Pigs in the Neolithic of the Eastern Fertile Crescent: new evidence from pre-pottery Neolithic Bestansur and Shimshara, Iraqi Kurdistan (7800 – 7100 BC)

Article

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Pigs in the Neolithic of the Eastern Fertile Crescent: New evidence from Pre-pottery Neolithic Bestansur and Shimshara, Iraqi Kurdistan (7800 – 7100 BC)

Running head: Pig exploitation at Neolithic Bestansur and Shimshara (7800-7100)

Authors: Donna de Groene[1*], Robin Bendrey[2], Roger Matthews[1]

1: University of Reading, School of Archaeology, Geography and Environmental Science
2: University of Edinburgh, School of History, Classics and Archaeology

*Contact details corresponding author:
email: d.a.j.degroene@pgr.reading.ac.uk

Abstract

Pigs are one of the earliest domesticated livestock species, first domesticated at least 10,000 years ago. The domestication of wild boar, including associated morphological changes, is a long process over several millennia. Across Southwest Asia, management, domestication and the adaption of the different livestock species was a highly localized process, influenced by both cultural and environmental factors.

This paper explores the size, age and diet of the suids of the Pre-Pottery Neolithic sites of Bestansur and Shimshara in order to further our understanding of the origins of suid management in the Neolithic Eastern Fertile Crescent. Our data suggest that the relationship between wild boar and humans was more complex than a strict hunter-prey relationship. This study demonstrates that the Neolithic in the Zagros was not uniform in the adaption and exploitation of different animals.

Introduction

The domestication of animals is a process in which relations between humans and animals gradually change (Zeder 2012). Pigs are one of the earliest domesticated livestock species, first domesticated at least 10,000 years ago (Albarella *et al.* 2006; Zeder 2008). According to recent aDNA analyses, they were independently domesticated during multiple events in both Western and Eastern Eurasia (Frantz *et al.* 2019; Zeder and Lemoine 2020a). Southwest Asia was one of the places where pigs were domesticated, and this has been the topic of research for several decades (Flannery 1982; Ervynck *et al.* 2001). However, the processes which led to their domestication are still not completely understood (Zeder 2012). One main difference between the domestication of pigs and the other key livestock species (goat, sheep, cattle) is that pigs are omnivores. Therefore, they potentially have a wider range of relationships with humans than purely herbivorous livestock (Albarella *et al.* 2006). Wild boar could have been attracted to food waste at early human settlements, so the first steps of domestication might be both through a hunter-prey relationship and/or a commensal one (Price and Hongo 2020, 9-10; Zeder 2012). Furthermore, humans can apply a wider range of management strategies for omnivores, since they can be kept and fed in different ways and consequently, the domestication process of wild boar may be more complex (Albarella *et al.* 2006).

The domestication of wild boar, including associated morphological changes, is a long process over several millennia (Price and Evin 2019; Zeder 2015). The earliest human management precedes morphological changes related to domestication, which makes it more complex to identify in the archaeological record. The postcranial size change of pigs under domestication is a continuous development, which may take millennia, and therefore pigs are not expected to be significantly smaller than their wild counterparts during the initial stages of domestication (Price and Evin 2017). Overall size reduction coincides with morphological changes (Albarella et al. 2006). Pigs undergo the largest brain size reduction of all domesticated animals (Zeder 2012), changing the skull shape completely so that, even in early stages of domestication, teeth in the jaw can be affected by this skull change. Teeth further back in the jaw (i.e. M2 and M3 to an even greater extent) seem to be most affected by this size reduction in the first stages of domestication (Albarella et al. 2006, 261). Demographic data of animal populations can be a more reliable early indicator than a change in their body size for the start of changes in human-suid relationships (Zeder 2012). Since managed pigs are often slaughtered when or just before they reach their full body size, to obtain maximum meat gain (Hadjikoumis 2012), a higher percentage of suids less than 2 years old would be expected in a managed herd than in a hunted population. Early management strategies, however, would likely not have as much of an emphasis on killing young animals as in current day domestic herds. Herd sizes were possibly smaller, so therefore a higher proportion of animals would have to be kept alive to reproduce. Also, since suid populations grow rapidly and pigs have larger litters than bovidae, intensified hunting can lead to a higher percentage of juveniles (Rowley-Conwy *et al.* 2012). However, at multiple prehistoric sites in Southwest Asia, a change in the mortality profile has been attested and interpreted as the start of pig management (Ervynck *et al.* 2001; Peters *et al.* 1999). Another indication for human management could be changes in the diet of wild boar. Wild boar are omnivorous, but their diet consists mostly of plant material such as roots, acorns and fruits. Since they are omnivorous, their diet can be easily adjusted by humans. When pigs are kept in a settlement and are fed on domestic waste, which might include animal products, they may become more carnivorous. On the contrary, pigs could also be managed extensively, being allowed to forage themselves in areas around the settlement. s. In that case, the diet need not necessarily differ largely from their wild counterparts. The composition of plant-based food for managed animals could still be different, with an increased uptake of agricultural waste instead of a more wild plant-based diet, which would include more root products (Albarella et al. 2006; Hadjikoumis 2012; Rowley-Conwy et al. 2012).

In the northern Fertile Crescent, an initial form of suid management has been suggested at Hallan Çemi (10th-9th millennium BC) based on a change in kill-off patterns (Price and Hongo 2020, 34; Rosenberg *et al.* 1998, 33). Later analysis indicated that around 68% of the pigs were slaughtered before or around the age of two and foetal/neonatal bones make up 44 % of the pig remains (Lemoine *et al,* 2014). It has been argued this would be the result of specified hunting strategies rather than management (Lemoine 2012). More conclusive evidence for pig management has been identified at Çayönü (9000-7500 BC) (Ervynck *et al.* 2001). Little evidence for pig management has been found in the Early Neolithic of the Eastern Fertile Crescent (Flannery 1983; Mashkour 2006; Price and Arbuckle 2015). However, the recent re-excavations at Asiab (10th millennium BC) in the high Zagros of western Iran, have recovered a 'special deposit' comprising 19 wild boar skulls in the centre of a large structure, implying a special status of the wild boar (Bansgaard *et al.* 2019). In addition, a recent restudy of the Jarmo archaeozoological assemblage gives evidence for possible wild boar management in the Pre-Pottery Neolithic (PPN) and management of domestic herds in the Pottery Neolithic (PN) (see SI for dates of phases) (Price and Arbuckle 2015, 446). Little is known about the diet of wild and managed suids in the Neolithic in the Fertile Crescent, since the collagen in bones often does not survive for dietary isotopic analysis.

Across Southwest Asia, management, domestication and the adaption of the different livestock species was a highly localized process, influenced by both cultural and environmental factors (Arbuckle and Atici 2013; Arbuckle *et al.* 2014). In this paper we explore the size, age and diet of the suids of Bestansur and Shimshara in order to further our understanding of early suid management in the Neolithic Eastern Fertile Crescent. This aim will be achieved by analysing the zooarchaeological assemblage from the Early Neolithic sites of Bestansur and Shimshara in Iraqi Kurdistan (Matthews *et al.* 2020).

Initial studies of the animal bones from both sites indicate that the percentage of suids at these sites was notably higher than at contemporary sites in the region (Bendrey *et al.* 2020) and a coprolite from a suid was found on site at Bestansur (Elliot 2020) indicating close interaction between humans and suids. In this study, our research aim is to investigate and more fully articulate the nature of human-suid interrelationships in this foothill region of the Zagros range through integrated analysis of the zooarchaeological evidence from two sites of 8th millennium cal BC date. The analysis of these assemblages will not only provide us with further understanding of human animal relationships in the Zagros area but with further insights in the domestication processes.

The sites: Bestansur and Shimshara

Bestansur is a Neolithic site located in the foothills of the Zagros Mountains, in Iraqi Kurdistan. The site has been excavated since 2012 over the course of eight field seasons by a team from the University of Reading in collaboration with the Sulaimaniyah and Erbil Directorates of Antiquities and Heritage. The site is about 4 ha and the top of the mound is 8 metres high, although on the edges of the site the Neolithic deposits are only 30-50 centimetres below modern plough depth (Richardson *et al.* 2020, 116). Neolithic occupation spans from ca. 7700-7000 BC, with Neolithic layers of at least 4 metres (Matthews *et al.* 2020a, 629), in places covered by a significant occupation dating to the Iron

Age (first millennium BC) and later. The site is ca. 550 metres above sea level. It is situated close to a variety of ecosystems comprising springs, flat steppe, river and marshlands, the foothills of the Zagros and the high Zagros mountains (Matthews *et al.* 2020, 633; figure 1). Present day vegetation is strongly influenced by environmental variables such as precipitation and temperature, with both the cold winter period and hot dry summer inhibiting plant growth (Zohary 1973,35)

Shimshara is a Neolithic site ca. 110 km northeast of Bestansur (figure 1). Today the region is characterized by mountain forest vegetation and mountain riverine forest. In the Neolithic the inhabitants of Shimshara had access to these different ecozones (Matthews *et al.* 2020b, 177). In phytogeographic terms Bestansur and Shimshara falls into the Kurdo-Zagrossian sub-division of the Irano-Turanian region, which is dominated by climax vegetation mostly in the form of steppe- or park-forests (Elliot *et al.* 2020, 92).

Shimshara was previously excavated in the 1957 by a Danish team (Mortensen 1970). Both Neolithic and Bronze Age layers were excavated. Since then, the site has been eroded by waters of a dam and a rescue excavation was carried out by the Central Zagros Archaeological Project in 2013. The material excavated has been radiocarbon dated to between 7450 and 7180 BC (Matthews *et al.* 2020b, 178-9).

Methods and material

This study includes all animal remains from the Neolithic layers of Bestansur from all field seasons up to spring 2019 and material excavated during the 2013 field season in Shimshara. Animal bones were collected using three different methods; hand-picking during excavation, dry sieving of the excavated deposits through a 4 mm mesh, and selected amounts of soil were wet sieved through a 4mm, 2-4 mm and 2-1 mm mesh. So far, 6117 fragments of animal bones have been recorded, a sample of which have been published at Bestansur and 4033 bone fragments have been recorded at Shimshara (Bendrey *et al.* 2020). Most of the zooarchaeological assemblages is currently stored at Sulaimaniyah Directorate of Antiquities and Heritage, but some specimens have been sampled and exported to the University of Reading for further analysis. The preservation of the bones is moderate, full bones have been found, but tend to fall apart after excavation.

The relative abundance of the different species has been calculated based on NISP (number of identified specimens) (see SI). For this study both cranial and post cranial elements were measured, according to on den Driesch (1976) and Payne and Bull (1988). Breadth measurements were taken on all the molars and the dP4, and lengths of the third molar and dP4.

In order to assess the size of the animals at Bestansur and Shimshara and compare them to other sites, the Log Size Index (LSI) method is used (Meadow 1999), comparing different measurements to a standard animal. The standards are the ones commonly used in Southwest Asia (Price and Arbuckle 2015); a modern Anatolian wild female boar (Hongo and Meadow 2000) for post cranial measurements and the mean values of a population sample of modern wild boar from Kizilcahamam, Turkey, for dental metrics (Payne and Bull 1988).

The mortality profile of the pigs from Bestansur was reconstructed based on dental eruption and wear and bone fusion, following Zeder *et al.* (2015) and Lemoine *et al.* (2014).

The diet of the suids of Bestansur is investigated using stable carbon and nitrogen stable isotopic analysis. The samples were taken and processed at the University of Reading, School of Archaeology, Geography and Environmental Science (details in SI).

Results

Relative abundance

Suids make up a very large part of the zooarchaeological assemblage of Bestansur as well as at Shimshara (see figure 2). At Bestansur caprines make up the majority of the assemblage, sheep outnumbering goat, but both based on NISP, suids are the second most abundant group (see figure 2 and figure 3). This high abundance of suids is unusual at Epipalaeolithic and Early Neolithic sites in the Eastern Fertile Crescent, only Shimshara showing a higher relative abundance of suids (see figure 3).

Biometry

The LSI data of both the cranial and the post cranial measurements of Bestansur display two ‘groups’ (see table 3 and 4; figure 4 and 5). For the post cranial measurements these two peaks could be the results of sexual dimorphism or domestic status, since adult male wild boar are about 1.3-1.4 times larger than females (Zeder and Lemoine 2020a, 7). However, the teeth measurements are less influenced by sex differences (Rowley Conwy *et al.* 2012, 14) and also show two peaks. Only one postcranial measurement of Shimshara was available.

The large post-cranial remains of the suids from Bestansur are overall larger than those of all other Epipalaeolithic and Neolithic sites in the Zagros (see figure 5). The smaller ‘group’ of the post cranial elements of Bestansur are still bigger than the smaller domestic animals of Pottery Neolithic Jarmo or late Neolithic Hajji Firuz (see figure 5). The molars of the suids at Bestansur are not bigger than those of all other sites, although fewer data are available. The smaller values of the molars from Bestansur are smaller than those of the domestic pigs at Pottery Neolithic Jarmo (see figure 4). The molars of the suids at Shimshara fall all within the ‘larger range’ (see figure 4).

Kill-off patterns

The age reconstruction of Bestansur suids based both on bone fusion (table 1) and the dentition (table 2), show that the suids died at a relatively old age. The majority of the suids died after they reached an age of two years. However, the age reconstruction based on dental eruption and wear shows that some young animals were present at the site too, including three animals under one year and one under two years (see table 2). The jaws were all fragmented so none of the animals could be aged with the ‘specific’ age class, neither could the sex of the animals be established (see supplementary information).

Cranial remains of suids under two years were identified, but bones of young individuals were absent.

Unfused bones of juveniles are in general more porous and therefore degrade faster (Zeder *et al.* 2015, 149), so it is possible those are underrepresented at the site.
Not enough data are available to make an age reconstruction for suids at Shimshara.

Isotopes and Diet

Forty bones of Bestansur were sampled for stable isotopic analysis of nitrogen and carbon. In general, the collagen quality was relatively low. The majority of the samples were unreliable because they did not match standards for bone collagen (Ambrose 1993, see SI for further information).

Discussion

The high representation of suids in the archaeozoological assemblage at Bestansur indicates that they were of major dietary value. This high abundance can possibly be explained by the location and environment of the settlement. Bestansur is a piedmont site likely located close to forest during the Neolithic, which would have provided a favourable habitat for wild boar. The proximity to water sources associated with reeds and rushes would have been a place where wild boar could shelter (Bendrey *et al.* 2020). Other Epi-Palaeolithic and Early Neolithic piedmont sites do not show such a high percentage of suids, with the exception of Shimshara. It is possible that the environment in Shimshara, along the banks of the Lesser Zab, was even more favourable for wild boar than Bestansur. Since the overall zooarchaeological assemblage of Shimshara is small, and limited data of the size and age of the suids at Shimshara is available, it is hard to say more on the nature of the human-suid relationships at Shimshara.

The bones of the suids of Bestansur are very large compared to other sites (figure 3). Present day wild boar of the Zagros region are larger than those in the Western Fertile Crescent (Zeder and Lemoine 2020a). However, the 'larger group suids of Bestansur' have larger bones than the wild boar from the Epi-Palaeolithic and Neolithic from the Zagros region. The smaller group of suids of Bestansur is still larger than the group of early domestic pigs of Pottery Neolithic Jarmo and the domestic pigs of Haji Firuz. In contrast, the molars of the suids of Bestansur are relatively small. The larger molars fall within the size range of the molars of Asiab and Pre-Pottery Neolithic Jarmo (figure 4). It is striking that the smaller molars of Bestansur are smaller than those of the Pottery Neolithic suids of Jarmo, where pigs are argued to be domesticated (Price and Arbuckle 2015). (Teeth are less influenced by sexual dimorphism and decrease in size as a result of the domestication process earlier than postcranial elements (Rowley-Conwy *et al.* 2012; Zeder 2012; Zeder and Lemoine 2020, 7-8). Therefore, the small molars of the Bestansur suids are likely to be an indication of early human management. The biological process behind the decrease in tooth size under domestication is unknown (Price and Hongo 2020, 22-3), so it is unsure how human suid interaction at Bestansur could have caused this tooth size decrease.

The kill-off pattern of the suids from Bestansur is not representative of a managed population. Young individuals may be underrepresented in the assemblage, but the majority of the suids reached an age beyond 2 years (see Table 1 and 2). In a managed herd it would be expected that most animals would be slaughtered before an age of 2 years (Hadjikoumis 2012). In the Neolithic, a larger part of the herd may have been kept alive, since the herds were usually smaller, and a greater percentage would be needed for reproduction, although, an increase in juveniles in the archaeological record is still expected when a herd is managed. At Pottery Neolithic Jarmo, 97% of the suids were slaughtered before they reached an age of two years (Price and Arbuckle 2015, 444-445). The suids from Asiab, which are interpreted as wild and unmanaged (Bansgaard *et al. 2020*), are of very mixed age categories. Both young suids and senile suids were present in this assemblage. However, it is significant that these suids come from a special deposit and therefore may have little in common with the animals that formed the mainstay of the hunted fauna (Bansgaard *et al.* 2020, 453).

Isotopic analysis could not provide any further insights due to the preservation of the collagen. Little is known about the diets of suids at other sites, since, to date, no isotopic research has been conducted on Neolithic suid remains in Southwest Asia and collagen in bones in this area often does not survive.

It is very interesting that at Bestansur there are no young kill-off or no small body sized suids, but that the suids have small teeth. This association of attributes has not been attested at other Neolithic sites in the Zagros region. Faecal material of a suid has been found at Bestansur (Elliot 2020, 338), which indicates presence of a live suid at the settlement. So, even though the population at Bestansur does not show the young kill-off associated with early management strategies, suids were at least occasionally in close interaction with humans on site.

The high abundance of suids at Bestansur and Shimshara is likely to be a combination of the suitability of local environments to this taxon and cultural preference. Why wild boar and pig contributed only modestly to other sites and the late overall adoption of domestic pigs in the Zagros region requires further investigation. In general, wild boar have a large ecological tolerance but they do lack sweat glands, so in hot areas they need to thermoregulate by wallowing and resting in cool places (Leaper *et al.* 1999).

Wild boar inhabit steppe, shrubland and farmland as long as there is water and some tree cover (Spitz 1989). Nevertheless, in the high and Southern Zagros higher aridity and more limited riverine marshy environments could have meant fewer wild boar in the environment, thus discouraging early pig management and domestication. It is likely that Neolithic settlements in the southern Zagros were only able to incorporate pig husbandry when they adopted more intensive husbandry practices (Price and Arbuckle 2015). It has been argued that during the Neolithic of Southwest Asia, extensive husbandry was possibly the dominant management strategy of suids (Dobney et al. 2007; Ervynck et al., 2001; Price and Arbuckle 2015; Price and Hongo 2020). Under such an extensive husbandry regime, herders maintain little control over pig reproduction, diet, and mobility, allowing pigs to forage for their own food and interbreed with wild boar (Price and Arbuckle 2015, 449). This approach could be mixed with more intensive strategies of keeping only the females at the settlement (Ervynck *et al.* 2001, Price and Arbuckle 2015). Strategies like this are employed by hunter-gathering groups in New Guinea (Price and Hongo 2020). However, at Jarmo, where pig management was practiced and where the location was favourable too, suids did not make up an important source of the food economy. The difference in relative abundance of suids between Shimshara, Bestansur and Jarmo and could be due to cultural preference or local environmental differences between two sites, with Bestansur and Shimshara more favourably located for rich proximate riverine environments. It is possible that this local favourable environment for wild boar encouraged the inhabitants of Bestansur and possibly Shimshara to experiment with such early management strategies. The animals at Bestansur clearly seem to be in a place in between wild and domestic. They have small teeth, but the inhabitants did not practice early kill-off and might have loosely managed the suids extensively.

Conclusion

The Bestansur and Shimshara zooarchaeological assemblages comprise an exceptionally high frequency of suids. The data of Bestansur suggest that the relationship between suidsand human was possibly different one than a strict hunter-prey relationship. The animals are very large but do have small molars relative to their body size. Most suids were slaughtered above an age of two years old, so there is no culling of young animals, which might be expected in a managed herd. It is possible that the suids were wild, but some experimentation with management strategies seems to have been underway. Young suids were present at the site and the evidence for pig faecal material indicates that they were probably brought to the site alive or kept there. Also, suids could have been attracted to the human settlement. Domestication may take several millennia and these site assemblages could represent examples where the animals are somewhere in this process.

This study has demonstrated that the Neolithic in the Zagros was not uniform in the adaption and exploitation of different animals. Environment does not seem to be the only factor influencing people’s choices regarding specific animals. Furthermore, the possible early management strategies of suids might have varied considerably throughout the Zagros region. So, it remains critical to study sites on their own terms in order to better understand the full Neolithisation process and the extent to which local environments and cultural traditions influenced early management and domestication practices and processes around the world.

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Data availability statement

The data that support the findings of this study are in the supplementary information.

Conflict of interest

No conflict of interest to declare.

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Figures and tables

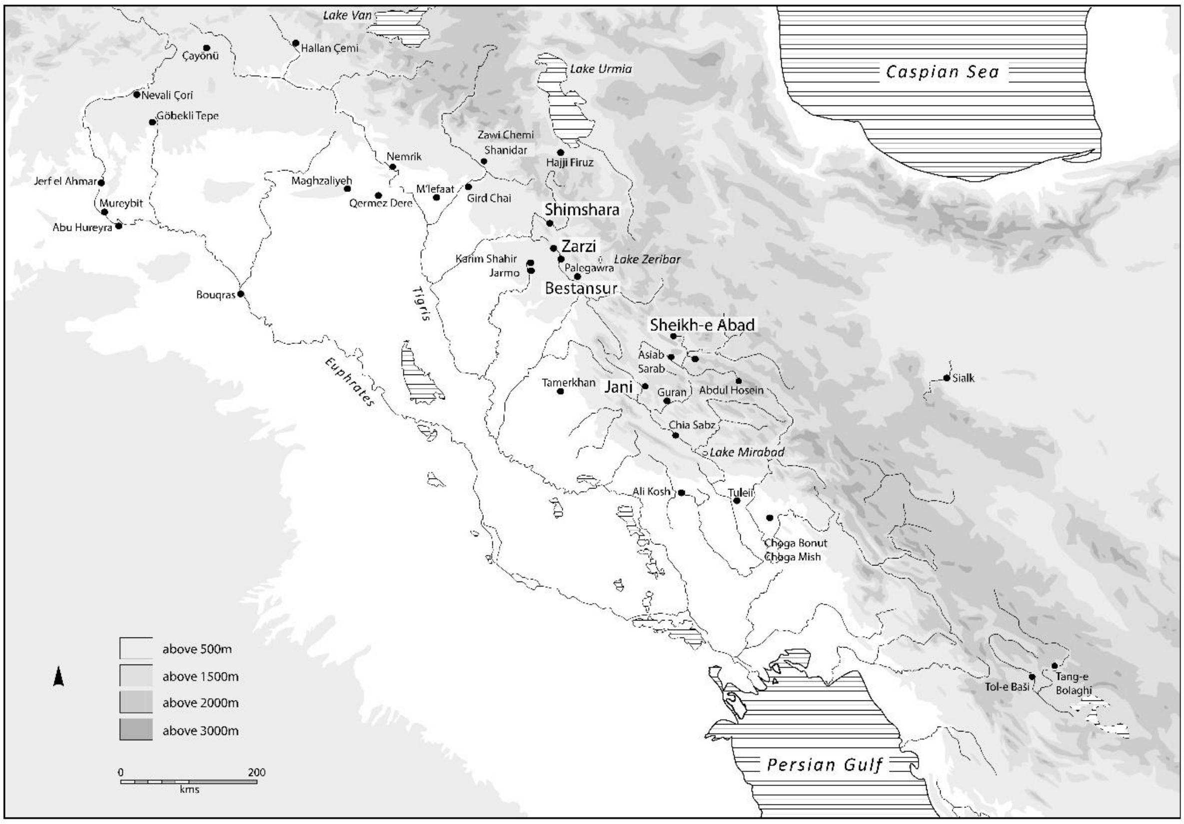


Figure 1: Map showing Epipalaeolithic and Neolithic sites in the Eastern Fertile Crescent.

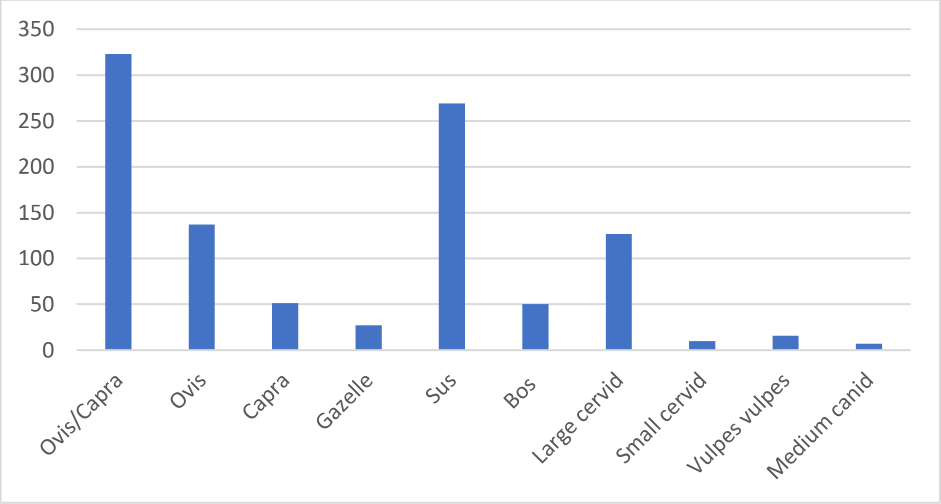


Figure 2: The count of the identified animal remains (NISP) of Bestansur (mammals only, small mammals and micromammals not included).

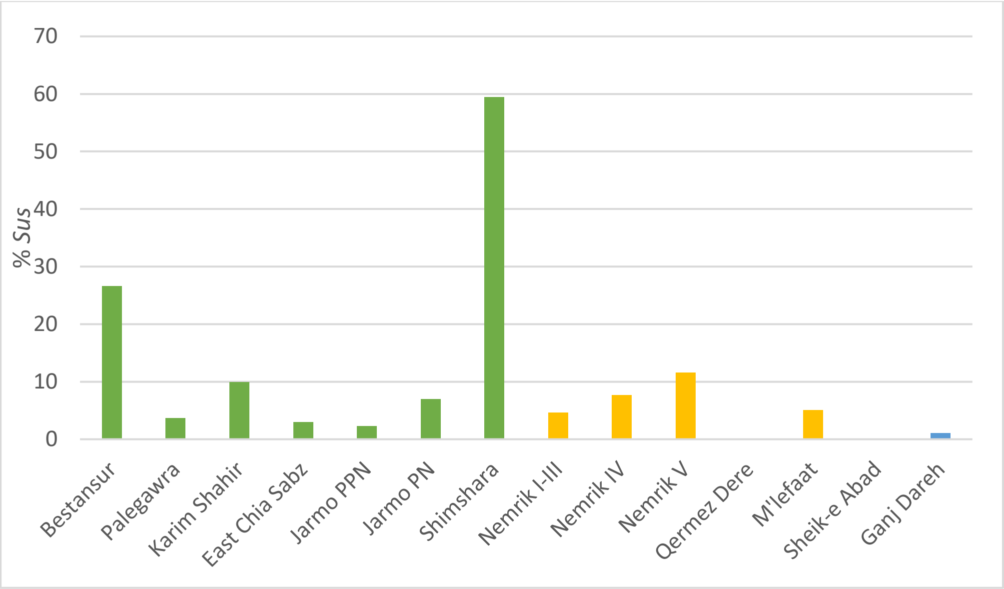


Figure 3: Percentage (NISP of total of the mammals identified to genus and sheep/goat) of suids at Epipalaeolithic and Early Neolithic sites in the Eastern Fertile Crescent. The colours represent the ecological setting of the site: green=piedmont, yellow=steppe and blue= highland (see supplementary information for NISP and references).

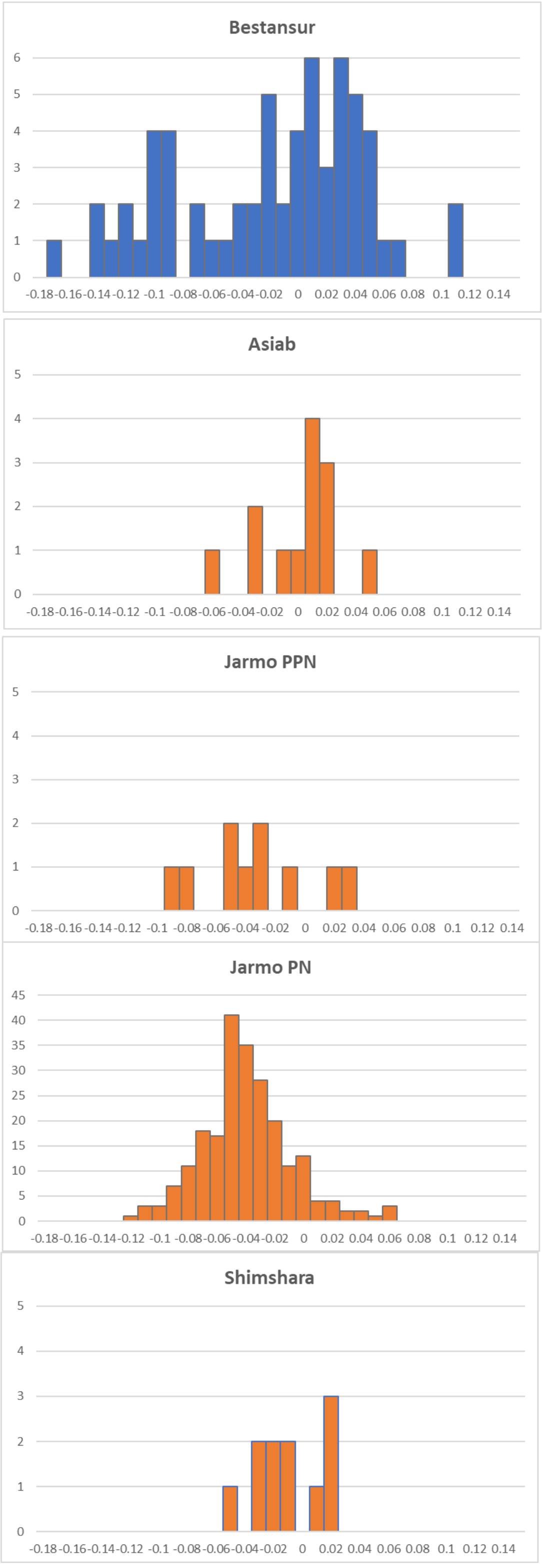
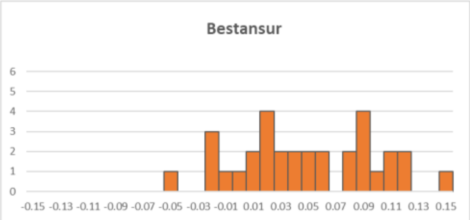


Figure 4: The LSI of the teeth measurements of Bestansur, Asiab (Bansgaard et al. 2019), Jarmo, Jarmo divided in PPN and PN (Price and Arbuckle 2014) and Shimshara (Bendrey et al. 2020 and this study), see supplementary information for dates of the sites and measurements


Bestansur
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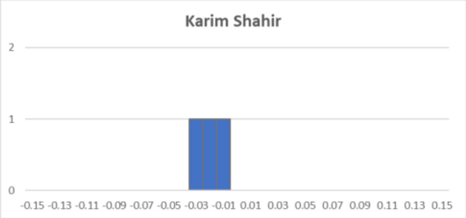
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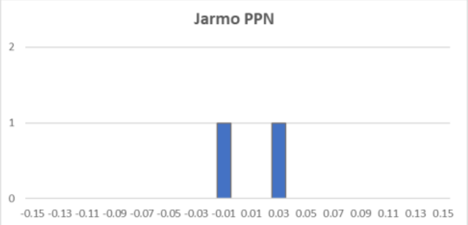
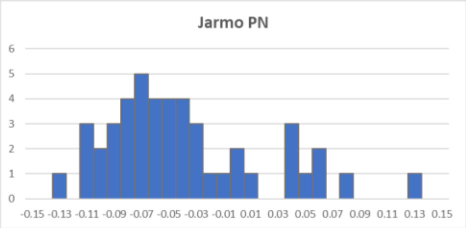
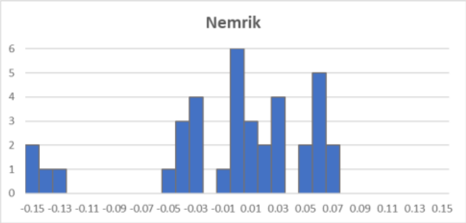
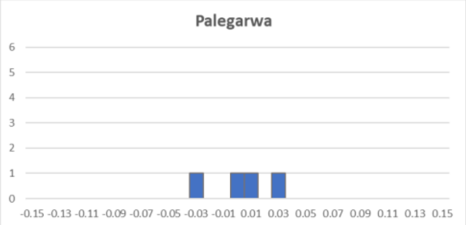
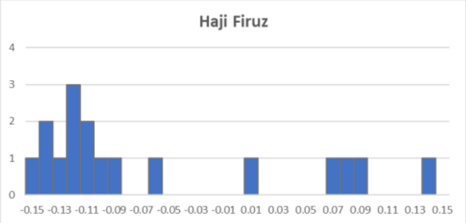

Jarmo PPN
0 1 2
-0.15 -0.13 -0.11 -0.09 -0.07 -0.05 -0.03 -0.01 0.01 0.03 0.05 0.07 0.09 0.11 0.13 0.15


Jarmo PN
0 1 2 3 4 5 6
-0.15 -0.13 -0.11 -0.09 -0.07 -0.05 -0.03 -0.01 0.01 0.03 0.05 0.07 0.09 0.11 0.13 0.15


Nemrik
0 1 2 3 4 5 6
-0.15 -0.13 -0.11 -0.09 -0.07 -0.05 -0.03 -0.01 0.01 0.03 0.05 0.07 0.09 0.11 0.13 0.15


Palegarwa
0 1 2 3 4 5 6
-0.15 -0.13 -0.11 -0.09 -0.07 -0.05 -0.03 -0.01 0.01 0.03 0.05 0.07 0.09 0.11 0.13 0.15


Haji Firuz
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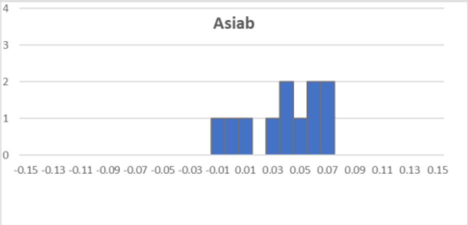
Asiab
0 1 2 3 4
-0.15 -0.13 -0.11 -0.09 -0.07 -0.05 -0.03 -0.01 0.01 0.03 0.05 0.07 0.09 0.11 0.13 0.15

Figure 5: The LSI of the postcranial measurements of suids from Epi-Palaeolithic and Neolithic sites in the Eastern Fertile Crescent, see supplementary information for references and dates of the sites. Only one postcranial element of Shimshara provided usable metrics and has an LSI of 0.05 (see table 4)

Table 1: The age of the suids of Bestansur based on bone fusion (age catergories following Zeder et al. 2014).

Fusing Elements	Age class	Age (months)	Fused	Unfused	Fusing	% fused
Scapula	D	7-8	3			
P. Radius	D	7-8	4			
Total D	**D**	**7-8**	**7**			**100**
D. Humerus	E	8-18	6			
Phalanx II	E	8-18	4	2		
Total E	**E**	**8-18**	**10**	**2**		**83.3**
D. Tibia	F	18-24	5			
Phalanx I	F	18-24	4			
Total F	**F**	**18-24**	**9**			**100**
D. Metapodials	**G**	**24-36**	**2**			**100**
Calcaneum	**H**	**36-48**	**2**			**100**
D. radius	I	48-60	2	1		
D. Femur	I	48-60	2	1	1	
P. Tibia	I	48-60	1	1		
D. & P. Ulna	I	48-60		4		
Total I			**5**	**7**	**1**	**46.2**
Radius and ulna	**K**	**>96**	**1**	**2**		**33.3**

Table 2: The age of suids from Bestansur based on dentition (age categories from simplified A (Lemoine et al. 2015), *for full data see SI)*

Age (months)	NISP
<12	3
12-24	1
24-36	
36-52	1
>54	8

Table 3: Teeth measurements of the suids of Bestansur and Shimshara (following Payne and Bull 1988). All LSI values are included in the diagram, even though some come from the same specimen given the size of our dataset and the fact that the values often differ. Mant=mandible with teeth and maxt= maxilla with teeth

Bestansur									
Bone ID	Context	Element	Tooth	Anterior (mm)	Posterior (mm)	Length (mm)	LSI Anterior	LSI Posterior	LSI Length
2518	1333	MANT	M1	11.2	12.4	19.3	-0.03	-0.02	
2622	1312	MANT	M1	9.4	10.5	17.6	-0.10	-0.09	
2666	1333	MANT	M2		17.5	25.2		0.03	
3025	1331	MANT	M1			12.5			
3146	1350	MANT	M3	20.8		48.3	0.06		0.07
3366	1340	MANT	M3	20			0.04		
7420	2122	MANT	M1	11.9	13.8	17.1	0.00	0.03	

7420	2122	MANT	M2	14.7			0.05		
7394	2117	MANT	M3	18.2		39.4	0.00		-0.02
7339	2117	MANT	dP4			22.4			0.11
7739	2217	MANT	M1	12.5	13.3	21.2	0.02	0.01	
7241	1976	MANT	M1	11.9	13.9		0.00	0.03	
7241	1976	MANT	M2	15.5	17	24	-0.01	0.01	
7187	1976	MANT	M2		17			0.01	
7187	1976	MANT	M3	20.2		43.6	0.04		0.02
7527	2129	MANT	dP4			21.8			-0.02
7527	2129	MANT	M1	12	12.7	20.4	0.00	-0.01	
7546	2129	MANT	M2	15	17.6	22.2	-0.02	0.03	
7546	2129	MANT	M3	16.9		37.9	-0.03		-0.04
7743	2161	MANT	M1		9.5			-0.10	
7743	2161	MANT	M2	10.7	12.1	20.3	-0.17	-0.13	
7748	2161	MANT	M1	12.1	13.9	18	0.01	0.03	
2623	1312	LM1	M1		10.6			-0.05	
3357	1412	LM3	M3	20.4		44.5	0.05		0.03
4450	1357	LDP4	dP4		10.1	21.5			-0.02
3370	1336	MAXT	M3	22.1			0.01		
3371	1336	MAXT	M1	20.5			0.11		
4125	1331	MAXT	dP4		9.5			-0.14	
4463	1347	MAXT	dP4		10	14.8		-0.12	-0.07
7559	2129	MAXT	dP4		9.6	15.8		-0.14	-0.04
7559	2129	MAXT	M1	12.7	13	14.5	-0.10	-0.09	
7559	2129	MAXT	M2	15.7	15.9	20.6	-0.11	-0.09	
7290	2117	MAXT	M1		17			0.02	
7290	2117	MAXT	M2			17.4			
3085	1331	UM2	M2	16.3	17	20.5	-0.09	-0.06	
3086	1331	UM1	M1	13.6		15.9	-0.07		
3087	1331	UM2	M2		15.5			-0.10	
7271	2103	UM3	M3	24.3		42.7	0.05		0.04
7190	1976	UM3	M3	23.8		40	0.04		0.01
Shimshara									
183	1276	MAXT	M1	14.8	15.1	17.5	-0.03	-0.03	
184	1276	MAXT (possibly same specimen as 183)	M2		19			-0.01	
2	SF113	MANT	M2		15.7			-0.02	
2	SF113	MANT	M3	19.3		42.1	0.02		0.01
182	1276	MANT	M1	10.7		18.4	-0.05		
182	1276	MANT	M2	15.2	15.9	24.6	-0.01	-0.02	
639	1660	MANT	M2	16.5	17.1	24.9	0.02	0.02	

Table 4: Postcranial measurements of the suids of Bestansur and Shimshara (following von den Driesch 1976) All LSI values are included in the diagram, even though some come from the same specimen given the size of our dataset and the fact that the values often differ.

Bestansur									
Scapula	Bone ID	Context	GLP (mm)	SLC (mm)	LG (mm(	BG (mm(	fusion	LSI (GLP)	LSI (LG)
	3290	1412	38	27.2	33.9	28.3		- 0.02	0.02
	7322	2117	47.9	38.4	39.7	37.1		0.08	0.09
	7143	1974	49	34.3	40.2	31.6		0.09	0.09
Humerus	Bone ID	Context	Bd	BT	HTC			LSI (Bd)	LSI (BT)
	6327	1721	53	40.4	24.4			0.06	0.03
	7425	2122	47.4	41.5				0.01	0.04
	7128	1950	47.6	40				0.02	0.03
	7737	2161		55.5	47.3				0.17
	7778	2161	56.1	46.6				0.09	0.09
Radius	Bone ID	Context	BpP	Bd				LSI (BFP)	LSI (BD)
	3226	1414	36.6					0.03	
	3704	1387		43.4			UF		0.04
	4931	1555		37.6			UF		-0.02
	7324	2117	41.7					0.09	
	7426	2122	38.1					0.05	
Ulna	Bone ID	Context	BPC					LSI (BPC)	
	5012	1538	25					- 0.01	
	6323	1721	22.8					- 0.05	
	7395	2103	35.6					0.15	
	7325	2117	33.7				UF	0.12	
	7616	2127	24.3					- 0.02	
MCIII	Bone ID	Context	BP	BD				LSI (BP)	LSI (BD)
	7331	2117	29.2	22.9				0.15	0.08
	7446	2122		21.4					0.05
MCIV	Bone ID	Context	BP	BD				LSI (BP)	LSI (BD)
	2767	1330	22.3	21.8				0.07	0.09
	7447	2122		23.2					0.12
Tibia	Bone ID	Context	BP	BD				LSI (BD)	LSI (BP)
	1996	1220		36.8					0.04
	2660	1333		40.1					0.08
	3153	1402	71.4				UF	0.10	
	7201	1976		42.8					0.11
Astragalus	Bone ID	Context	GLl	GLm				LSI (GLl)	LSI (GLm)
	7188	1976	51.3	47.2				0.03	0.03
	7497	2135	54.4	48.3				0.06	0.04
	7782	2161	49.4	44.3				0.02	0.01
	7356	2117	49.9	38.4				0.02	-0.06

Calcaneus	Bone ID	Context	GB	GL				LSI (GB)	LSI (GL)
	4088	1331	96	36.1				0.00	0.1
Metatarsal III	Bone ID	Context	Bp	Bd				LSI(Bp)	LSI (Bd)
	3056	1331	18.8					0.02	
	7749	2161	23.1					0.11	
Metatarsal IV	Bone ID	Context	Bp					LSI (Bp)	
	4077	1331	18.1					0.01	
Shimshara									
Radius	Bone ID	Context	BpP	Bd				LSI (BFP)	LSI (BD)
	-	1276		38.3					0.05