2			2	27
Melanopsis (praemorsa)	melanopsis	1	1	15	15	16	28
Bittium reticulatum							1
Columbella rustica	dove snail	1	1	3	3	1	1
Conus ventricosus	cone snail					3	3
Tritia neritea	dog whelk			2	4	2	3
Euthria cornea	spindle euthria					1	1
Galeodea echinophora	helmet shell		1				
Mitromorpha olivoidea					1		
Nassarius reticulatus	netted dog-whelk	1	1			2	3
Turritella sp.						1	2
Vermetidae	worm snail		1				
Tenagodus sp.		1	1				
Helix cincta	large garden snail			1	1		
Helix sp.		1	20	3	22	2	35
Hellicellinae				2	4		
Oxychilus sp.							1
Theodoxus		1	1	2	2	6	6

Table 9: Gastropoda from Çukuriçi Höyük.

Discussion

The excavations mainly took place in the living areas of the partially excavated settlement, which reflect the life style and behavior of the settlers. Just looking at the bare bones a difference between the Neolithic and the EBA1 becomes visible. The Neolithic bones exhibit a greater degree of fragmentation than in the EBA1. The extraction of marrow was probably more important in the earlier stages and it may also reflect a more antiquated technical ability with regard to dismembering carcasses in the Neolithic.

Another important fact apparent from the analysis is the presence of fully domesticated animals already at the beginning of the 7th millennium and that they were with certainty brought in by the Neolithic pioneers. Other Neolithic sites like Ulucak, Menteşe, Fikirtepe and Ilıpinar reveal a similar situation (Çakırlar 2012a; Gourichon & Helmer 2008; Buitenhuis 2008; Boessneck, J. & von den Driesch 1979). Çukuriçi Höyük, a costal settlement, was situated at a key location along the Neolithic marine expansion route into the Aegean (Broodbank 2006; Dawson 2014; Horejs et al. 2015),

		EBA1		X-VIII		XIII-XI		total	
		MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP
Bivalvia	bivalve		2		36		1		39
Acanthocardia tuberculata	spiny cockle	6	9			1	1	7	10
Cerastoderma glaucum	lagoon cockle	3631	8777	392	1108	408	1168	4509	11234
Donacilla cornea	corneous wedge clam	171	239	829	991	244	261	1256	1508
Chamelea gallina	venus shell	1	1					1	1
Donax sp.	wedge clam			2	4			2	4
Dosinia lupinus		6	9					6	9
Glycimeris sp.	glycimeris	1	1	1	1			2	2
Mactra glauca	thick trough shell			1	1			1	1
Ruditapes decussatus	carpet shell	9	89	32	206	79	611	120	911
Solen marginatus	grooved razor shell	12	194	8	35	2	3	22	240
Venus verrucosa	venus shell	9	11	15	23	3	5	27	39
Pinna nobilis	pen shell		7		5		9		21
Anomia ephippium	common saddle oyster			2	2	2	3	4	5
Arca noe	Noah's Ark shell	118	305	217	385	46	76	386	787
Barbatia barbata	bearded arc shell	16	26	6	7	1	1	24	35
Mytilus galloprovincialis	blue mussel	26	195	188	663	55	230	272	1095
Ostrea edulis	oyster	67	143	236	381	194	439	504	976
Spondylus gaederopus	spondylus	83	152	77	106	16	23	180	287
Lithophaga lithophaga	date mussel	1	1	1	2	59	73	61	76
Pholas dactylus	common piddock			3	6	2	5	5	11
Unio sp.	unio shell			3	7	2	3	5	10
Sphaeridae		1	1	1	1			2	2
total	total	4156	10162	2010	3970	1112	2912	7389	17303

Table 10: Bivalvia from the Çukuriçi Höyük.

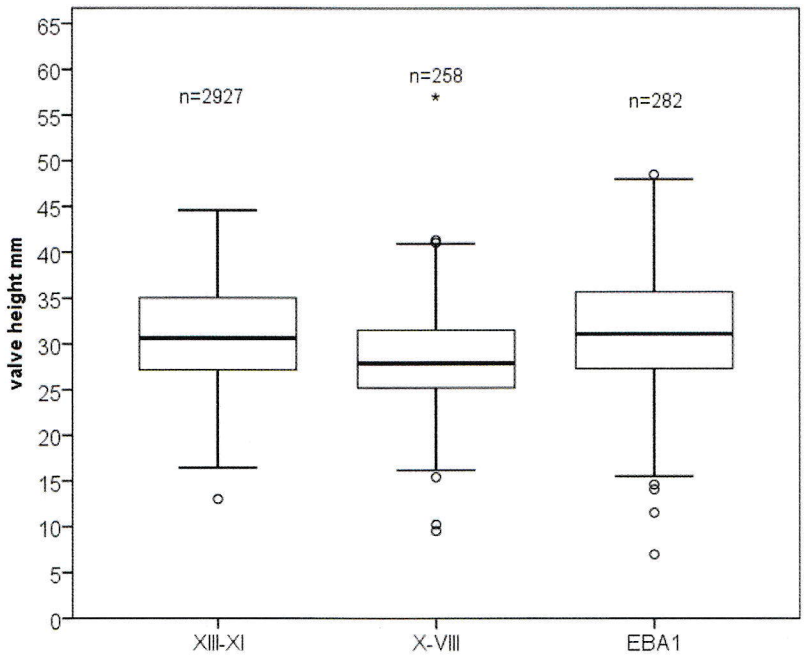

Fig. 17: Size distribution of the lagoon cockle in the Neolithic and the EBA1.

which also coincides with the appearance of early Neolithic Aegean sites like Knossos (Douka et al. 2017), Argissa-Magula (Reingruber & Thissen 2009; Reingruber 2011) or Mavropigi in western Macedonia (Karamitrou-Mentessidi et al. 2016).

Nevertheless, throughout the Neolithic phases, intermediate or very large specimens resembling wild progenitors are present. Eurasian species like wild boar or aurochs certainly were native in this geographical region. A large goat cranial fragment with unfused frontal sutures appeared in phase VIII. The horn core has a straight and sabre-like shape, a circumference at the basis of 184 mm and resembles a wild goat. Wild goat was probably hunted in the mountainous regions around the site. Other bezoar goat remains outside its present-day geographical distribution (Shackleton 1997, Grimmberger & Rudloff 2009) are documented at Ulucak (Çakırlar 2012a) or the Troas (Uerpmann 2006) in Western Anatolia, but also at the southern Anatolian coast in Limyra (Galik et al. 2012). Wild sheep can hardly be explained at the site considering its present and prehistoric regional distribution (Ueprmann 1979, Shackleton 1997; Grimmberger & Rudloff 2009). Nevertheless, the presence of rather large specimens, which are morphologically like the wild progenitors, is also evidenced among the Çukuriçi Höyük material. The largest horn cores have a circumference at their base of 174 mm, 160 mm and 150 mm but show unfused frontal and parietal sutures. Similar shapes but smaller horn cores are described from Besik-Yassitepe Troia1 and display a size of 140 mm and are considered stemming from domesticated individuals (von den Driesch 1999). If the idea of a larger distribution area in ancient times is dismissed, these large remains probably represent the appearance of large wild sheep individuals in the concurrent domestic flocks. Reflecting the very early finds from Cyprus (Vigne et al. 2000, 2011), another idea might be worth considering: The large individuals may represent feral animals, descendants of immigration events by human pioneers prior to the 7th millennium BC.

Change in size obviously played a role through the millennia in keeping, breeding and certainly exploiting domesticates. A general tendency for a moderate increase in the size of sheep and goat is observable, while cattle size decreased towards the EBA1. The modest size increase in ovicaprines could also be due to a higher frequency of males in the herds as reflected in the sex profiles. However, phase ÇuHö X-VIII depicts a specific pattern affecting the size of domesticates. The sizes of domesticates indicate a very wide distribution from "*minute*" to "*giant*" individuals, while most of them are placed in the group of "*regularly*" sized animals. This pattern probably mirrors an active breeder's control, experimenting with the full potential of size development of domesticates in the Neolithic phases, while the EBA1 populations reflect quite stable size distributions and thus higher selectivity by the breeders. A shift from sheep to goat in the EBA1 may indicate that the pioneers concentrated more on sheep but that goat prevailed. Nevertheless, Çukuriçi Höyük depicts a different pattern compared to Neolithic sites in northwest Anatolia where sheep was the dominating ovicaprine (Boessneck & von den Driesch, 1979; Gourichon & Helmer 2008; Buitenhuis 2008).

Slaughtering patterns stay similar through the Neolithic for the major domesticates, with an emphasis on the killing of neonates/infants to young individuals. Being aware of a long discussion about using dairy products beginning with McCormick (1998), for example, over Takaoğlu (2006), Evershed (2008), Çakırlar (2012b), Arbuckle et al. (2014), Greenfield et al. (2015) to Halstead (2017), I interpret the slaughtering pattern according to Vigne and Helmer (2007). The exploitation focused on "Tender Meat A" and "Milk Typ A" at Çukuriçi Höyük for ovicaprines and cattle in the Neolithic. In the EBA1, the pattern probably indicates that the minor exploitation of "Milk Type A" and "Tender Meat" and "Meat- and Milk Type B" became more important. However, the changes of culling strategies affect all domesticates in the same way, including pigs, which reached higher ages in the EBA1. Improved keeping- and foddering strategies certainly allowed a higher survival of young individuals and a slowing down of the killing times in the livestock important for sustaining people living in a dense "proto-urban" settlement.

With respect to coxae of adult or at least subadult individuals, models employing the preferential slaughter of male individuals do not seem to be applicable to the available data. A quite undifferentiated killing pattern of male and female cattle and ovicaprine most probably indicates mixed livestock exploitation. The mixed stock management and the deferred killing ages of ovicaprines probably mark the beginning of an increase of the exploitation of animal fibres (Arbuckle et al 2009) in the EBA1 at Çukuriçi Höyük. Exploitation of ovicarpine fibres/sheep wool is discussed from the Chalcolithic onwards in central Anatolia and probably provided the basis for structural social changes (Arbuckle 2012). In west Anatolia the Neolithic "hair sheep" is originally interpreted as being small and slender and kept mainly for meat, while the woolly sheep was supposed to be larger (Boessneck & von den Driesch 1979). However, sheep remains revealed that stocks in west Anatolia were of similar but also of different sizes from Neolithic to EBA and it turned out to be difficult to identify the woolly sheep by a shift in size (Uerpman 2001, Gündem 2010).

The size development of sheep in phase X-VIII indicates a high variability in ovicaprine size, which disap-

pears with a modest size increase in the EBA1. This increase in sheep cannot indicate the introduction of a new larger woolly sheep breed and the EBA1 seems quite early for the arrival of such a typical breed (Gündem 2010). The underrepresentation of individuals older than four to six years contradicts the interpretation of regular woolly sheep stock exploitation. Nevertheless, the discussed phenomenon coincides with textile production and the appearance of spindle whorls and weaving weights in the 4th and the 3rd millennium at Çukuriçi Höyük (Britsch & Horejs 2017). The sheep size is more or less in a Gaussian distribution, while goat size is clearly skewed towards larger specimens in the EAB1. A higher amount of male goats slaughtered later in life probably indicates a certain contribution to the fibre production obtained from local sheep and goat stocks rather than the import of different, new breeds at the EBA1 at Çukuriçi Höyük.

The few pathologies observed on the Neolithic bones do not indicate an accumulation of exostotic bone growth in the autopodials of cattle in the Neolithic. The few arthopathological changes in the EBA are more specific and affect cattle toe bones, although this evidence is not strong enough to suggest their usage as draught animals.

Pigs appeared from the beginning of the settlement onwards, but became more important in the subsequent phases. The presence of pigs indicates a situation similar to Ulucak (Çakırlar 2012a), while pigs are more or less absent in the northwestern sites (Boessneck & von den Driesch 1979; Gourichon & Helmer 2008).

Bird remains appear in all phases, but they do not indicate a high importance, which is quite contrary to exploitation pattern at northeastern sites like Fikirtepe or Menteşe (ibid.), and eggshells are completely missing. The exploitation of squail, corvids and raptor birds played a certain role, but the difference seems to be an increased exploitation pattern of waterfowl in the EBA1 at the Çukuriçi Höyük.

The richness of game animals is comparably high in the Neolithic and the EBA1 with fallow deer being the most important hunted species. The frequency of fallow deer increases from about 50% up to 80% in the EBA1 yet only contains about 5% antler remains. Some of the fallow deer antlers are preserved in their entirety, although they were valued as raw material. Especially large game, i.e. leopards, brown bear and an accumulation of large fallow deer stags may support the theory of prestigious and elitary hunting rather than subsistence hunting (Galik 2013, Horejs & Galik 2016). The "proto-urban and wealthy metal workers" probably targeted stags as trophies in the EBA1 society.

In addition to the cultural changes and improvements from the Neolithic to the EBA1, like settlements organization or the utilization of ore for metal production, the connecting element between the Neolithic and the EBA1 from an archaeozoological point of view is the affinity for maritime resources. Seafood played a prominent role in the settlers' nutrition. The remains indicate a major change, while in the Neolithic about one third of the archaeozoological finds represent molluscs, during the EBA1 this increases to up to half of the material, even in weight distribution. This pattern may be interpreted as a different focus in food gathering or foodstuff selection or changes in waste disposal. Ecological and environmental changes could also have been responsible. In any case, the size distribution of cockles does not indicate overexploitation and size diminution – quite the contrary: the cockles are even somewhat larger in the EBA1. Bivalve stocks may have recovered during the settlement hiatus in the Chalcolithic. In combination with the predominance of cockles and the reduction of hard substrate encrusting molluscs such as spondylus or Noah's Ark shell, the shell remains indicate a probable increase of the input of sediment into the still marine shore habitat around Çukuriçi Höyük (Stock et al. 2015). The corneous wedge clam with its small shell needs extra documentation. The occasional "mass"-occurrences certainly indicate the exploitation of these little bivalves as food. They prefer sandy ground and an absence or lack of water energy, exactly the habitat of the large lagoon cockles at Çukuriçi Höyük. Considering the large quantities of shells at Çukuriçi Höyük it is remarkable that almost no shell artefacts were discovered. Shaping molluscs to ornaments was obviously of no interest at this maritime site and stands in contrast to contemporaneous inland sites (Çakırlar 2015). Only the earliest phases yielded coarse beads and rings made from molluscs (Horejs et al. 2015).

Fishing was of importance in the Neolithic as well as in the EBA1, although fish hooks are almost absent at Çukuriçi Höyük, while stones and probably sherds were used as net sinkers (Britsch & Horejs, in print). Fish species like large blue fish or tuna might on one hand reflect the skills needed to catch such pelagic and large fishes and on the other they reflect an accessible coastal habitat for the exploitation during the Neolithic. The dominant species are coastal and lagoon fish such as sea bream, mullets, and cockles probably indicate a prograding sediment input into the bay in the EBA1. The use of stingray spines also suggests a kind of cultural continuity, when prehistoric people consciously paid attention to an extraordinary and poisonous fish from the 7th to the 3rd millennium BC at the Aegean Sea. The seafaring people continued introducing Melian obsidian up to the EBA1 at Çukuriçi Höyük (Bergner et al. 2009). Besides farming and hunting, the archaeozoological evidence of Çukuriçi Höyük relates to soci-

eties closely connected to the sea, which probably kept the maritime identity developed in the Neolithic (Horejs et al. 2015) in their socio-cultural memories up to the EBA1 at Çukuriçi Höyük.

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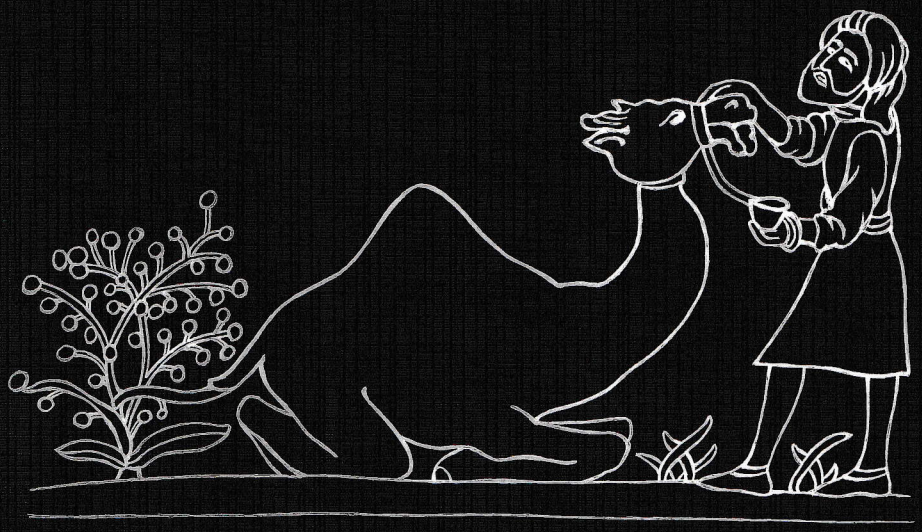
DOCUMENTA ARCHAEOBIOLOGIAE

15

Joris Peters, George McGlynn and Veronika Goebel (Eds.)

Animals: Cultural Identifiers in Ancient Societies?



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