



DOI: 10.5281/zenodo.824731

CENTRALIZATION AT ASINE DURING THE BRONZE AGE FROM A ZOOARCHAEOLOGICAL PERSPECTIVE

Stella Macheridis

*Department of Archaeology and Ancient History, Lund University, Sweden
(stella.macheridis@ark.lu.se)*

Received: 02/03/2017

Accepted: 27/06/2017

ABSTRACT

From at least the Late Neolithic through the end of the Bronze Age and onwards, people continued to inhabit the settlement of Asine. For this reason, the site makes an interesting starting point for discussing long term change. This short paper presents new data on the animal bones from Bronze Age Asine. The data set is used for a zooarchaeological discussion of the site from a diachronic perspective in terms of centralization and regional change. This has not been attempted previously. Zooarchaeological patterns from urban or central sites in other parts of the world are compiled as a framework for this purpose. The focus is on patterns of relative taxonomic abundances, anatomical distribution, mortality curves and sex distributions of cattle, sheep/goat and pigs. These are examined specifically for the animal bone assemblage from Bronze Age Asine. Differences and/or similarities with the general trends indicative of centralization are discussed for the study site. The results show that the Early Helladic Asine should be seen as a smaller rural site. The even relative abundances of cattle, sheep, goat and pigs indicate that the animal management was not specialized but rather mixed, pointing the site was relatively independent in terms of animal management. The increase in sheep/goat during the Middle Helladic indicates an increasing dependency on animals yielding secondary products, symptomatic of regional and centralized organization. This supports the archaeological evidence of the site, indicating that it was an important village to its immediate valley during this period. This function persisted during the Late Bronze Age. From a zooarchaeological perspective, it is not likely that Asine was a regional center. Some degree of sustainable animal management was probably existent near or at the site. I propose that Asine should be seen as an intermediary key site in the communication system as well as for the exchange of animals.

KEYWORDS: Asine, Aegean Bronze Age, Zooarchaeology, Centralization, Regional change, Animal management

1. INTRODUCTION

On a peninsular cliff-and-bay-site in the region of Argolis, we find the prehistoric settlement of Asine. Here the habitation was more or less continuous from at least the Early Helladic (EH, ca. 3100-2100 BC), to the 8th century BC (Frödin & Persson, 1938; Hägg & Hägg, 1973; Wells, 1983; Nordquist, 1987; Figure 1). Because of its long continuity, Asine makes a good case for studying general patterns of change from a long-term perspective.

This paper aims to investigate Bronze Age Asine in terms of centralization, a concept including discussions regarding independence vs dependence on the surrounding area or local resources and regional organization. Because Asine was important for its immediate surrounding valley area in at least the Middle Helladic period (MH, 2100-1600 BC) (Nordquist, 1987), any changes in the local economy should be reflected in the archaeological record of the settlement. Are there any zooarchaeological indications of centralization at Asine during the Bronze Age? Asine has not been the focus of research from a zooarchaeological diachronic perspective, making this study even more relevant for the site and for the Argolis region.

Zooarchaeological perspectives on centralization during the Bronze Age in mainland Greece are needed. In order to expand this type of research a comparative approach is required. By pinpointing zooarchaeological patterns occurring at other central and/or urban sites a theoretical frame can be set up, which can be tested on a data set. In order to do so, a schematic review on zooarchaeological studies from early urban sites is presented. This schematic functions as a model for the process of centralization in this study.

2. ZOOARCHAEOLOGICAL PATTERNS OF CENTRALIZATION

Centralization is a process which concentrates interaction, decision-making and power within a specific group or location (e.g. Nakoinz 2012: 219; Joyce & Barber 2015: 820). Urbanization is a contextual concept where signs of growing dependency on surrounding farms indicate that the settlement is growing in importance regionally. This is due to the gathering of people who specialize in not only subsistence but also economic, administrative and/or religious aspects of the society. These settlements affect a larger hinterland (Smith 2007: 4; see Mogren 2013). While centralized environments often are characterized by the influence and dependence of the hinterland, such settlements are not necessarily characterized by urbanization in terms of the gathering of people. For example, political centres might not be

characterized by the gathering of people, but rather as the location for the concentration of political authority.

In the present study, the focus is on relative taxonomic abundance, skeletal part frequencies, and mortality curves and sex distributions. These categories often form the basis of zooarchaeological studies of centralization or urbanization processes (e.g. Ekman 1973; Zeder 1991; Wapnish & Hesse, 1988; Vretemark 1997; Magnell 2009; Allentuck & Greenfield 2010; Redding 2010; cf. deFrance 2009). The data derive from sheep/goat, pig and cattle, because they are most abundant in number, and more prone to provide statistically significant counts.

In order to provide the frames for the study, I review examples from foremost urban environments, summarized in Table 1. Table 1 is not intended to be a formulation of a set of correlates. It is important to remember that complementary local data and trends are needed, since the effects of socio-economic processes regarding animal management and production differ geographically and temporally (deFrance, 2009).

2.1. *Relative taxonomic abundances*

Relative taxonomic abundances are basic ingredients of almost any zooarchaeological study, and can give important information about the animal consumption, management and production at a site.

Halstead (1996) connects the dominance by one species to a large scale specialization in animal management. An increase of sheep/goats in urban environments has been interpreted as the intensification of stock-keeping for centralized provision, import/export systems, and surplus (Zeder, 1991; Allentuck & Greenfield, 2010; deFrance, 2009; Table 1). The decrease of pig seems in some areas be symptomatic of the above as well. Since the pig is mainly a meat and fat animal, they are not as valuable for producing surplus (e.g. Ekman, 1973; Redding, 1991; Zeder, 1998). This was discussed by Zeder (1998) in her study of the decrease of pig in the Ancient Near East, which was linked to the eventual prohibition of the animal. The presence of pig that still occurred might be indicative of domestic production, i.e. at a household level (Redding, 1991). Similarly, a decrease in pig abundance at some Mediterranean sites, e.g. Cypriote LBA sites, has been demonstrated. In this area, the decrease in pigs is ascribed to deforestation, i.e. larger grazing areas, and improved agricultural technology, which made the keeping of bovids advantageous (Schwartz, 1974; Ekman, 1977; cf. Macheridis, 2011).

A decrease in pigs is often indicative of urban environments, explained by the increased import of sheep/goat and cattle from surrounding rural com-

munities to support the population within the city walls (e.g. Vretemark, 1997; Magnell, 2009). This bovid/pig opposition is not universal and is not always 'positive' for the sheep/goats, as in the above examples. In the early stages of urbanism, the keeping of pigs could have been the easiest solution for generating meat for a larger amount of people. This has been noted for a number of Swedish as well as German Early Medieval towns (Vretemark, 1997;

Benecke, 1994). Even if extensive large-scale pig husbandry seemingly decreased with time in Scandinavian towns, the keeping of pigs might have been an important part of urban household strategies. Since they are relatively easy to keep and feed, and can have a fast growth curve, it has been suggested that it was the most important type of urban animal husbandry until the 18th century (Szabó, 1970).

Table 1 Schematic overview of zooarchaeological patterns from central or urban sites

Variables	Zooarchaeological trends in urban environments		Explanations	References
	General	Specific		
<i>Bovines and caprines</i>	Increase		Intensification of stock-keeping for centralized provisioning, import/export systematization (in comparison to rural sites) and surplus of secondary products	Ekman, 1973; Vretemark, 1997; 2001; Magnell, 2009; Zeder, 1991; deFrance, 2009:115; Allentuck & Greenfield, 2010
	Specific age and sex patterns, beyond seasonal and pastoral need	Older culling ages; Older milk cows/draught oxen	Prime-age animals imported, local non-elite consumption of older animals	Wattenmaker, 1994
			Import of animals from surrounding farms/villages	Ekman, 1973; Vretemark, 1997; 2001; Magnell, 2009; Redding, 2013
<i>Pigs</i>	Decrease		Effect of demand of cattle due to agricultural intensification	Szabo, 1970; Ekman, 1973; Vretemark, 1997; 2001; Magnell, 2009; Redding, 1991; Zeder, 1998
		Increase within households	Not generating surplus of renewable kind needed for redistributive societies and large-scale husbandry, not as easily managed in closed space. Suitable for domestic rearing	
<i>Anatomical distributions</i>	end-products and consumption	Uneven distribution	Dependent on meat provision from imported animals	Zeder, 1991; Wapnish & Hesse, 1988
			Selective distribution of body parts and standardization of butchery	Zeder, 1991; Allentuck & Greenfield, 2010:21
		Differential spatial distribution	Selection of body parts made on basis of socioeconomic status	Wapnish & Hesse, 1988; Allentuck & Greenfield, 2010:21

2.2. Skeletal part's representation

In her study of the early urban economies in the Near East, Zeder found body part selection and standardized butchery to be the most indicative variable in the study of urban economies and redistributive systems (Zeder, 1991).

The interpretation of body part selection is made directly from animal bone assemblages, while animal husbandry is perhaps a more indirect measure (ibid., 1991). As a contrast, an even anatomical representation is often used as a sign of slaughter and butchery on-site, and not of the distribution of meat or provision from elsewhere. Before any interpretation, it is important to consider the matter from a taphonomic perspective. The most famous example of this discussion is the equifinality of patterns where compact long bones dominate (e.g. Binford,

1978; Lyman, 1994; 2004; Marciniak, 2005; Orton, 2012). It is thus important to discuss whether a cultural selection is the most probable explanation or whether such a pattern is due to post-depositional processes.

If an uneven anatomical distribution, such as a focus on the meaty long bones, is present within a sample, and is culturally derived, it can be interpreted in different terms than centralization. For example, it can be thought of as remains of consumption restricted to these body parts, while the slaughter waste has been disposed of elsewhere in the settlement. In order to discuss uneven anatomical representations as indicative of regional distribution of standardized meat portions, i.e. that the animal carcass was cut up and specific body parts selected prior to entering the settlement, other strands of evi-

dence must also be considered, such as contextual information from the site.

Samples selected from a mixture of primary deposits could disturb general tendencies by instances of special depositions. For example, if the samples only derive from specific infills it cannot be guaranteed to accurately describe tendencies, such as the general patterns of body parts representation. For this purpose, samples from secondary or tertiary material could instead be more suitable, as they are more likely to represent average everyday-life activities (Fuller *et al.*, 2014: 181).

2.3. Mortality curves and sex distributions

The selection of specific ages seems to be a universal pattern indicating centralization or urbanization.

From non-elite dwellings at Kurban Höyük, Wattenmaker (1994) suggests the lack of 2-3 year-old caprines to be a sign of export of prime-age animals for meat purposes, while the older are eaten locally, perhaps part of a state-controlled system. At the

Worker's Town at Giza, the large set of faunal remains is dominated by young male cattle and sheep/goat, taken as signs of import and not self-supported subsistence (Redding, 2010). The faunal remains from the EBA urban center Titris Höyük show an even skeletal element representation together with specific culling ages, which are interpreted by Allentuck and Greenfield (2010) as a sign that the animals were brought alive and then butchered, and also perhaps raised on site, i.e. that it was a consuming site. Later culling ages in slaughter frequencies of foremost cattle have been observed in urban environments (Vretemark, 1997; Magnell, 2009; deFrance, 2009). This particular pattern is seen, for example, in assemblages from Medieval Scandinavia, such as Skara (Vretemark, 1997), Kungahälla (Vretemark, 2001) and Lund (Ekman, 1973). In this region, it is often interpreted as the result of import or tax incantation.

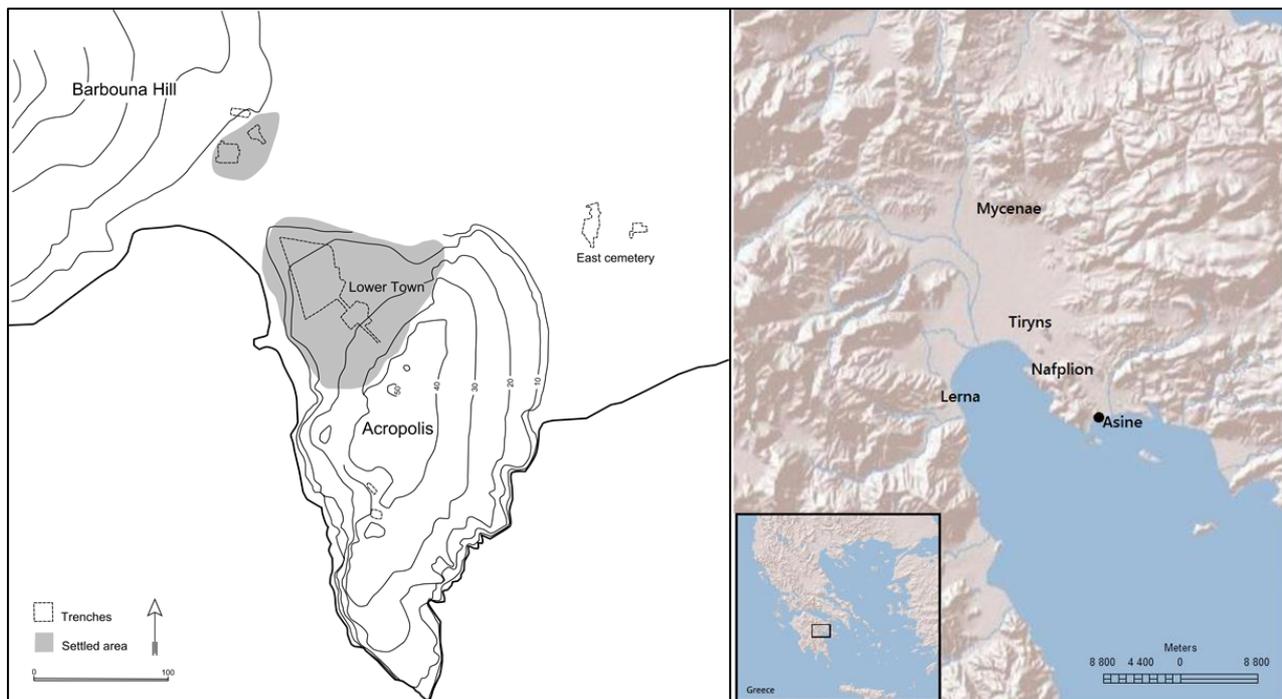


Figure 1 Map of Asine and Argolis. Right: the region Argolis with mentioned sites; Left: the excavation areas of Asine. Figure reproduced from Macheridis (2017) with permission.

3. ASINE DURING THE BRONZE AGE

Urbanization in Aegean Bronze Age societies has been the focus of debate and discussion (e.g. Branigan, 2001). According to Bintliff (1997), waves of urbanism are not evidenced in Greece until the Late Archaic, even if he later argued for towns and early state formation processes in the Middle and Late Bronze Ages of Greece (Bintliff, 2012). Asine was not a key site during these periods, but rather a village central to its immediate surrounding valley

and the sites within (Nordquist, 1987). Further, as the settlement was coastally located, it is also possible that it had a harbour function, which would also have made Asine an important settlement in the region during this period. If the above is true, the faunal remains should nevertheless yield patterns indicative of centralization.

The Swedish excavations of Asine started with the initial project 1922-1930 (Frödin & Persson, 1938), and were followed by several campaigns in the 1970s (Hägg & Hägg, 1973; Hägg & Fossey, 1980;

Hägg & Nordquist, 1992). There is evidence of a smaller Early Helladic (EH, 3100-2100 BC) settlement. This continued in the EH III-MH I (ca. 2200-1900 BC), which is characterized, among other things, by its *bothroi*, a type of pit often found on EH sites (Strasser, 1999; Macheridis, 2016). The first real expansion of Asine was during the Middle Helladic (2100-1700 BC). As indicated by its architectural remains, diverse material as well as inclusion of differentiated grave goods and cemeteries (Nordquist, 1987), MH Asine could have had a central function for the immediate valley. The settlement expanded to the Barbouna Hill during the late part of the period (Figure 1). This area was reused as a cemetery during the Late Helladic (LH, 1700-1050 BC) (Nordquist, 1987; Ingvarsson-Sundström et al., 2013).

There are several signs of increasing social complexity in the MH III-LH I period (ca. 1800-1600 BC). The mortuary evidence, with graves from different burial areas, is different in, among other things, grave morphology and in number of grave goods (e.g. Nordquist, 1987: 101; Voutsaki et al., 2011; Ingvarsson-Sundström et al., 2013). This development continues to the LH. For example, the pottery of the LH settlement has been interpreted as modest; yet the chamber tomb collection of Asine is amongst the most numerous and “wealthy” in the region (Gillis, 1996). Judging by the graves and architectural remains as well as material culture, we have a rather complex social situation represented on a small area during these periods, compared to other sites such as Mycenae.

4. THE ANIMAL BONES FROM BRONZE AGE ASINE

Previous studies on the animal bones from Asine have only partly been published (Moberg Nilsson, 1996; Macheridis, 2016; 2017). The zooarchaeological data in this study derives from a re-examination of the animal bones from the excavations of the Lower Town 1926 and the Barbouna campaigns 1970-1974 and 1989.

4.1. Sample selection

Of the 6129 identifiable animal bone fragments from Bronze Age Asine, this paper focuses on the bones from sheep/goat (1833 bones), pig (1701 bones) and cattle (1264 bones). These animals constitute the majority, 4798 bones (ca. 78%), of the animal bones from the site. As visible in Table 1, these animals are often central in the discussion of zooarchaeological patterns of centralization. Further, the material from Asine was mostly hand-collected, which means that smaller bones from birds and fishes are most likely under-represented (Mylona, 2003). Because of this, a focus on smaller animals would

probably be biased and is therefore excluded as a variable in this paper. Still, smaller bones, such as carpals and tarsals from medium-sized animals, could also be under-represented because of the lack of systematic sieving (Davis, 1987: 29).

The animal bones derive from mainly secondary, and even tertiary, deposits, meaning that they reflect redeposited waste materials from the site. Primary deposits, such as pit infills, are excluded. Thus, the animal bones from Asine reflect general tendencies rather than contextual variations as specific patterns of consumption (see section 2.2).

An exception from this is the bones from EH III-MH I, most of which derive from so called *bothroi*-pits. These are primary deposits, i.e. the animal bone waste that was thrown in the pits was produced nearby (Schiffer, 1987). It has been acknowledged that these features are probably closely connected to the houses and households at the site (Macheridis, 2016). Thus, the content of the *bothroi* might not be representative of the general EH III-MH I. However, a chi-square test of significance ($\chi^2 = 0.480$, $df = 2$, $p = >0.05$) showed that excluding animal bones from the *bothroi* did not produce any differences statistically, which is why they are included in this paper.

4.2. Zooarchaeological methods

In this study, the Number of Identified Specimens (NISP) is used as quantification, instead of secondary measures such as Minimum Number of Individuals (MNI). This depends mainly on the potential problem of ‘interaggregate interdependence’ when using MNI (Lyman 2008: 58). In short, MNI is a secondary measure and will be different, depending on the level of contextual resolution. The NISP-count remains the same whether based on single units or the whole assemblage. Further, research has shown that MNI-counts can be predicted using NISP, which is why the former is here considered redundant (Grayson & Frey 2004). Although NISP is problematic because, amongst other things, increased fragmentation increases NISP, it is nevertheless considered more suitable than MNI, given the above-mentioned issue.

Postcranial data have been used for age assessments (see section 4.5). Fusion status and recording follow Silver (1969), Habermehl (1961), and Vretemark (1997).

4.3. Relative taxonomic abundances

The relative abundances of cattle, sheep/goat and pig during the Bronze Age are illustrated in Figure 2. The results of a chi-square test indicate that the species compositions were different through time ($\chi^2 = 98.5$, $df = 8$, $p = <0.05$).

During the EH, it seems that a mixed herd strategy existed: all animals contributed 32-35% to Figure 2. The ratio between sheep and goats is relatively even, 1:1.6, supporting this scenario. An increase in pigs is visible during the EH III-MH I period. This could perhaps indicate that the settlement became more independent in terms of production and more isolated from other sites in the region. This was argued by Fillios (2006) regarding the over-representation of pig bones in the late EH Helike.

The EH III-MH I sheep:goat ratio, 1:2.6, shows that goats might have been more common, but this difference evens out in the MH period (1:1.3). A decrease of pig is visible during the Middle Helladic and into the early Late Helladic period (Figure 2). This coincided with an increase in sheep/goats. This general change has also been noted by Ingvarsson-Sundström et al. (2013). Perhaps the decrease in pigs can be connected to the growing social dynamics associated with the MH III-LH I. As discussed in section 2.1, the decrease in pigs and increase in sheep/goats is often associated with a regional change, in which the demand for a surplus of secondary products leads to an intensification of stock-keeping of ovicaprines (see Table 1). The regional changes during this period, as visible in e.g. the wealthy Shaft graves of Mycenae, are often seen as the prequel to the creation Mycenaean cultural complex later on. It is possible that already during this transitional period the process of centralization had begun in the region, leading to a focus on sheep/goat in animal production.

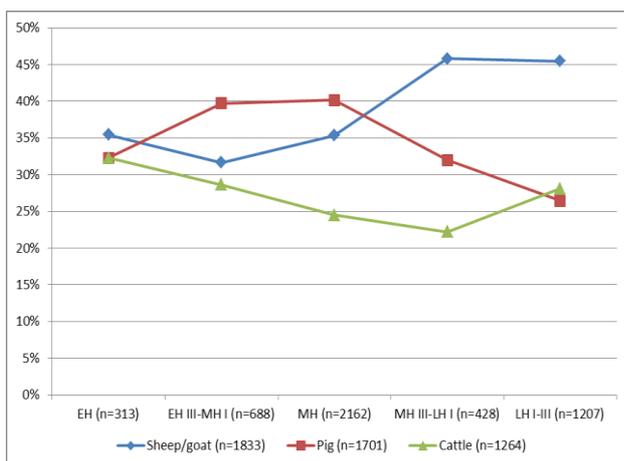


Figure 2 Relative abundances of sheep/goat, pig and cattle during the Bronze Age, Asine. Data from MH from Macheridis (2017).

Sheep increased in relation to goats (1:0.5), which changed to the LH when goats increased again (1:2.2). The LH animal management seems, however, to have been based on ovicaprines at Asine. This is consistent with the social dynamics in the region during the Mycenaean period, in which obvious cen-

tral places, such as Mycenae and Tiryns, emerged. Cattle seem to diminish in importance after the EH, but then appear steady at around 25%. Still, the cattle body contains more meat in relation to the smaller animals, so the importance of cattle meat might be somewhat invisible in Figure 2 (see Gejvall, 1969).

4.4. Skeletal parts' representation

Anatomical distributions for sheep/goat, cattle and pig are illustrated on Figure 3. The following categories are used: *Head* (horn, skull, mandible, loose teeth), *Trunk* (vertebrae, sternum, ribs), *Upper front* (scapula, humerus, radius, ulna), *Lower front* (carpals, metacarpals), *Pelvis* (the innominate bones), *Upper hind* (femur, patella, tibia, fibula), *Lower hind* (astragalus, calcaneus, tarsal, metatarsals), and *Feet and metapodials indet.* (metapodials and phalanges).

Chi-square tests on the anatomical distributions with and without loose teeth of all three animals did not result in any statistical differences, which is why loose teeth are included. The anatomical part distributions of all three animals share some characteristics. Most of the body is represented, with an over-representation of head and upper body. The lower elements are missing, except for cattle. Since parts from the whole body are represented among all animals during the BA, this probably means that living animals or whole bodies were butchered on or close to the site (see Macheridis & Tornberg, 2011).

The under-representation of fragile bone fragments such as spongy bone as vertebrae and pelvises, as well as fragile juvenile remains, is evident. It is probable that post-depositional processes have disturbed the general character of the animal bone assemblages from Asine (Macheridis, 2017); post-depositional destruction often targets less dense bones, such as vertebrae and ribs (Lyman, 1994). The lime-rich soils of Asine have proved to preserve the fragile skeletal remains of many infants and children buried within the settlement (Ingvarsson-Sundström, 2008; see Bannert, 1973). This speaks against the assemblages as totally biased by taphonomic processes below ground.

The differences between skeletal parts' representations of sheep/goat, pig and cattle during the different periods of the Bronze Age were tested through chi square statistics. This allowed for the detection of any statistically significant patterns within each period. Non-significant results indicate that the anatomical distributions should not be used for archaeological discussion, as they are most likely random. Still, the extent of the post-depositional destruction bias warrants that the interpretation of statistically significant patterns of anatomical distributions must take this into account, as is the case below.

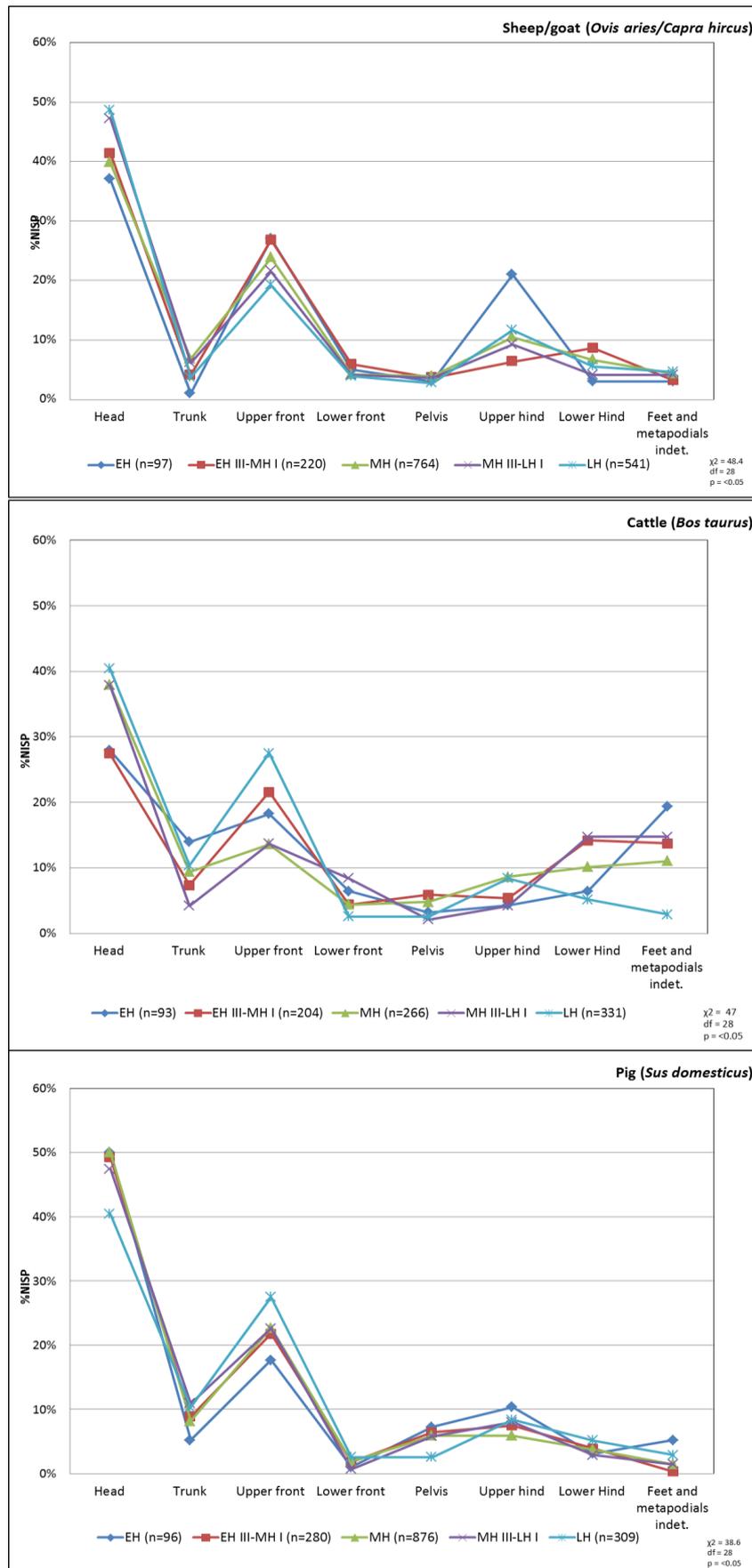


Figure 3 Skeletal part frequencies (%NISP) for sheep/goat, cattle, and pig, Bronze Age Asine

Even though the temporal differences of body parts' distributions of sheep/goat are statistically significant (Figure 3), there seems to be no major significant systemic change in carcass use. The peak of bones from the upper hind leg during the EH is unusual, but it cannot be verified, as it is based on a relatively small sample. The anatomical distributions of cattle are statistically different through time (Figure 3). The general characteristics, with relatively even frequencies of the head, upper limbs and the distal extremities, are different from the other animals (Figure 3). The head becomes gradually more abundant, while the proportion of the lower extremities and feet decreases towards the LH. This could be a consequence of chopping off the distal extremities or of skinning the carcasses before entering the settlement. If so, it would indicate that the bodies entered the village already slaughtered and perhaps butchered in larger pieces during the LH. As this can be contradicted by the presence of other parts of the body, it is hard to argue for.

The over-representation of head bones from pigs in the EH and MH is statistically significant (Figure 3). Although loose teeth are more uncommon in pigs than in the bovids, this over-representation could also be due to taphonomy, as the skull is more robust in suids. Still, the head is also meatier among pigs. The focus on heads seems to diminish after the MH period. Whether or not this reflects human selection is difficult to establish.

4.5. Mortality curves and sex distributions

The mortality curves for the three domesticates (Figure 4) are based on postcranial fusion data, since dental data was insufficient as complete mandibles were only found in a few cases. The use of such data means that juvenile and senior individuals are not well-represented. Figure 4 presents uniform curves for all animals in all Bronze Age periods.

For both sheep/goat and cattle, there is a focus on older individuals. This could be a taphonomic bias favouring adult specimens, since bone fragments from younger individuals are more fragile and smaller, and thus less prone to survive post-depositional density-mediated attrition. Individuals slaughtered at 2.5-3.5 years and above make up ca. 50-56% of the age assessed bones from sheep/goat (Figure 4). Ca. 13-17% derived from animals below

the age of one year, indicating animal management in proximity of and/or connected to the site. No statistically significant difference between the mortality curves of sheep/goat could be detected (Figure 4).

Between 59-71% of the specimens from cattle were from individuals aged 3-4 years and above during all periods. Compared to other time periods, the mortality curves signal that less juvenile and young cattle were killed off during the MH and LH. This difference is statistically significant. Perhaps the herd management at Asine favoured the slaughter of predominantly old cattle. This does not explain the lack of juvenile individuals, needed to sustain the flock, in Figure 4. As mentioned above, taphonomic post-depositional erosion targeting fragile bone might explain the lack of juvenile bone fragments. Alternatively, this particular pattern could be discussed as the importation of such animals to the settlement from the surrounding farms. This was, as presented in Table 1, one of the most common zooarchaeological patterns of centralization.

The mortality patterns of pigs seem to differ (Figure 4). There is a gradual shift towards increasing culling of juvenile pigs (<12 and around 12 months). In the MH and during the transition to the LH, specimens from pigs aged one year or below make up 47%, respectively 43% of the age assessed assemblage, while this number increases to 57% in the Late Helladic. This corresponds to the general decrease in pigs through time (Figure 2). This is, however, not a statistically significant pattern, and is therefore difficult to discuss zooarchaeologically.

Table 2 includes sex assessments made on specimens from sheep/goat, cattle, and pig. The samples are small, and cannot be verified as representative. The results of Kolmogorov-Smirnov tests show that in none of the cases is the observed D_{max} above the minimum D_{max} , indicating that the H_0 , i.e. that there is no differences between the samples, cannot be rejected (Shennan, 2007, 56-60). Sex assessed bones of sheep/goat are in general evenly distributed between males and females, although with slightly more males in the MH and LH. More males are identified in the EH sub-assemblages of cattle. Similar to sheep/goat, we can observe a peak of male specimens during the MH. Perhaps this is an indication of a focus on meat rather than milk production. There are more sex assessments of specimens of pigs.

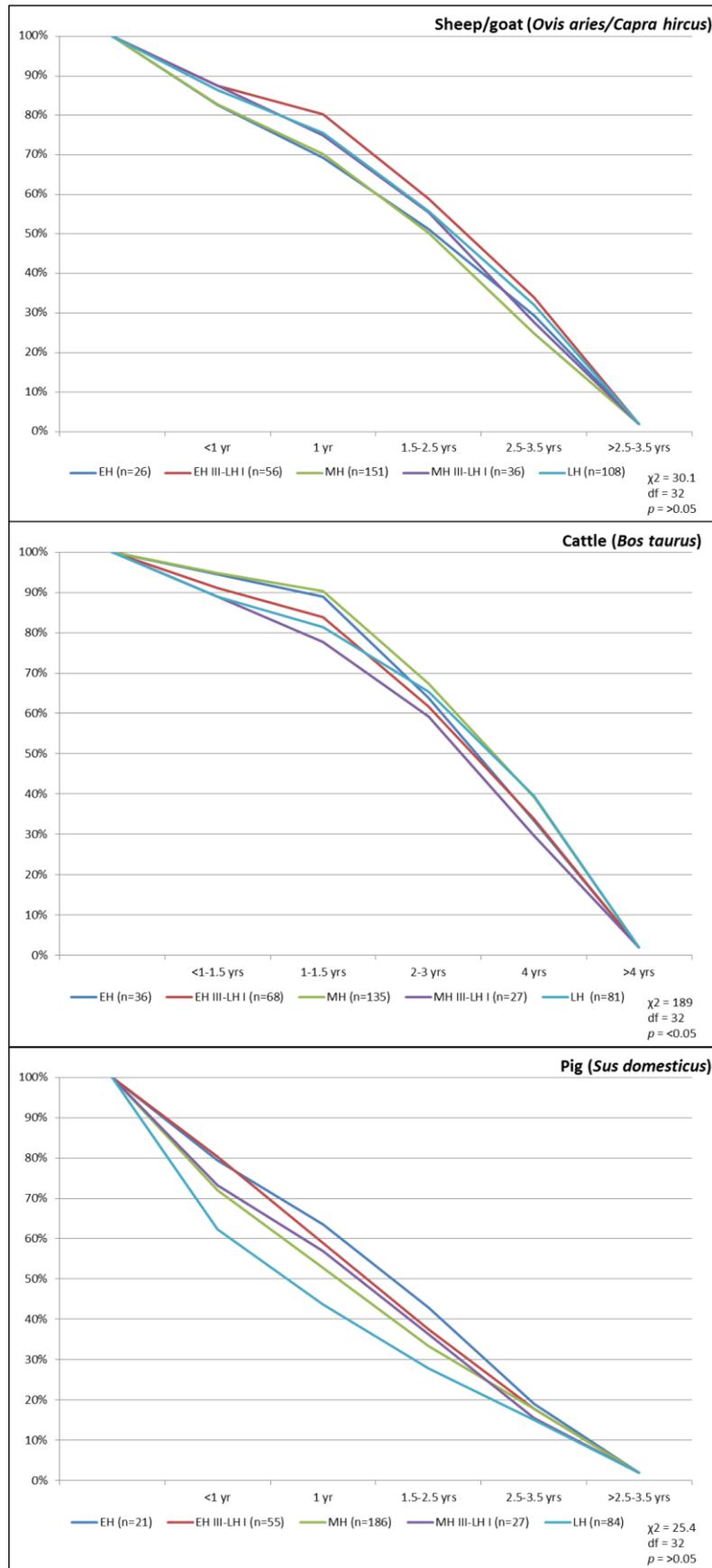


Figure 4 Relative survivorship curves, based on epiphyseal union data (%NISP), of sheep/goat, cattle, and pig in Bronze Age Asine.

This can be explained in taphonomic terms, since sex assessments are made on the basis of teeth, which are more resilient to post-depositional destruction than bone. There is a domination of tusks from suid males in all periods (Table 2).

Table 2 Sex assessments on bones from sheep/goat, cattle and pig from Bronze Age Asine.

	Sheep/goat		Cattle		Pig	
	Ram	Ewe	Bull	Cow	Boar	Sow
<i>EH</i>	1	1	2	0	5	0
<i>EH III-MH I</i>	4	3	2	1	6	2
<i>MH</i>	10	7	9	4	29	7
<i>MH III-LH I</i>	0	4	0	0	6	1
<i>LH</i>	4	3	2	0	10	5
Total	19	20	14	6	57	15
Dmax min.	0.435		0.581		0.395	
Dmax obs.	0.136		0.341		0.155	

5. ASINE, ITS FUNCTION AND ITS RELATION TO THE REGION

The aim of this paper is to provide some perspectives on Asine and its place in the region during the Bronze Age. Table 3 contains the general conclusions on whether or not the animal bones from the site indicate centralization in comparison, with general trends of such processes compiled in Table 1.

The relative taxonomic abundances of the three animals indicate that there was no large-scale specialization. Even if we can observe a trend with mixed relative abundances of sheep/goat, cattle and pig in the EH to more uneven in MH and LH, to call this a large-scale specialization is presumptuous, since no clear domination of any animal can be observed. This appears to be the case for other sites in Argolis, and the Aegean (Halstead, 1996; Trantalidou, 1989).

The animal bones do not indicate any centralization of Asine during the EH. The transition to a focus on pig during EH III-MH I could be a clue to changes of the regional communication and societal system in the end of EH, or the so called EH II/III collapse or gap (e.g. Bintliff, 2012; Davis, 2013; Wiener, 2014; cf. Weiberg & Finné, 2013). The high abundances of pigs at EH IIIA Helike have been suggested to be symptomatic of a more isolated rural environment (Fillios, 2006). Although uncertain because of revised chronologies (see Reese 2008), pig also increased between EH III and MH at nearby Lerna, according to Gejvall (1969).

At Asine, pigs decreased in abundance towards the LH, while sheep/goat increased. An increase of sheep/goat is visible also at LH I Lerna (Gejvall 1969:6). When compared to the general trends of centralization (Table 1) and the archaeological

knowledge of the emergence of a complex societal structure, the so called Mycenaean economies, this ovicaprine increase perhaps reflect higher regional demands for such animals. This might have come from regional centers, or production centers, for wool making and/or meat consumption. In which part of the chain was Asine located: the importing or exporting node?

Although the input of prime-age and old sheep/goats at Asine could be used to indicate imported animals from the surrounding area, the existence of younger individuals suggests local husbandry, i.e. from the immediate surrounding or stock-keeping activities connected to the site. There are no clear signs of import of sheep/goats to the village. A focus on old cattle existed (60-70% of age assessed specimens), which could be explained in terms of them being imported to Asine. The older animals might have been brought to the village when no longer usable for work, as a form of taxation on the nearby farms, as in the Scandinavian parallel, mentioned earlier (Vretemark, 1997; Magnell, 2009). One possible interpretation of Asine's regional function is as a small but central village for the immediate valley, where animals were occasionally brought in by passing pastoralists and nearby farms.

Halstead (1996) has previously suggested that the supposed animal husbandry supporting Mycenaean palatial sites was neither large in scale nor highly specialized. Rather, the palace economies relied on mixed farming communities in the surrounding area. Palatial sites should then show similar characteristics to early urban environments, following the above reasoning, in terms of taxonomic abundance, body parts' selection, and age/sex distributions.

The closest palatial site with published animal bone data is Tiryns (von den Driesch & Boessneck, 1990). If we compare Asine to this site, we can note that the faunal remains from Asine actually duplicate some of the patterns that are also evident at Tiryns. Among these is the on-site slaughter of sheep/goats, primarily of adult ages, but with inclusion of older animals (von den Driesch & Boessneck, 1990). The faunal remains from Tiryns testify to a focus on wool production, according to von den Driesch and Boessneck (1990).

While local centres exported sheep to the bigger regional ones, for example, they still affected the hinterland and still maintained their central importance to the immediate surroundings. Tiryns was probably foremost supported by its own local area, but advantaged on trade input from other smaller local centres in the form of control of raw materials and craft production rather than subsistence and basic economic needs (Halstead, 1999; 2011; Earle, 2011). This reveals a regional economy built on local centres,

communications and exchange, rather than pyramidal-controlled systems (cf. Small, 1999). It is possible that Asine was one such local centre. During the LH, sheep were lacking in relation to goats at the site (ratio 1:2.2). This indicates perhaps that they might have been imported rather than consumed within the site's boundaries. In addition to the zooarchaeological patterns, it is important to note the possible function of Asine as a harbour, as well as indications of social stratification at the site visible in the chamber tombs. This indicates a central and dynamic function of the site, at least to its immediate valley (see Gillis, 1996).

If there were no suitable areas to keep pigs, this might be a reason as to why pig decreases. This is maybe not the case, though, in Argolis, even if periods of aridity occurred throughout the Bronze Age (e.g. Wiener, 2014; Kaniewski et al., 2013; Weiberg et al., 2016). According to Redding (1991) and Zeder

(1998), the pig is not as suitable as the main stock if the aim is to produce surplus and generate secondary products. At Asine, the slaughter of juvenile pigs and piglets becomes more accentuated towards the later Bronze Age. Together with the general decrease in pigs observed in this period, this indicates that perhaps the domestic production of pigs grew as a supplement to the increasing management of sheep/goat. More offspring than needed were produced inside the settlement. They were consequently killed off. An over-representation of juvenile pigs to slaughter and the possible local keeping of swine seem to have occurred at Tiryns (von den Driesch & Boessneck, 1990). As noted by Halstead and Isaakidou (2011), to fatten one or two pigs was a significant cost to the household. This would be consistent with the tendency at Asine over time to cut costs by not breeding too many pigs into adulthood or optimum meat weight.

Table 3 Zooarchaeological patterns of centralization at Bronze Age Asine

Variable	EH	EH III-MH I	MH	MH III-LH I	LH	General characteristics
Relative taxonomic abundances	Mixed stock	Increase in pigs	Slight increase of sheep/goat, slight decrease of pigs	Clear increase of sheep/goat, clear decrease of pigs		
Skeletal parts' representation					Decrease of cattle lower extremities and feet (result of long-term change or taphonomic bias?)	Presence of whole bodies on site
Age/sex distribution		Increase of juvenile pig			Increase of juvenile pig	Focus on adult and older cattle
Context information		Bone input of the <i>bothroi</i> does not disturb the general tendencies				Cultural layers with primary and secondary refuse
Post-depositional disturbance						Post-depositional impact is evident but to an uncertain degree Smaller elements of medium-sized mammals might be underrepresented due to lack of sieving
Overall indicative of centralization	No	No	Uncertain	Perhaps	Perhaps	Perhaps in the later Bronze Age periods

6. CONCLUSIONS

The comparison between more general patterns of centralization and the specific patterns at Bronze Age Asine has built up a narrative of animal management at the site from a diachronic perspective.

Starting off as a rural community during the Early Helladic, zooarchaeological evidence indicates that the settlement developed to include other site functions during the course of the Bronze Age. In the

MH, it is credible that Asine took on an important function for its immediate surroundings and nearby farms. Older bovids were brought to the site, although Asine probably had an independent sustainable stock-keeping system for secondary products. Older and used cattle might have been occasionally brought into the settlement as large portions of meat. While pig keeping in general declined during the MH and onwards, it is possible that domestic production of pig became important into the Late Hel-

ladic, based on the increase in slaughter rates of juvenile pigs. In relation to the bigger regional sites, Asine passed on suitable animals for wool production or larger feasting activities. The site would in this scenario have functioned as a key site in the small region, connecting the Asine valley with the larger palatial sites and the vaster Argolid region.

In this discussion, the zooarchaeological patterns at Asine were briefly compared to the ones from the nearby sites, Lerna and Tiryns. However, as this study focuses on Asine solely, a holistic comparative approach was not attempted. For this purpose, other regional sites from Argolis and the vaster Peloponnesian region, which has been zooarchaeologically examined, such as Pylos (Nobis 1993), Midea (Gejvall 1983; Reese 1998) and Ayios Stefanos (Reese 2008), should be included. Future studies focusing on such a comparative approach are vital, in further

testing the zooarchaeological patterns of centralization presented in this paper.

To further illuminate Asine's place in the region it is necessary to study the coastal as well as industrial aspect of the site, in terms of antler craft refuse. Together with the osteological analysis, isotopic studies of the bones could also further illuminate animal sourcing and management (e.g. Madgwick et al., 2013; Guiry et al., 2014; Meier et al., 2014; Reitsema et al., 2015). For example, analysis of strontium isotopes could give information on the migration and movement of animals, and thus provide a basis for the discussion of the export/import of animals, animal exchange and long distance trade of animals (e.g. Viner et al., 2010; Thornton, 2011; Arnold et al., 2013). The shifting functions of Asine during the Bronze Age can thus be further investigated, and the hypotheses proposed in this study more thoroughly tested.

ACKNOWLEDGEMENTS

This study has gratefully received funds from the Längmanska Kulturfonden. I am grateful to Torbjörn Ahlström, Dimitra Mylona and Ola Magnell for valuable comments on earlier drafts. I am thankful for the comments from two anonymous reviewers, which helped improved the paper greatly. Any faults or misconceptions are however my own. An earlier version of this paper was presented in the 12th ICAZ conference in San Rafael, Argentina, 2014. I wish to thank the session organizers for organizing the session and all participants at the conference.

REFERENCES

- Allentuck, A., and Greenfield, H. (2010) The organization of animal production in an Early urban center: the zooarchaeological evidence from Early Bronze Age Titris Hoyük, Southeastern Turkey. In *Anthropological Approaches to Zooarchaeology: Complexity, Colonialism, and Animal Transformations*, S. Campana, P. Crabtree, S.D. deFrance, J. Lev-Tov, and A. Choyke (eds.), Oxbow Books, Oxford/Oakville, pp. 12-29.
- Arnold, E. R., Greenfield, H. J., & Creaser, R. A. 2013. Domestic cattle mobility in early farming villages in southern Africa: Harvest profiles and strontium ($^{87}\text{Sr}/^{86}\text{Sr}$) isotope analyses from Early Iron Age sites in the lower Thukela River Valley of South Africa. *Archaeological and Anthropological Sciences*, vol. 5, pp. 129-144.
- Bannert, D. (1973) Geologische Bemerkungen zur Ausgrabung am Barbouna-Hügel. In *Excavations in the Barbouna Area at Asine. Fascicle 1: General Introduction, Bibliography, Geological Background and a Report on the Field-work in the Levendis sector, 1970-1972*, I. Hägg, and R. Hägg (eds.), Uppsala University, Uppsala, pp. 16-21.
- Benecke, N. (1994) *Archäozoologische Studien zur Entwicklung der Haustierhaltung in Mitteleuropa und Skandinavien von den Anfängen bis zum ausgehenden Mittelalter*. Akademie Verlag, Berlin.
- Binford, L. (1978) *Nunamiut Ethnoarchaeology*. Percheron Press, New York.
- Bintliff, J. (1997) Regional survey, demography, and the rise of complex society in the Ancient Aegean: Core-Periphery, Neo-Malthusian, and other interpretive models. *Journal of Field Archaeology*, vol. 24, pp. 1-37.
- Bintliff, J. (2012) *The complete archaeology of Greece: from hunter-gatherers to the 20th century A. D.* Wiley-Blackwell, Malden.
- Branigan, K. (ed.) (2001) *Urbanism in the Bronze Age*. Sheffield Academic Press, London.
- Davis, J. L. (2013) "Minding the Gap": A Problem in Eastern Mediterranean Chronology, Then and Now. *American Journal of Archaeology*, vol. 117, pp. 527-533.
- Davis S. J. (1987) *The Archaeology of Animals*. B.T. Batsford Ltd, London.
- deFrance, S. D. (2009) Zooarchaeology in complex societies: Economy, status, and ideology. *Journal of Archaeological Research*, vol. 17, pp. 105-168.

- von den Driesch, A. and Boessneck, J. (1990) Die Tierresten von der mykenischen Burg Tiryns bei Nauplion/Peloponnes, In *Tiryns : Forschungen und Berichte, band XI*, Verlag Philipp von Zabern, Mainz, pp. 87-164.
- Earle, T. (2011) Redistribution and the political economy: the evolution of an idea. *American Journal of Archaeology*, vol. 115, pp. 237-244.
- Ekman, J. (1973) *Early Medieval Lund: the fauna and the landscape*. Museum of Cultural History, Lund.
- Ekman, J. (1977) Animal bones from a Late Bronze Age settlement at Hala Sultan Tekke. *Studies in Mediterranean Archaeology*, vol. 45, pp. 237-244.
- Fillios M. A. 2006. *Measuring complexity in Early Bronze Age Greece: The pig as a proxy indicator of socio-economic structures*. Unpublished PhD dissertation, Faculty of the graduate school, University of Minnesota.
- Frödin, O. and Persson, A. W. (1938) *Asine. Results of the Swedish Excavations 1922-1930*. Generalstabens litografiska anstalts förlag, Stockholm.
- Fuller, D. Q, Stevens, C. and McClatchie, M. (2014) Routine activities, tertiary refuse, and labor organization: Social inferences from everyday archaeobotany. In *Ancient plants and people: Contemporary trends in archaeobotany*, M. Madella, C. Lancelotti and M. Savard (eds.), The University of Arizona Press, Tucson, pp. 174-217.
- Gejvall, N. G. (1969) *Lerna: A preclassical site in the Argolid. Volume I: The fauna*. American School of Classical Studies at Athens, Princeton.
- Gejvall, N. G. (1983) Appendix VI. Animal Bones from the Citadel. In *The Cuirass Tomb and other finds at Midea. Part 2: Excavations in the cemeteries, the Lower Town and the Citadel*, P. Åström (ed.), Paul Åströms Förlag, Göteborg, pp. 51-54.
- Grayson, D. K., & Frey, C. J. (2004) Measuring skeletal part representation in archaeological faunas. *Journal of Taphonomy*, vol. 2, pp. 27-42.
- Gillis, C. (1996) Tin at Asine. In *Asine III. Supplementary studies on the Swedish excavations 1922-1930*, R. Hägg, G. C. Nordquist, B. Wells (eds.), Swedish Institute at Athens, Stockholm, pp. 94-100.
- Guiry, E.J., Harpley, B., Jones, Z., & Smith, C. (2014). Integrating stable isotope and zooarchaeological analyses in historical archaeology: A case-study from the urban nineteenth-century Commonwealth Block site, Melbourne, Australia. *International Journal of Historical Archaeology*, vol. 18, pp. 415-440.
- Habermehl, K. H. (1961) *Die Altersbestimmung bei Haustieren, Pelztieren und beim jagdbaren Wild*. Verlag Paul Parey, Berlin.
- Halstead, P. (1996) Pastoralism or household herding? Problems of scale and specialization in early Greek animal husbandry. *World Archaeology*, vol. 28, pp. 20-42.
- Halstead, P. (1999) Towards a model of Mycenaean palatial mobilization. In *Rethinking Mycenaean Palaces: New interpretations of an old idea*, M. L. Galaty, and W. A. Parkinson (eds.), The Cotsen Institute of Archaeology, Los Angeles.
- Halstead, P. (2011) Redistribution in Aegean palatial societies: Terminology, scale, and significance. *American Journal of Archaeology*, vol. 115, pp. 229-235.
- Halstead, P. and Isaakidou, V. (2011) A pig fed by hand is worth more than two in the bush: Ethnoarchaeology of pig husbandry in Greece. In *Ethnozooarchaeology: the past and present of human-animal relationships*, U. Albarella, and A. Trentacoste (eds.), Oxbow Books, Oxford and Oakville, pp. 160-174.
- Hägg, I. and Hägg, R. (1973) *Excavations in the Barbouna Area at Asine. Fascicle 1: General Introduction, Bibliography, Geological Background and a Report on the Field-work in the Levendis sector, 1970-1972*. Uppsala University, Uppsala.
- Hägg, I. and Fossey, J.M. (1980) *Excavations in the Barbouna area at Asine. Fascicle 4: The Hellenistic nekropolis and later structures on the middle slopes, 1973-77*. Uppsala University, Uppsala.
- Hägg R. and Nordquist G. C. (1992) Excavations in the Levendis Sector at Asine, 1989: A Preliminary Report. *Opuscula Atheniensiensia*, vol. 19, pp. 59-68.
- Ingvarsson-Sundström, A. (2008) *Asine III: supplementary studies on the Swedish excavations 1922-1930. Fascicle 3: Children lost and found*. Swedish Institute at Athens, Stockholm.
- Ingvarsson-Sundström, A., Voutsaki, S. and Milka, E., (2013) Diet, health and social differentiation in Middle Helladic Asine: a bioarchaeological view. In *Diet, Economy and Society in the Ancient Greek World: Towards a better integration of archaeology and science*, S. Voutsaki, S. M. Valamoti (eds.), Peeters, Leuven, pp. 149-162.

- Joyce, A.A., and Barber, S.B. (2015) Ensoulment, entrapment, and political centralization: A comparative study of religion and politics in Later Formative Oaxaca. *Current Anthropology*, vol. 56(6), pp. 819-847.
- Kaniewski, D., Van Campo, E., Guiot, J., Le Burel, S., Otto, T., and Baeteman, C. (2013) Environmental roots of the Late Bronze Age Crisis, *PLoS ONE*, vol. 8, e71004.
- Lyman, R. L. (1994) *Vertebrate Taphonomy*. Cambridge University Press, Cambridge, United Kingdom.
- Lyman, R. L. (2004) The concept of equifinality in taphonomy. *Journal of Taphonomy*, vol. 2, pp. 15-26.
- Macheridis, S. (2011) Appendix 5: Preliminary report on the osteological material from Hala Sultan Tekke 2010. In *New Swedish Cyprus Expedition 2010 Excavations at Dromolaxia Vizatzia/Hala Sultan Tekke: preliminary results*, P. Fischer (ed.), *Opuscula*, vol. 4, pp. 93-94.
- Macheridis, S. (2016) Home, refuse, and reuse during the EH III to the MH I transitional period: a social zooarchaeological study of the Asine *bothroi*. *Opuscula*, vol. 9, pp. 71-91.
- Macheridis, S. (2017) The use of multiple correspondence analysis (MCA) in taphonomy: The case of Middle Helladic Asine, Greece. *International Journal of Osteoarchaeology*, vol. 27 (3), pp. 47-487.
- Macheridis, S. and Tornberg, A. (2011) Matrester och slaktavfall på Hovdala borg: osteologisk analys av djurbensmaterialet från Gårdstalien 2008. In *Händelser längs en väg: Finjasjöbygden med den medeltida Hovdalarborgen i centrum*, A. & C. Ödman (eds.), Dept. of Archaeology and Ancient History, Lund University, Lund, pp. 286-303.
- Madgwick, R., Sykes, N., Miller, H., Symmons, R., Morris, J., and Lamb, A. (2013) Fallow deer (*Dama dama dama*) management in Roman South-East Britain. *Archaeological and Anthropological Sciences*, vol. 5, pp. 111-122.
- Magnell, O. (2009) Den urbana borgen och den lantliga staden. Djurhållning och kost i det medeltida Sölvesborg. *Ale, Historisk Tidsskrift för Skåne, Halland och Blekinge*, vol. 2009, pp. 20-24.
- Marciniak, A. (2005) *Placing Animals in the Neolithic: Social Zooarchaeology of prehistoric farming communities*. UCL Press, London.
- Meier, J., Price, G., and Shelton, K. (2014) Animals beyond the Cyclopean walls: Integrating faunal and isotopic analysis at Late Helladic IIIA2 Petsas House. In *Abstracts = Libro de Resúmenes. ICAZ 2014, 12th International Conference of Archaeozoology. September, 22nd-27th. A.D. Izeta (ed.)*, Universidad Nacional de Cordoba: San Rafael, Argentina, p. 107.
- Moberg Nilsson, K. (1996) Animal bones from Terrace III in the Lower Town of Asine. In *Asine III. Supplementary Studies on the Swedish Excavations 1922-1930. Fasc. 1*, R. Hägg, G. C. Nordquist, and B. Wells (eds.), Skrifter utgivna av Svenska Institutet i Athen, 4^o, Stockholm, pp. 111-115.
- Mogren, M. (2013) The first sparks and the far horizons: stirring up the thinking on the earliest Scandinavian urbanization processes – again. *Lund Archaeological Review*, vol. 18, pp. 75-88.
- Mylona, D. (2003) Archaeological fish remains in Greece: General trends of the research and a gazetteer of sites. In *Zooarchaeology in Greece: Recent advances*, E. Kotjabopoulou, Y. Hamilakis, P. Halstead, C. Gamble, and P. Elefanti (eds.), The British School at Athens, London, pp. 193-200.
- Nakoinz, O. (2012) Models of centrality. *Journal for Ancient Studies*, vol. 3, pp. 217-223.
- Nobis, G. (1993) Archäozoologische Untersuchungen von Tierresten aus dem "Palast des Nestor" bei Pylos in Messenien/SW-Peloponnes. *ZFA (Zeitschrift für Archäologie)*, vol. 27, pp. 151-173.
- Nordquist, G. C. (1987) *A Middle Helladic Village. Asine in the Argolid*. PhD dissertation. Uppsala Universitet, Uppsala.
- Orton, D. C. (2012) Taphonomy and interpretation: An analytical framework for social zooarchaeology. *International Journal of Osteoarchaeology*, vol. 22, pp. 320-337.
- Reese, D. (2008) Faunal remains from Late Helladic Lerna (Argolid, Greece). *Mediterranean Archaeology and Archaeometry*, vol. 8, pp. 5-25.
- Reese, D. S. (1998) Appendix II: The faunal remains. In *Excavations on the Acropolis of Midea, Vol. I:1. The excavation on the Lower Terraces*, G. Walberg (ed.), Paul Åströms förlag, Stockholm, pp. 277-291.
- Reese, D. S. (2008a) Appendix 8: The mammalian and reptilian remains: Catalogue and comparanda. In *Ayios Stefanos: Excavations at a Bronze Age and Medieval settlement in Southern Laconia*, W. D. Taylour and R. Janko (eds.), British School at Athens, London, pp. CD156-185.
- Redding, R. W. (1991) The role of the pig in the subsistence system of ancient Egypt: a parable on the potential of faunal data. In *Animal use and culture change*, P. Crabtree, and K. Ryan (eds.), The University Museum, University of Pennsylvania Philadelphia, pp. 20-30.

- Redding, R. W. (2010) Status and diet at the Worker's Town, Giza, Egypt. In *Anthropological approaches to zooarchaeology: Complexity, colonialism, and animal transformations*, S. Campana, P. Crabtree, S. D. deFrance, J. Lev-Tov, and A. Choyke (eds.), Oxbow Books, Oxford and Oakville, pp. 65-75.
- Reitsema, L.J., Brown, T.E., Hadden, C.S., Cutts, R.B., Little, M.E., and Ritchison, B.T. (2015) Provisioning an urban economy: isotopic perspectives on landscape use and animal sourcing on the atlantic coastal plain. *Southeastern Archaeology*, vol. 35(3), pp. 237-254
- Schwartz, J. (1974) The paleozoology of Cyprus: a preliminary report on recently analyzed sites. *World Archaeology*, vol. 5, pp. 215-220.
- Silver, I. A. (1969) The ageing of domestic animals. In *Science in Archaeology*, D. R. Brothwell, and E. Higgs (eds.), Thames & Hudson, London, pp. 283-302.
- Small, D. (1999) Mycenaean polities: states or estates? In *Rethinking Mycenaean Palaces: new interpretations of an old idea*, M. L. Galaty, and W. A. Parkinson (eds.), The Cotsen Institute of Archaeology, Los Angeles, pp. 43-48.
- Smith, M.E. (2007) Form and meaning in the earliest cities: A new approach to ancient urban planning. *Journal of Planning History*, vol. 6(1), pp. 3-47.
- Strasser, T. F. (1999) Bothroi in the Aegean Early Bronze Age. In *Meletemata: studies in Aegean Archaeology presented to Malcolm H. Wiener as he enters his 65th year*, P. P. Betancourt, V. Karageorghis, R. Laffineur, and W.-D. Niemeier (eds.), Université de Liège/University of Austin, Liège/Austin, pp. 814-817.
- Szabó, M. (1970) *Herdar och husdjur: En etnologisk studie över Skandinavians och Mellaneuropas beteskultur och vallningsorganisation*. Nordiska Muséet, Stockholm.
- Thornton, E.K. (2011) Reconstructing ancient Maya animal trade through strontium isotope ($^{87}\text{Sr}/^{86}\text{Sr}$) analysis. *Journal of Archaeological Science*, vol. 38 (12), pp. 3254-3263.
- Trantalidou, C. (1989) Animals and Human Diet in the Prehistoric Aegean. In *Thera and the Aegean World III*, D. A. Hardy, J. Keller, V. P. Galanopoulos, N. C. Flemming, and T. H. Druitt (eds.), The Thera Foundation, Santorini, Greece, pp. 392-405.
- Wapnish, P. and Hesse, B. (1988) Urbanization and the organization of animal production at Tell Jemmeh in the Middle Bronze Age Levant. *Journal of Near Eastern Studies*, vol. 47, pp. 81-94.
- Wattenmaker, P. (1994) Household economy in early state society: Material value, productive context, and spheres of exchange. In *The Economic Anthropology of the State*, E. M. Brumfiel (ed.), University Press of America, Lanham, pp. 93-118.
- Weiberg, E. and Finné, M. (2013) Mind or Matter? People-Environment Interactions and the Demise of Early Helladic II Society in the Northeastern Peloponnese. *American Journal of Archaeology*, vol. 117, pp. 1-31.
- Weiberg, E., Unkel, I., Kouli, K., Holmgren, K., Avramidis, P., Bonnier, A., Dibble, F., Finné, M., Izdebski, A., Katrantsiotis, C., Stocker, S. R., Andwing, M., Baika, K., Boyd, M. And Heymann, C. (2016) The socio-environmental history of the Peloponnese during the Holocene: Towards an integrated understanding of the past. *Quaternary Science Reviews*, vol. 136, pp. 40-65.
- Wells, B. (1983) *Asine II: results of the excavations east of the Acropolis. Fascicle 4: the Protogeometric period. Part 1 an analysis of the settlement*. Svenska institutet i Athen, Stockholm.
- Wiener, M. H. (2014) The interaction of climate change and agency in the collapse of civilizations ca. 2300-2000 BC. *Radiocarbon*, vol. 56, pp. S1-S16.
- Viner, S., Evans, J., Albarella, U. and Parker Pearson, M. (2010) Cattle mobility in prehistoric Britain: Strontium isotope analysis of cattle teeth from Durrington Walls (Wiltshire, Britain). *Journal of Archaeological Science*, vol. 37, pp. 2812-2820.
- Voutsaki, S., Ingvarsson-Sundström, A. and Dietz, S. (2011). Tumuli and social status: A re-examination of the Asine tumulus. In *Ancestral landscapes: Burial mounds in the Copper and Bronze Ages*, E. Borgna, and S. Müller Celka (Eds.), Maison de l'Orient et de la Méditerranée : Lyon, pp. 445-461.
- Vretemark, M. (1997) *Från ben till boskap: kosthåll och djurhållning med utgångspunkt i medeltida benmaterial från Skara. Del 1*. Skaraborgs länsmuseum, Skara.
- Vretemark, M. (2001) Kungahälla - om handel och varututbyte med animalieprodukter. In *Kungahälla - problem och forskning kring stadens äldsta historia*, H. Andersson, K. Carlsson, and M. Vretemark (Eds.), Bohusläns museums förlag, Uddevalla/Stockholm, pp. 111-133.
- Zeder, M. A. (1991) *Feeding cities: specialized animal economy in the ancient Near East*. Smithsonian Institution Press, Washington.

Zeder, M. A. (1998) Pigs and emergent complexity in the Ancient Near East. In *Ancestors for the pigs: pigs in prehistory*, S. M. Nelson (ed.), The University Museum, University of Pennsylvania Philadelphia, pp. 109-122.