Eurasian Journal of Anthropology Euras J Anthropol 4(1):23−35, 2013

Reconstructing ovicaprid herding pattern in Anatolian and Mesopotamian settlements during the Bronze Age

Lubna Omar*, A. Cem Erkman

Department of Anthropology, Ahi Evran University, Kırşehir, Turkey

Received July 12, 2013
Accepted December 30, 2013

Abstract

This study focuses on examining caprine herding strategies during Early and Middle Bronze periods, throughout the analysis of the faunal materials that belong to Anatolian and upper Mesopotamian sites. The main argument of this paper is assessing the role of both environmental factors and socio-economic strategies in the development of caprine herding patterns. The zooarchaeological research methods which were applied on several faunal assemblages assisted us in evaluating the frequency of herded species in each settlement, the distribution of age groups and the variation of animal's size. While conducting a comparative study among several archaeological sites situated in two distinctive geographical regions, will give us the chance to illustrate if environmental or socio-economic factors lead to the adaptation of certain herding patterns. Consequently we will able to shed new light on the developments of early urban societies.

Keywords: *Zooarchaeology, animal economy, Bronze Age, Anatolia, Mesopotamia, early urbanism*

Introduction

Bronze Age era marks the beginning of the historical periods as human communities altered their subsistence strategies toward specialized economical system that paved the way for the raise of urbanism. Therefore, the study of the economic activities of various Bronze Age settlements located in the Anatolian plateau all the way to the southern Mesopotamian valley, will provide us with an exceptional opportunity to evaluate the background and the and fundamental elements of the early urban organizations.

The advantage of studying a Historical periods such as the Bronze Age is the availability of the written records which could be employed to the support results of the archaeological work. The data obtained from ancient archives and previous archaeological research in the region propose that the emergence of early urban

* Corresponding: Department of Anthropology, Faculty of Arts and Sciences, Ahi Evran University, 40100 Kırşehir, Turkey (**e-mail:** lubnaomar@gmail.com)

ISSN: 2166-7411

estates in southwestern Asia is connected with maintaining of specialized economical relationships between intra-rural and urban settlements, which were controlled via the channels of the administrative organization of early urban societies (Akkermans and Schwartz, 2003; Hole, 2007; Schwartz and Curves, 1992; Wilkinson, 2003). Alternatively, the archaeological evidence is a more reliable method of investigation to obtain a wider view of ancient life, and it would assist us to explain the various features of urban centers beyond the written records which only provide limited information concerning the dynamics of human communities.

Aiming to trace the different stages of interregional socio-economic developments during the Early and Middle Bronze Phases, this paper concentrates on assessing zooarchaeological investigations which have been conducted on a number of faunal assemblages from early-urban settlements located in the Anatolia and upper Mesopotamia. The intra-settlements comparative study of the socio-economical characteristics of the Bronze Age at both regions demonstrates how early-complex societies in southwest Asia managed to enhance their quality of life on economic and cultural levels. The main focus of this study is to assess the role of animal resources in the economical organization of Anatolian and Mesopotamian settlements, and to displays what influenced the changes in early urban-centers during Early and Middle Bronze periods, in particular, we aim to discern the role of environmental conditions in shaping specialized economical patterns at Bronze Age estates. Therefore, in the beginning we will discuss below the environmental and historical context of these settlements.

Environmental and historical background of Anatolia and upper Mesopotamia

Central southern Anatolia is a semi-arid area, the precipitation in the plateau range from 330 mm in Konya to 360 mm in Nigde on the eastern margin, while the plains of Cappadocia receive 400 mm. The perception is considerably high around the south western boarder of the plateau this area receives almost 500 mm per year (Van Ziest et al., 1975). The analysis of pollen core and the geomorphological evidence are the main sources of information of paleoclimate during the Bronze Age period. Pollen core studies in the Anatolian region indicate that (3900-1650 BP) (BP= before present) period is characterized by the increase of cedar and pine, and an expansion in forest around Cappadocia (Woldring and Bottema, 2001/2002). By the end of this period the number of arboreal pollens levels declined, which in turns suggests a decrease in the area of woody forests. While Beyşehir I core indicates that arboreal pollen levels stayed high until a massive clearance of forests around (3500 BP) (Van Zeist et al., 1975). Upper Mesopotamia region represented a dry steppe environment. The northern part of al-Jazira (upper Mesopotamia) received a mean annual rainfall of 350-400 mm, which in turns had role in transforming the northern region of al-Jazira to a moist steppe zone. While it's southern part is characterized by a low mean rainfall of 200-350 mm (Guest and Townsend, 1980). The valleys of the Euphrates and its tributaries Khabur and Balikh were amenable to irrigation, particularly in their lower reaches.

The numerous excavations expeditions which are carried out in both Anatolia and upper Mesopotamia region highlight the historical events that took place during the early stages of Bronze Age. Hence, both areas witnessed the establishment of a mosaic of 'city-states' varying in powers and scales. The discovery of fortified structures and public architecture in these settlements attest the alternation of human organizations during this period of time toward highly complex cultural and economic organizations. The interaction among urban centers in the both Anatolia

and Mesopotamia is poorly understood, but the available archaeological and written evidences suggest similarities in material culture and socio-economical patterns reflected by the complex administrative systems detected through the archives of the early urban centers and the increasing importance of public structures. The Middle Bronze period is characterized by the collapse of most of the settlements in the upper Mesopotamian valley, while some of the urban centers continued to flourish in the Anatolian highlands, and the northern part of upper Mesopotamia (Akkermans and Schwartz, 2003; Ristvet and Weiss, 2005, Van de Mieroop, 2006).

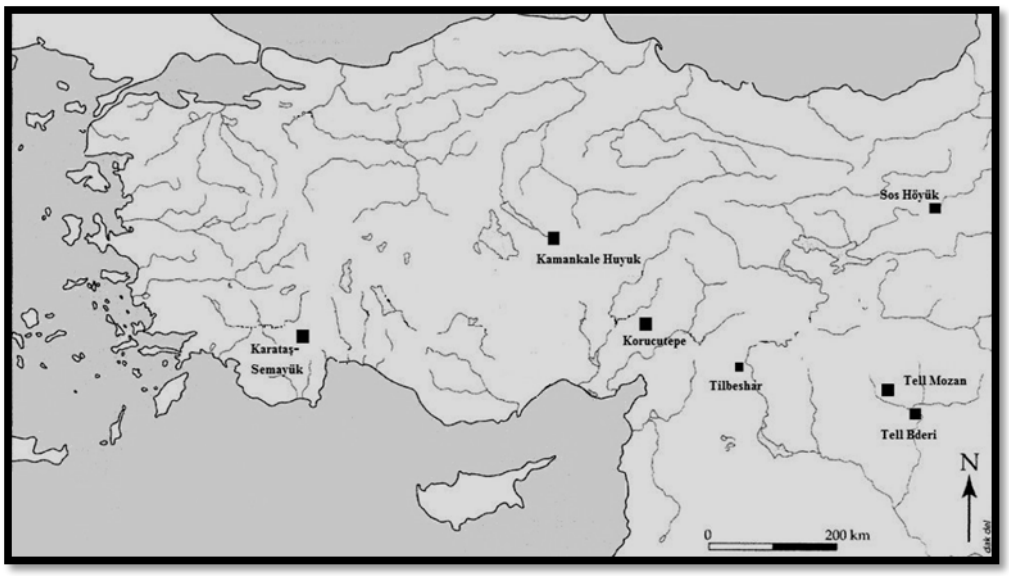

Figure 1: Map of the studied area and the examined archaeological sites.

The sites included in this paper located in the Anatolian plateau are Tilbeşhar which is a large settlement situated close to one of Euphrates tributaries, and in spite of its proximity to the dry steppe, it's the surrounding environment was far more fertile during the Bronze Age with its water resources and deciduous oak forest (Kepinski et al., 2006: 258) (Figure 1). The settlement of Tilbeşhar was long inhabited since Chalcolithic times, while its faunal assemblage assessed in this study belong to the early urban center that flourished during the Early and Middle Bronze Age periods (Table 1). Sos Höyük site is a small settlement which was inhabited during Early Bronze Age period (Table 1) and it's located in the province of Erzurum (Figure 1). The site is situated on sparsely vegetated plains bordered by mountain ranges, and the climate conditions could be considered harsh with low precipitation, cold long winters, and short summers. The environmental and topographical constraints of the site might encourage practicing mobile pastoralism in that area (Howell-Meurs, 2001: 321). The settlement of Karataş-Semayük lies in the Elmalı plain southeast Turkey (Figure 1)." The surrounded area of the site consisted of sub-montane and montane forests" (Warner, 1994). The settlement is considered as an urban-center during the Early Bronze Age (Table 1). Korucutepe site in Southeastern Anatolia is situated in Altinova plain (Figure 1). It's one of the important early urban centers during the Hittite period; several settlements proceeded at the site starting from the Chalcolithic period until the Iron Age, as mentioned previously this study will focus on the Early and Middle Bronze Age faunal assemblages (Table 1). The final site is Kaman-Kalehöyük which is located in centre of the Anatolian plateau. The settlement belonged to a medium-sized mound, which was revealed a long chronological sequence. In this paper we will discuss the results of the faunal analysis conducted on

Early Bronze Age and Middle Bronze Age bone collections (Table 1).

The faunal assemblages included from upper Mesopotamian sites; Tell Bderi (EBA), and Tell Mozan (EBA and MBA). Both sites located in the dry-steppe zone, where Tell Mozan is situated in a more fertile area up in the northern side of the steppe (Figure1). Tell Bderi site was inhabited during the Early Bronze age period, and it could be classified as a medium-sized urban center, while Tell Mozan had longer occupational sequences which extended to Middle Bronze phase (Table 1).

Table 1: Chronological distribution of the faunal assemblage from Anatolian and upper Mesopotamian sites

Chronological levels	Anatolia	
	Early Bronze Age	Middle Bronze Age.
Karataş-Semayük	Hesse B, Perkins D (1974)	
Tilbeşar	Berthon R, Mashkour M (2008)	Berthon R, Mashkour M (2008)
Korucutepe	Boessneck J, Von Den Driesch A (1974)	Boessneck J, Von Den Driesch A (1974)
Sos Höyük	Howell-Meurs S (2001)	
Kaman-Kalehöyük	Acıtı L (2005)	Hongo H (1998)
	Upper Mesopotamia	
Tell Mozan Tell Bderi	Doll M (2010) Omar L (2010)	Doll M (2010)

Zooarchaeological research

The faunal assemblages collected during the archaeological excavations in several settlements within Anatolia and upper Mesopotamia, are an adequate parameter to detect the role of animal resources in the development of economical features in early–urban centers (Zeder, 2003). Therefore, we utilized some of the published zooarchaeological work discussing animal exploitation strategies during Early and Middle Bronze Age in Anatolian plateau, and the results of zooarchaeological research which have been conducted on two upper Mesopotamian sites from the same period.

Performing a comparative study on the faunal assemblages from the selected geographical areas, which witnessed the emergence of early urban centers, assist us in achieving a better understanding of the socio-economic framework of early complex societies. At the same time we will be able to assess the factors that impacted the development of socio-economic organizations during the different phases of the Bronze Age period. Aiming to approaches the previously mentioned objectives we examined faunal assemblages belong to Early Bronze and Middle Bronze periods, utilizing several zooarchaeological research methods.

Frequencies of identified animal species

Bronze Age period is mainly characterized by the dependency on domestic animals exploitation in the first place to provide the main bulk of primary (meat) and secondary (dairy, wool, hide, energy) products (Sherrat, 1983; Zeder, 1991). The distribution and the frequencies of animals at each settlement highlight the contribution of each species to animal economy. The most common parameter to reconstruct the proportions of animal species in each faunal collection is NISP or (the number of identified specimens). However, additional measuring methods could be employed to give a further comprehensive analysis of the ratios of identified animal

species at each studied site, such as the WISP or (weight of identified specimens)— which is considered a good indicator to the proportions of meat— (Uerpmann, 1973). Nevertheless, most of zooarchaeological studies conducted Anatolia focused on demoestrating quantity ratios in the first place. Therefore, we directed our comparative analysis toward examining the distribution of identified animal species based on the number of identified skeletal fragments as displayed in (Figure 2 and 3).

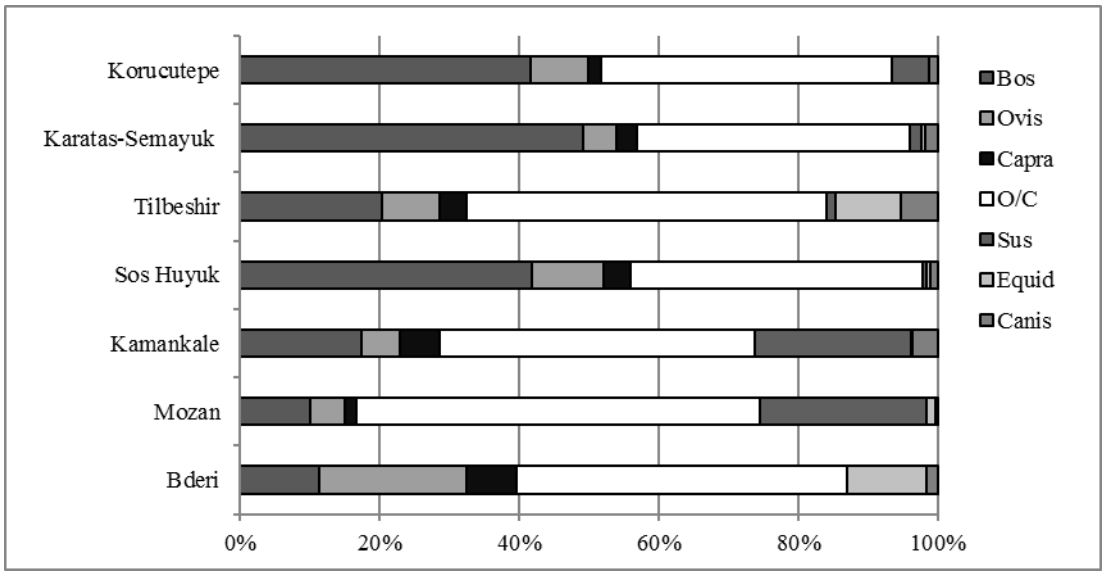

Figure 2: Ratios of identified animal species in Anatolian and upper Mesopotamian settlements during EBA.

The examination of animal frequencies in Anatolian and upper Mesopotamian areas during the Bronze Age period is divided on a chronological level; Early Bronze Age sites, and Middle Bronze age sites, as we intended to display the main characteristics of subsistence strategies which were implemented in each area.

The ratios of main represented animal species in the faunal collections of Anatolian sites during the Early Bronze Age period are represented in Figure 2. It demonstrates displays the anticipated high ratios of sheep and goats remains. The importance of caprine products is addressed in both archaeological and literature evidences, and the results of the zooarchaeological research support this conclusion. While the dependency on sheep and goats primary and secondary products is a clear matter in all the Anatolian and northern Mesopotamian sites, it seems that within the settlements which received a higher precipitation rates cattle ratios were close to sheep/goats category. In both and Karataş-Semayük and korucutepe the ratios of cattle remains were quite close to sheep/goat proportions (49% in Karataş-Semayük, and 57% in korucutepe) (Figure 2). Smaller settlements exploited a wider spectrum of animals to sustain their economy as observed Kaman-Kalehöyük; hence, pig remains constituted about 22.2% of the identified faunal collection. If we move to the south we witness a different pattern. In the immense urban center at Tell Mozan, again sheep and goats were the most represented, but the ratios of pigs where even higher than cattle. Pig's remains constituted about 23.8% of the studied sample. In the neighboring settlement of Tell Bderi located to the south of Mozan pigs were not present in the faunal collection and it seems that the inhabitants of this early urban-center sustained their existence in this dry-steppe environment depending on the products of pastoral organization in the first place, while cattle and Equid (*Equus Asinus, Equus Hemionus*) played a secondary role in economy of Tell Bderi (Figure 2).

During the Middle Bronze Age phase we observed a change in the pattern of subsistence strategies in Anatolian and upper Mesopotamian sites. During this period of time the ratios of caprine decreased in favor of cattle and pigs in comparison with early Bronze Age. In the urban centers of Tilbeşhar the MBA collection contained high numbers of cattle, pigs and even Equid more than the EBA sample (Figure 3). The smaller settlement at Kaman-Kalehöyük displayed a slight change in the ratios of identified animal species, though there was an increase in the cattle and pigs proportions. The historical scene in upper Mesopotamia witnessed curial change during the MBA, and several settlements were abandoned during this period of time including Tell Bderi, while other urban-centers continued to flourish like Tell Mozan, and carried on the economic trends of the previous period, however, there was a decrease in the proportions of sheep/goats versus Cattle/pigs (Figure 2 and 3).

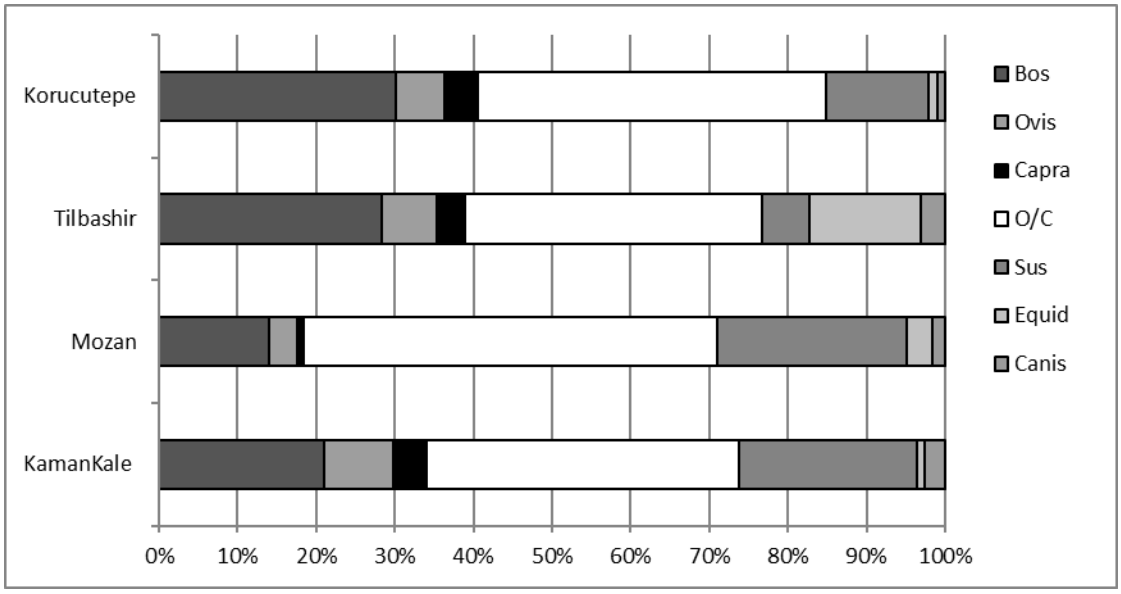

Figure 3: Ratios of identified animal species in Anatolian and upper Mesopotamian settlements during MBA.

Kill-off patterns

This method of analysis depends on reconstructing the kill-off patterns of sheep and goats utilizing age at death estimations of mandibular teeth introduced by Payne (1973). In this analysis both sheep and goats elements are combined. Therefore, our evaluation to the caprine production, consuming and distribution model in each region and period of time is hinder by the fact that both sheep and goats were generally raised to provide different set of products. Consequently our comparative approach results are biased due to combing cranial elements of two distinctive species into one category[1], and it only gives a broad interpretation of the exploitation strategies. The reconstruction of secondary products' profile —dairy products-profile or wool production-profile— requires a further separation of caprine elements to species level. Figure 4 shows that during the EBA period on the Anatolian side Tilbeşhar produced a kill-off pattern with an emphasis on culling young and older individuals. There was a peak in the culling of caprine between 6 months and 12

[1] Sheep and goats mandibles are quite similar in shape and distinguishing the morphological differences between the teeth and mandible bone of both species requires an in-depth experience, therefore, in many zooarchaeological studies the teeth of both species are clustered in one category.

months (38%), while the second peak in the kill-off pattern is connected with adult individuals between 4-6 years. Focusing on culling young individuals before reaching the optimal meat age and later culling older animals could implies to secondary products exploitation at the site. The small settlement of Sos höyük produced a mix kill-off profile, without a notable peak in a certain age group. While in upper Mesopotamia a different trend is observed in both Tell Mozan and Tell Bderi the culling of older individuals is the most predominant process in the kill-off profiles of both sites (Tell Bderi over 4 years of age about 40.5%, Tell Mozan over 6 years of age about 45%) this trend implies the presence of animal economy oriented towards exploitation of secondary products in the first place.

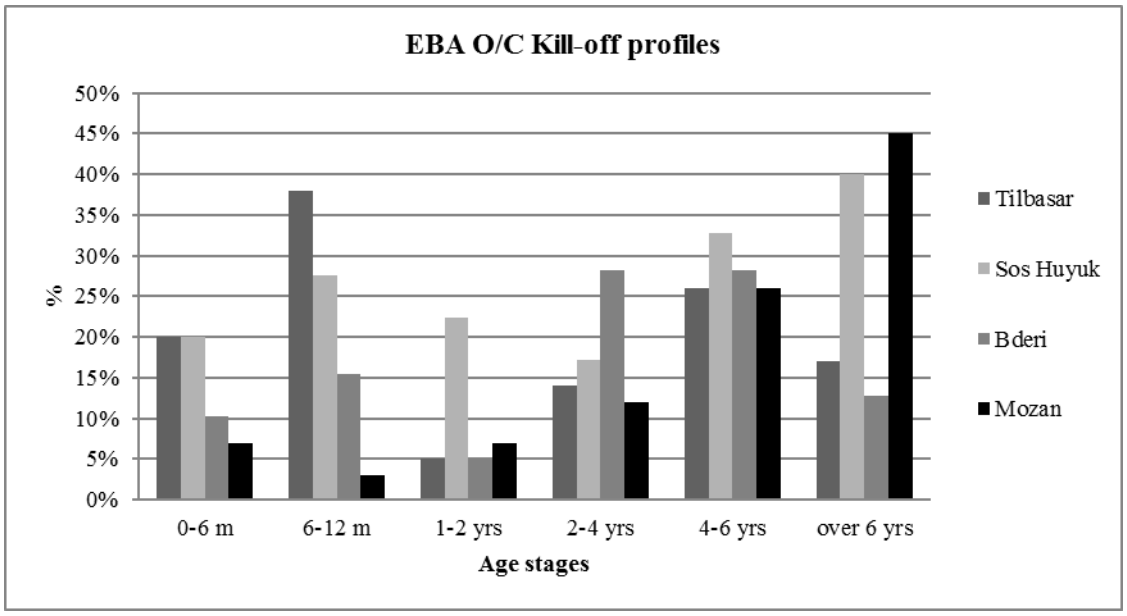

Figure 4: Kill-off patterns of domestic sheep and goats from Anatolian and upper Mesopotamian sites during EBA.

Depending on the limited information that we could integrate in our comparative study of sheep and goats kill-off patterns, it seems that human communities during Middle Bronze Age period continued to carry out the traditions of the preceding period in exploiting sheep and goat herds to acquire variety of primary and secondary products. The Kill-off profile from Tilbeşhar MBA materials consists of two age peaks in the mandible collection; young individuals beyond the optimal meat age and old individuals. Considering the proportion of individuals slaughtered beyond the 4 year of age is smaller in comparison to Tilbeşhar EBA's sample. In Kaman-Kalehöyük settlement mixed production strategies were applied. While in Tell Mozan slaughtering for secondary products acquisition and meat production seems is the model followed in Mozan during the MBA (Figure 5).

Estimation of size

Examination of the morphological and metrical characteristics of domestic animals aims to illustrate the degree of variation in the size of various taxa represented in the faunal assemblage using the LSI method "Logarithmic size indices" or "Index method" introduced by (Uerpmann, 1979) or the "Difference of logs" method developed by (Meadow, 1981; 1983; 1999). The metrical data of the archaeological specimens are compared to one another by relating them to the measurements of the

same anatomical element of "standard animals". The advantage of using these methods is the ability to combine the measurements of different skeletal elements. Therefore, these methods are adequate to be used on small sample of measured elements.

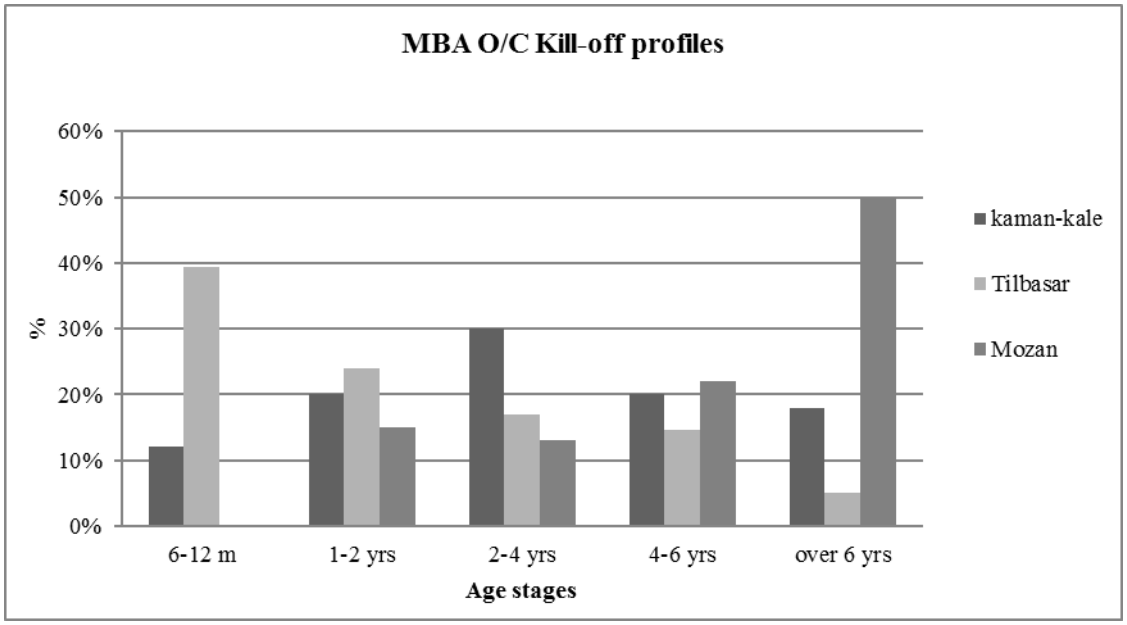

Figure 5: Kill-off patterns of domestic sheep and goats from Anatolian and upper Mesopotamian sites during MBA

In this zooarchaeological research special focus was attributed to caprine remains, due to its high representation within the faunal collections. We utilized the measurements of post-cranial skeletal elements to evaluate the fluctuations in the size of sheep and goat livestock's during the Early Bronze Age and Middle Bronze Age period in Anatolia and upper Mesopotamia.

The LSI values generated from the measurements of sheep remains that belong to Anatolian sites demonstrate that the sheep from Karataş-Semayük were bigger in size in comparison to Tilbeşhar's sheep values. The mean values of western Anatolian site Karataş-Semayük are about 0.01, while the eastern Anatolian site Tilbeşhar produced much smaller median values -0.01. The factors which might impact the differences in mean values could be attributed to the differences of climatic zones; hence, Karataş-Semayük is located in a more fertile area in comparison to Tilbeşhar which is situated at the boarder of the plateau close to dry-steppe land. At the same time the variation in socio-economic strategies could lead to the differences in LSI values. In Karataş-Semayük very small individuals and large-sized animals were present at the sample that could be result of breeding preference. While the sheep in Tilbeşhar clustered between -0.04 and 0.04 interval implying that the majority of the sample are more or less grouped in one category of size with a small groups of large-sized and small-sized individuals (Figure 6).

In northern Mesopotamian sites sheep LSI values were very close in both samples. The mean values in Tell Bderi -0.01 and in Tell Mozan -0.02. Examining the values of Anatolian and upper Mesopotamian sites suggests that sheep size in the southern site was much smaller than Anatolian sheep, while Tilbeşar at the boarder of both regions produced values closer to upper Mesopotamian sheep.

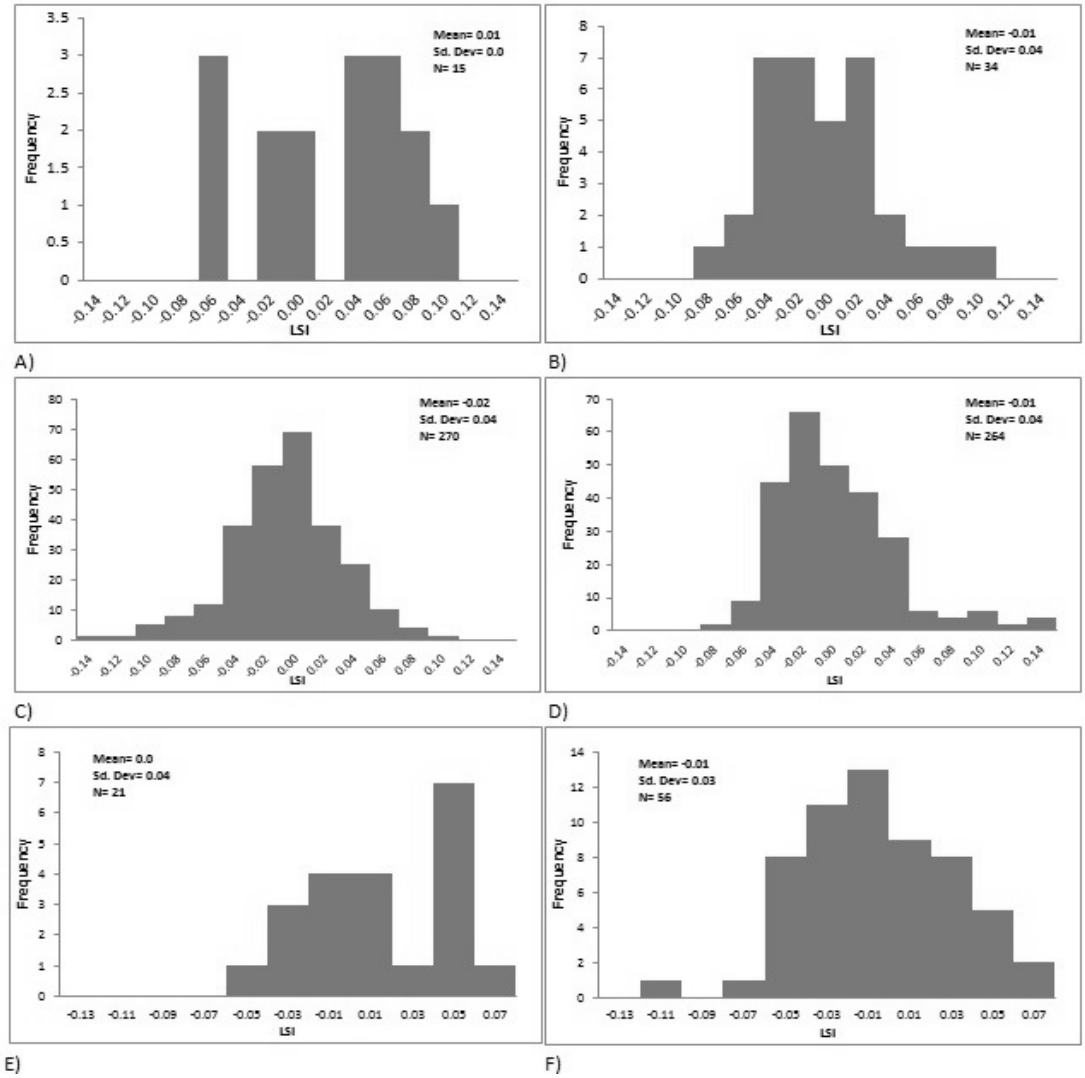

Figure 6: Histograms of LSI values of sheep metrical data from Anatolian and upper Mesopotamian sites. A: Karataş-Semayük; B: Tilbeşar; C: Tell Bderi; D: Tell Mozan; E: Tilbeşar (MBA); F: Tell Mozan (MBA).

Figure 6 displays the difference in logarithms of sheep skeletal elements that belong to Middle Bronze Age assemblages. The results of LSI analysis suggest a change in the size values during this period of time in comparison with the Early Bronze. LSI mean values of Tilbeşar sample demonstrates a slight increase in the MBA (mean = 0.00 in MBA while in EBA mean = -0.01). While in upper Mesopotamian site Tell Mozan the sheep size didn't display a significant change.

The results of LSI analysis applied on the goat's measurements are displayed in the following histograms

The differences in goat sizes among Anatolian sites are quite small as demonstrated in (Figure 7) In Karataş-Semayük and Tilbeşhar the Mean values were between -0.03 in Karataş-Semayük and -0.04 in Tilbeşar. Correspondingly, the LSI values of goats from upper Mesopotamian sites are very close to each other's the Mean values in both sites were -0.05. However, it seems that goats breed in Mesopotamia were smaller in size in comparison with the goats from Anatolian sites (Figure 7). During the MBA period there was an increase in the size of goats in both areas, but still the goats from

Anatolia are bigger than goats from upper Mesopotamia (Figure 7: e and f). As we discussed in the sheep case these changes in sizes fits with the environmental scenario. Accordingly, the more favorable climatic condition in the Anatolian plateau might impact the size of sheep and goats breeds, in comparison with the livestock of the settlements in the dry-steppe area.

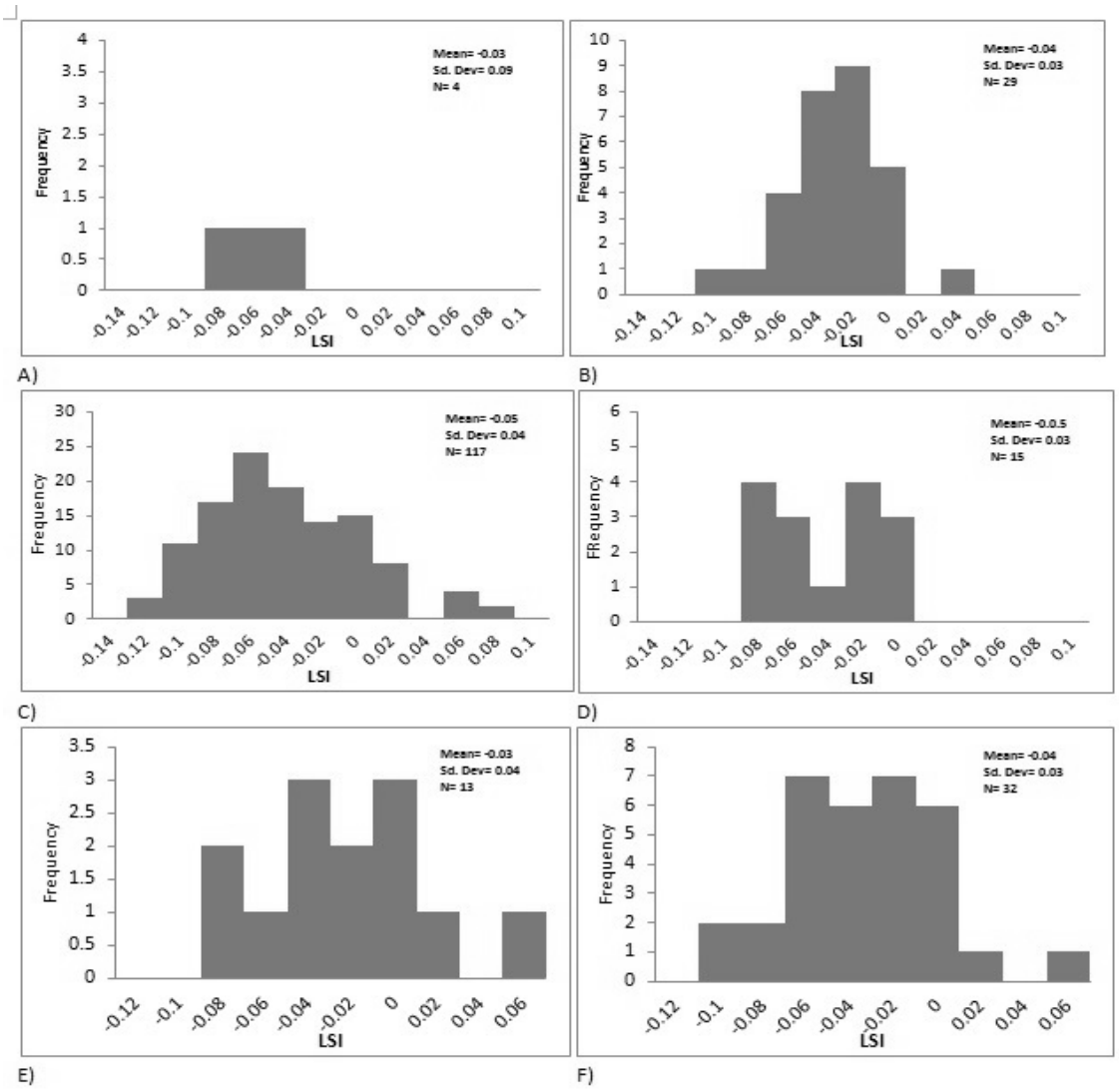

Figure 7 Histograms of LSI values of goats metrical data from Anatolian and upper Mesopotamian sites. A: Karataş-Semayük; B: Tilbeşar; C: Tell Bderi; D: Tell Mozan; E: Tilbeşar (MBA); F: Tell Mozan (MBA).

Conclusion

Addressing the changes of socio-economical organization in the early urban settlements and the factors that triggered these changes in animal economy during the Early Bronze Age and Middle Bronze Age period is a crucial process to evaluate the development of complex societies. The zooarchaeological investigation focused on demonstrating the fundamental characteristics of animal economy within the various settlements included in this study, while the comparative examination of the interregional features of early urban centers were utilized to evaluate the factors which stimulated the alternations of socio-economical patterns during the early stages of the historical era represented in this study by the Early and Middle Bronze

Age periods.

Examining the frequencies of most represented animal species at each faunal collection indicates the economic importance of caprine as main source of various products. Accordingly, we can consider sheep and goats the pillar on animal economy in Anatolia and upper Mesopotamian settlements. Sheep numbers exceeded goats in all faunal collections. The spectrum of exploited animals, domestic animals in the first place, alternated according to the socio-economical organization of each settlement. However, the intra-regional examination of identified animal species demonstrated the tendency to acquire a wider spectrum of animal species in smaller settlements, most probably to sustain settlement subsistence in the first place. That was the case in Anatolian sites case while in upper Mesopotamia early urban centers witnessed an intense dependency on sheep and goats products in comparison with the northern Anatolian sites, and these large settlements most likely maintained centralized economical patterns.

The reconstruction of caprine kill-off profiles produced two distinctive trends in the age groups during the EBA period. Small settlements produced a mix-strategy profile; hence sheep and goats were culled at different age stages, while larger urban sites such as Tell Mozan, Tilbeşhar and Tell Bderi demonstrated an emphasis on obtaining secondary products in the first place, this trend is indicated by high representation of older individuals and very young individuals that were culled before the optimal meat age for both sheep and goats. The Middle Bronze Age period produced similar profile of sheep and goat kill-off stages. The small settlement of *Kaman-Kalehöyük* followed mixed-production strategy, while Tilbeşhar and Tell Mozan continued exploiting sheep and goats herds to provide secondary products, which were supposed to be controlled by the centralized administrative system of these urban settlements.

Assessing the size of sheep and goat individuals from Anatolian and upper Mesopotamian sites though computing the differences of logarithm of sheep and goats postcranial metrical data, showed substantial results related with the interregional environmental and socio-economical settings. During the Early Bronze period sheep LSI values implies that the sheep's size within Anatolian settlements exceeded the size of sheep in the southern settlements, and that could be attributed to the difference in environmental settings, which might have left its impact on sheep. Moreover, the evaluation of goat individual's size produced similar results which in turn support our interpretation of the difference in size in both sheep and goat populations. The Middle Bronze phase illustrated similar size patterns of sheep and goats in both Anatolian and upper Mesopotamian sites. Nevertheless the northern individuals were larger in size in comparison to goat and sheep from upper Mesopotamian settlements. The change in size ratios is revealed by crossing the results of size estimation with the chronological sequence of the southwestern Asia. LSI values of Middle Bronze age were attributed to larger animals in relation with sheep and goat populations in EBA period. On the other hand the paleoclimatic research indicates that our area of interest witnessed a phase of harsh climate conditions (Bar-Matthews and Ayalon, 2002; Hazan et al., 2005). The archaeological evidence paint a picture of a period of turmoil for many of early Bronze Age urban-centers in Anatolia and Khabur region in upper Mesopotamia while some other urban centers survived and contained to flourish. Therefore, the increase of sheep and goats size in this scenario seems to be related to socio-economic strategies more than its connection to the fluctuation in climatic conditions which it didn't leave a substantial impact on the sheep and goats herd. In conclusion examining the main characteristics of animal economy on an interregional level indicates that during

Early and Middle Bronze Age Anatolian and upper Mesopotamian settlements maintained similar economic trends in terms of animal exploitation strategies. On the other hand each settlement had its own distinctive economical features that were related with location, the degree of centralization in its social organization.

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