ANIMAL ECONOMY IN THE MIDDLE EUPHRATES VALLEY: FAUNAL ANALYSIS AT THE SITE OF TELL GHANEM AL-ALI (SYRIA)

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Introduction

The Bronze Age is a critical period in the history of the Mesopotamian region. During this phase new cultural and social development of human settlements led to the appearance of exceedingly sophisticated communities in southern Mesopotamia, while the northern parts of Mesopotamia witnessed the formation of its first estates in several centuries following the southern renowned urban centers.

The study of human occupations that emerged throughout upper Mesopotamia principally aims to demonstrate the steps of estates formation in northern Mesopotamia, and to identify the contributions of the Syrian urban-centers to the history of the region. The Middle Euphrates valley in north-eastern Syria which is known as al-Jazira (Arabic for the Island) is one of the areas that witnessed the emergence of a matrix of cities and towns during the Early Bronze Age period [Akkermans and Schwartz 2003]. Archaeological investigations conducted in al-Jazira mainly focused on the examination of large-scale occupations, which were situated along river valleys [Buccellati 1998; Orthmann 1990; Oates, Oates and McDonald 2001; Hole 2007; Schwartz and Curvers 1992; Schwartz, Curvers, Gerritsen, MacCormack, Miller and Weber 2000; Schwartz, Curvers, Dunham, Stuart and Weber 2006; Ristvet and Weiss 2005]. The archaeological and textual records from northern Mesopotamian settlements imply to the substantial role of the rural settlements in supporting the high economical demand of the populated urban centers [Clason and Buitenhuis 1998]. Therefore, the examination of the socio-economical organizations in the countryside settlements should provide us with a wider view to the progressive developments of interregional exchange among northern Mesopotamian sites, and would assist the process of reconstructing the features of economical systems during the Bronze Age period.

Tell Ghanem al-Ali is one of the small EBA settlements in the Jazira region, situated on the right bank of the Euphrates River, about 45 km south-east of the modern city of Raqqa (Fig. 1). The site has an oval shape with a long axis about 400 m stretching in the NNE-SSW direction. It is located within the Jabel-Bishri area that belongs to the greater southwest Asian arid zone marked by the line of 250 mm isohyets. This sensitive agricultural area depends on irrigation to support farming, due to the low precipitations which does not allow dry farming in the agricultural land of the area [Van Zeist and Bottema 1982; Pustovoytov, Schmidt and Taubald 2007; Bar-Matthews, Ayalon, Gilmour, Matthews and Hawkesworth 2003]. In August 2007 a joint Japanese-Syrian project commenced researching the Jabel Bishri area, and the excavations at Tell Ghanem al-Ali is part of an ongoing project investigating the Bronze Age settlements in the Jebel Bishri region. The excavations at Ghanem al-Ali started with two squares on the northeastern side of the *tell* (Fig. 2). The excavated areas revealed several stone-walled and mud-brick structures. The finds within the building area, such as hearth and pottery remains, suggest the use of these areas for domestic activities. The date of the recovered structures are still under study, however, the pottery sequence at the site strongly indicates that the layers of the site date back to the EB III period [Ohnuma 2007].

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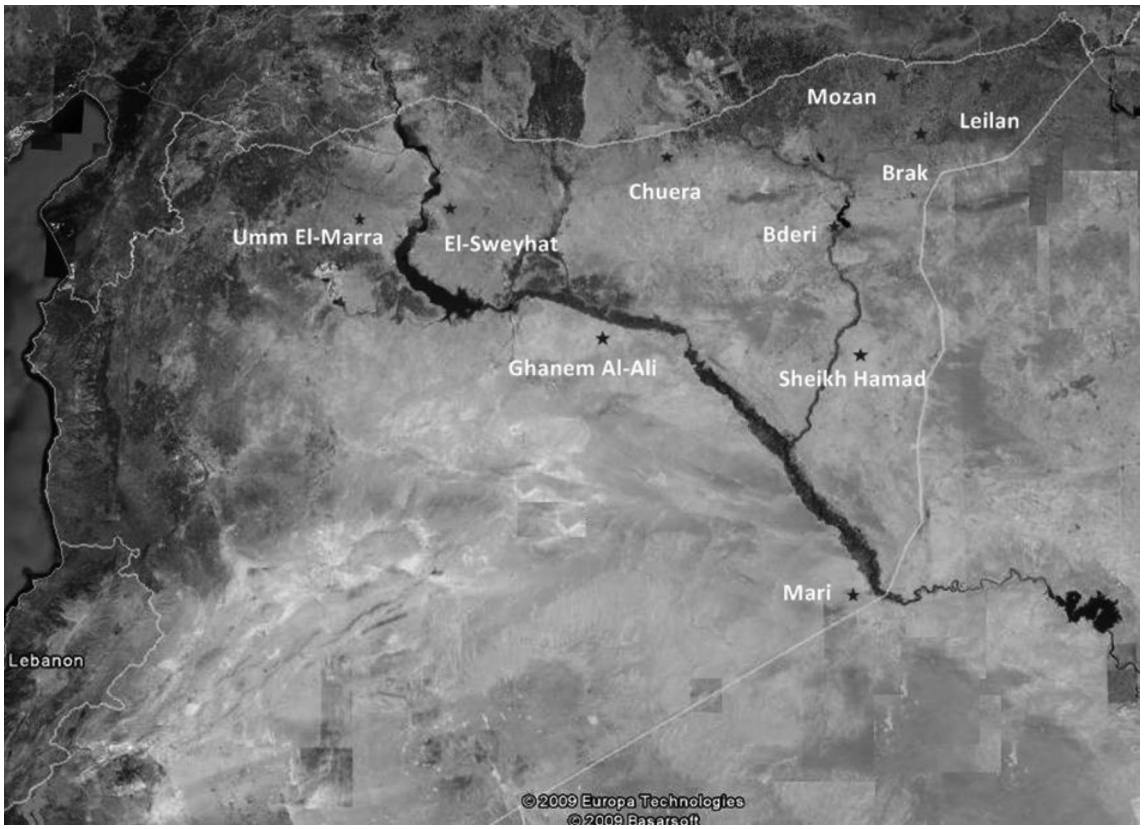

Fig. 1 Geographical map displaying some of the Bronze Age sites in north-eastern Syria.

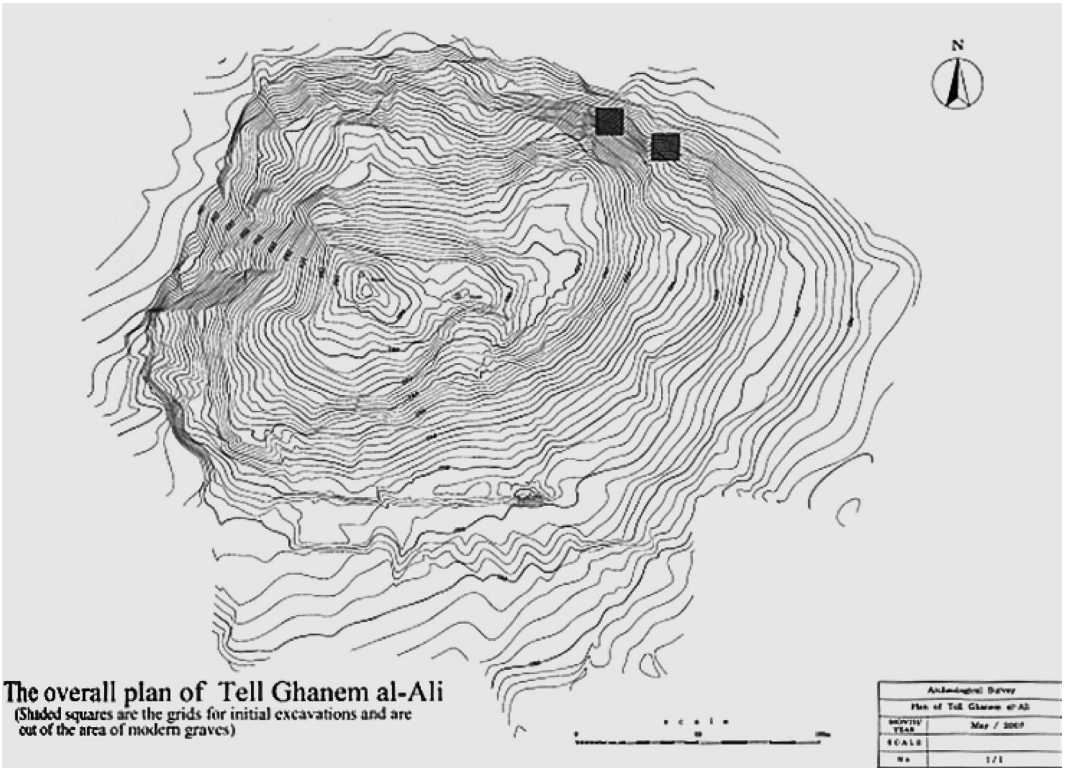

Fig. 2 Topographical map of Tell Ghanem al-Ali displaying the area of the excavated trenches [Ohnuma 2007].

The Faunal analysis

Materials

The animal bones which are incorporated in this study were retrieved during the second and the third season of excavations at Tell Ghanem al-Ali. Excavated faunal remains were collected by hand-picking, while wet sieving was applied to some of the contexts. The results of wet sieving of the excavated soil did not produce identifiable skeletal elements of small mammals or fish remains, which indicate that the collection method did not cause a substantial bias in the relative abundance of taxa at the site. The faunal assemblage belongs to the step trench area at the western side, and the squares on the northern slope of the *tell*. The preservation of faunal remains is quite good. Few elements were subject to weathering, and the mean value of unidentified fragments weight is relatively low (2.4 g).

Methods

The identification of the faunal assemblage was carried out at the field; each skeletal fragment was computed according to the coding system devised by Uerpmann [1978]. Each bone fragment was recorded with its corresponding anatomical and taxon identification, the state of preservation, approximate age and sex, and any surface modifications. The identification of sheep and goat bones is based on the morphological differences presented by Boessneck, Müller and Teichert [1964], and Prummel and Frisch [1986] for the identification of postcranial elements, while sheep and goat mandibular teeth are distinguished following Halstead, Collins and Isaakidou [2002], and Payne [1985]. The separation of equid bones depends on the morphological characteristics discussed by Uerpmann [1990] and Vila [2006a] for most of the postcranial elements; and the characteristics of the dental elements were recommended by Vila [2006a]. The analysis of the age at death of domestic animals is based on age stages defined by Silver [1969]. The measurements of postcranial skeletal elements follow the standards defined by Von Den Driesch [1976], except for Equid bones measurements, which required additional criteria introduced by Eisenmann [1986]. Differences in logarithm method presented by Meadow [1999] is used to examine the size indices of the major domestic animals at the site.

The Faunal assemblage

The total number of fragment counts is 1033 (according to the number of identified specimens, NISP), and the weight of the assemblage is 11375.4 g. Within the studied sample, only 44.7% of the total number of identified fragments is attributed to species level, and 64.7% of the total weight (Tab. 1). Medium-sized animals are the most represented category within the faunal collection, and it comprises more than 78% of the bone counts. Only 0.7% of the total assemblage was not identified.

Domestic species are dominant in the assemblage. The identification of

Taxa	NIS	%	WIS	%
Cattle (*Bos Taurus*)	39	3.8	1433	12.6
Donkey (*Equus asinus*)	11	1.1	1154	10.1
Sheep (*Ovis aries*)	97	9.4	1361	12.0
Goat (*Capra hircus*)	27	2.6	407	3.6
Sheep or Goat (*Ovis/Capra*)	204	19.7	1495	13.1
Pig (*Sus scrufa var.dom*)	8	0.8	105	0.9
Equid	38	3.7	1556	13.7
Gazelle (*Gazella subgutturosa*)	13	1.3	218	1.9
Fallow deer (*Dama mesopotamica*)	1	0.1	34	0.3
Dog (*Canis familiaris*)	1	0.1	9	0.1
Hare (*Lepus capensis*)	20	1.9	8.1	0.1
Birds	3	0.3	5	0.0
Undetermined Mammals				
Large	96	9.3	1482	13.0
Medium	464	44.9	2077	18.3
Small	4	0.4	7.5	0.1
Unidentifiable bones				
Unidentified	7	0.7	23.8	0.2
Total	1033	100.0	11375.4	100.0

Tab. 1 Frequencies distribution of Taxa at Tell Ghanem al-Ali according to the count and weights of fragments.

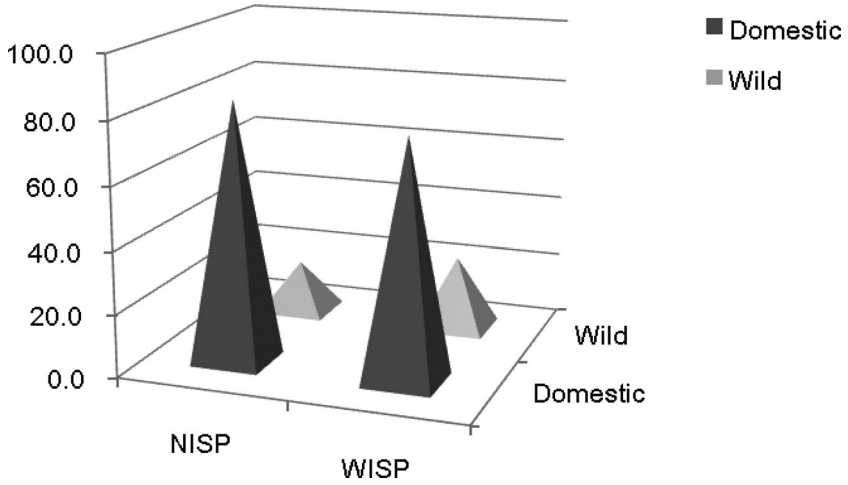

Fig. 3 Frequency of wild and domestic animals within the faunal assemblage at Tell Ghanem al-Ali.

domestic sheep, goats, cattle and pigs was primary based on the ratios of animal sizes. Approximately 84% of the total number of identified bones belongs to domestic animals, which obviously formed the main resource of animal subsistence strategy at the site (Fig. 3).

Major identified taxa

Sheep and goat

Domestic sheep and goat are the most abundant species in both count and weight of fragments. It comprises 71% of the total number of identified specimens (Tab. 2). The ratio of goat to sheep according to fragment count is 1:3.6. The estimation of sheep and goat ratio indicates the concentration on ovicaprid herd that mainly consisted of sheep with fewer goat individuals. The size of sheep present at the site is evaluated using the difference of logarithms method presented by Meadow [1999]. The following formula is employed to produce size indices using the breadth and depth measurements of postcranial elements of the studied species.

$$LSI = log(x) - log(s)$$

Taxa	NISP	%	WISP	%
Cattle (*Bos Taurus*)	39	8.4	1433	18.4
Donkey (*Equus asinus*)	11	2.4	1154	14.8
Sheep (*Ovis aries*)	97	21.0	1361	17.5
Goat (*Capra hircus*)	27	5.8	407	5.2
O/C (*Ovis/Capra*)	204	44.2	1495	19.2
Pig (*Sus scrufa var.dom*)	8	1.7	105	1.3
Equid	38	8.2	1556	20.0
Gazelle (*Gazella subgutturosa*)	13	2.8	218	2.8
Fallow deer (*Dama mesopotamica*)	1	0.2	34	0.4
Dog (*Canis familiaris*)	1	0.2	9	0.1
Hare (*Lepus capensis*)	20	4.3	8.1	0.1
Birds	3	0.6	5	0.1
Total	462	100.0	7785.1	100.0

Tab. 2 Frequencies of identified species according to NISP and WISP.

Where *(x)* is the value of the measured species, *(s)* represents the corresponding measurements of a standard animal. The difference in log values indicates whether the specimens are smaller or larger in size comparing with the standard measurements (Fig. 4). This displays the results of logarithm differences of measured sheep specimens based on the standard measurements of modern female sheep documented by Uerpmann and Uerpmann [1994]. The analyzed sample demonstrates two peaks of size indices: one represents the values close to the standard measurements, and the other belongs to animals bigger in size. These peaks in LSI values suggest

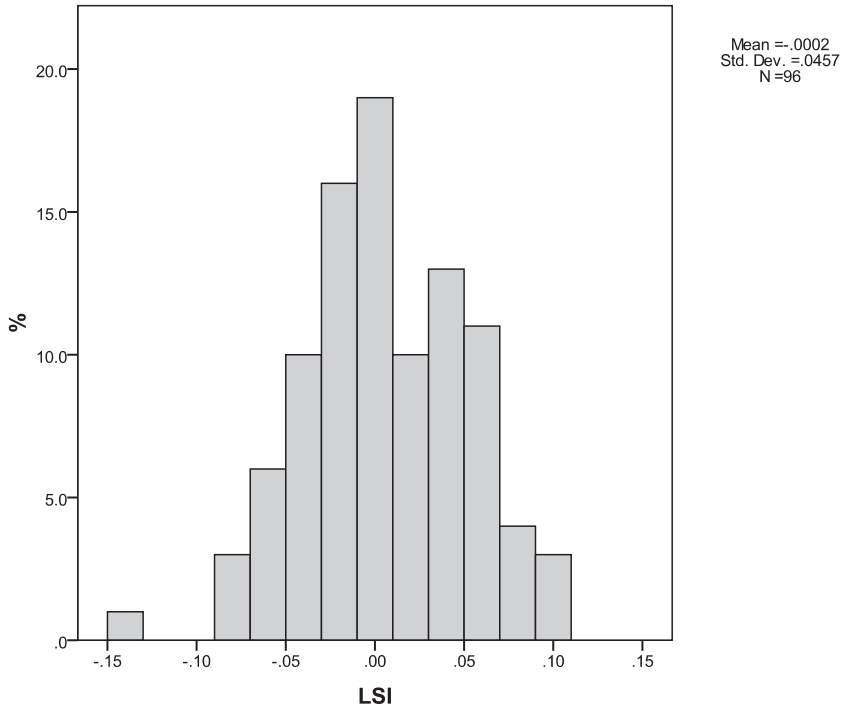

Fig. 4 Distribution of size index values of measured sheep elements at Tell Ghanem al-Ali.

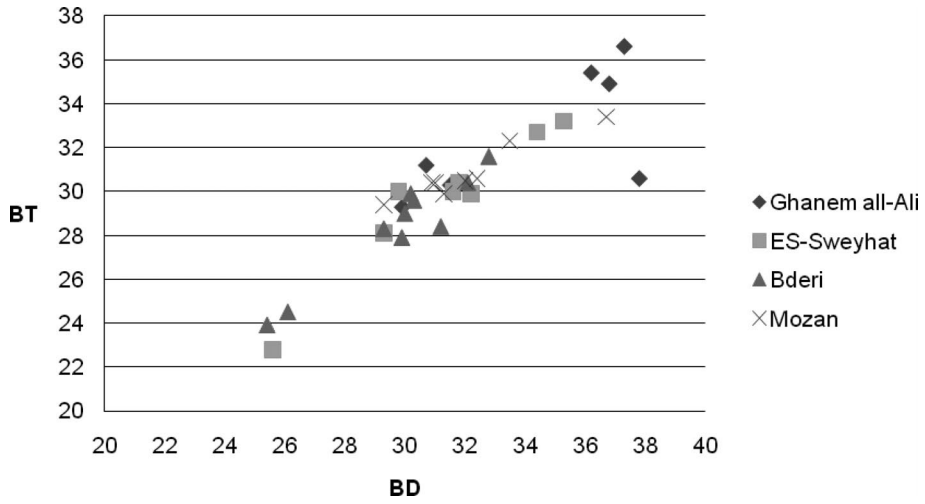

Fig. 5 Comparison of distal humerus measurements of Tell Ghanem al-Ali to other Bronze Age sites in the Jazira area.

the dominance of female individuals in mix herding strategies focusing on the exploitation of both female and male individuals.

The measurements of sheep humeri are used to evaluate the variances of sheep size among Tell Ghanem al-Ali and other Bronze Age sites located in the Euphrates valley and north-eastern Syria (Fig. 5). It seems that the sheep from Ghanem al-Ali are separated into two groups of individuals. This could be a possible result to the sexual dimorphism within the herd. In the measured humerus sample male individuals are equally present at the site in comparison with females. The humeri from Tell Ghanem al-Ali were bigger in size than those of other sites. The Tell es-Sweyhat sample analyzed by Weber [1997] displayed similar sizes to those of Ghanem al-Ali. The values extracted from the Tell Mozan Sample [Doll n.d.] showed a close range of measurements, but it seems

that the sheep at Tell Bderi- located in the arid southern Khabur valley- are smaller in size than the rest of the studied sample.

Cattle

Cattle (*Bos taurus*) is the third most abundant domestic animal among the faunal assemblage, and makes up about 3.8% of the faunal assemblage (Tab. 1) and about 8.4% of the total identified species animals at the site (Tab. 2). None of the fragments could have been assigned to wild cattle *Bos primigenius*. The number of the measured cattle elements is not sufficient to perform morphometric analysis. However, depending on the evaluation of the size, the majority of the fragments most likely belong to domestic individuals.

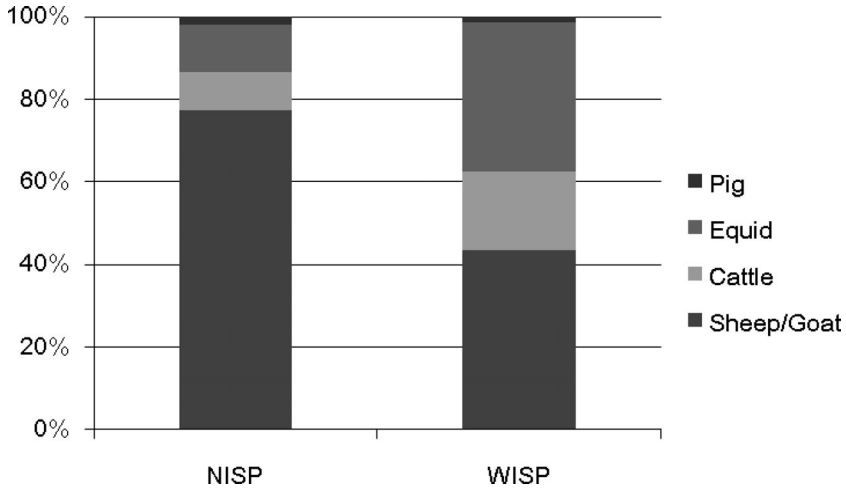

Fig. 6 Relative abundance of major identified taxa at Tell Ghanem al-Ali according to NISP and WISP.

Equid

The morphological and the morphometric analysis of the faunal remains of equid at the site indicates that *Equus Asinus* and *Equus hemionus* are both present at the site. Most probably other equid species were exploited within the Euphrates valley area [Uerpmann 1987; Vila 2006a; Weber 2008], but it was not visible at Tell Ghanem al-Ali possibly due to the small sample size, which affected the availability

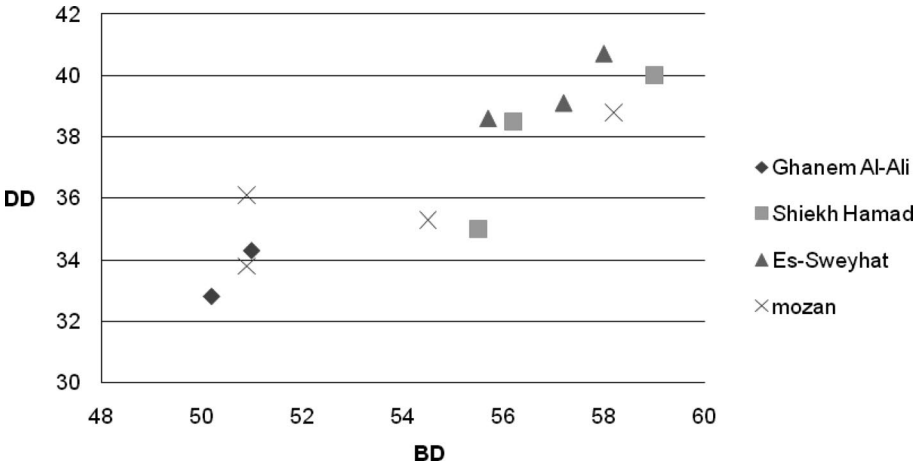

Fig. 7 Comparison of the distal tibia measurements of Tell Ghanem al-Ali equid to other Bronze Age sites.

of measurable fragments. The scatter plot of distal tibia breadth versus depth measurements (Fig. 7) shows that the equid individuals of Ghanem al-Ali are smaller than those from other sites in northern Syria that date back to the Early or Late Bronze period. The sample from Tell Mozan is closer in size to Ghanem al-Ali individuals, and they might belong to donkey (*Equus asinus*), which supposedly increased in number during the Middle Bronze Age period [Vila 2006b; Vila 1998], and had a substantial economical role in product distribution and exchange [Ismail, Sallaberger, Lebeau and Talon 1996; Clutton-Brock 1989; Clutton-Brock and Davies 1993]. The clay figurine which has been recovered at the site [Ohnuma 2007] represents a member of the Equidae family (Fig. 8), and attests the cultural and the economical importance of this animal at the Ghanem al-Ali community.

Fig. 8 Equid figurine retrieved during the 2007 excavation season [Ohnuma 2007].

Minor identified taxa

Within the domestic animal range few pig and dog remains were present at the site, each species formed less than 1% of the total number of identified specimens. Nevertheless, the archaeological records provided a piece of evidence related with the presence of pig at the site, represented by a clay figurine, which might belong to wild boar or domestic pig (Fig. 9).

Of the wild species, gazelle is the second abundant species. Within the collected fragments, only one horn core was found, and it is morphologically similar to *gazella subgutturosa*. Few cervid bones including one antler (Fig. 10) and hare remains formed the rest of the wild species assemblage at the site.

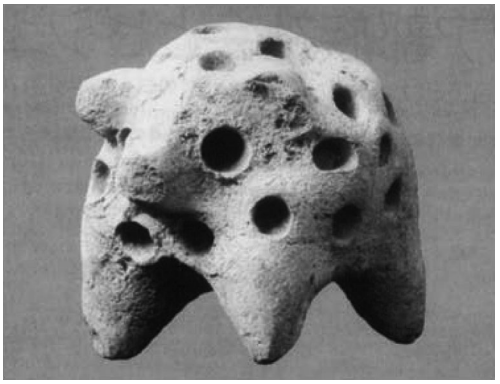

Fig. 9 Animal figurine retrieved during the 2006 excavation season.

Fig. 10 Deer antler from Tell Ghanem al-Ali.

Herd Management Strategies

Sheep/goats, cattle, donkey, and pigs are the principle domestic species at the site. Fig. 6 demonstrates their proportions according to NISP and WISP frequencies. Sheep and goats dominate the faunal assemblage, indicating the importance of the caprine herd as the main provider of meat products beside the exploitation of a variety of secondary products of each species [Sherratt 1983].

Age in months	Elements	Fusion stages	
		Fused	Unfused
I. 6–12	Scapula (d), humerus (d), radius p	27	5
II. 13–16	phalanx (p)	10	2
III. 18–28	tibia (d), metapodial (d)	18	9
IV. 30–36	femur (d), Calcaneum (p)	9	4
V. 36–42	humerus (p), radius (d), femur (d), tibia (p)	4	3

Fusion stages after Silver 1969.
P = Proximal, d = Distal.

Tab. 3 Epiphyseal stages of sheep and goats postcranial skeletal elements.

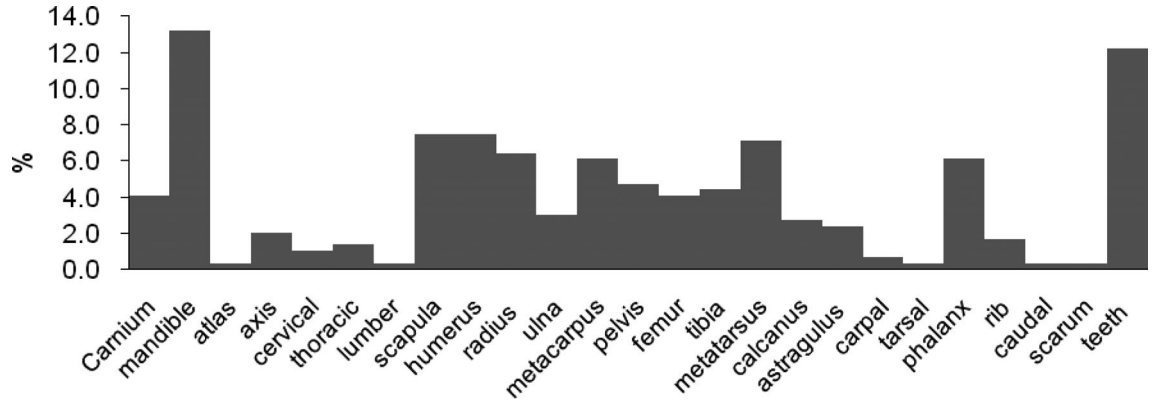

Fig. 11 Distribution of ovicaprid skeletal elements.

The estimation of the age profile of ovicaprid herd at the site was based on documenting the bone fusion stages of postcranial elements. The survival rate of sheep and goat individuals is based on fusion sequence presented by Silver [1969], and the results are presented in Tab. 3. The number of fused elements is quite high: more than 71% of the sample belongs to individuals older than one year of age, while 33.3% of the bones belong to ovicaprids over three years old. The estimation of age depending on the fusion stages of epiphyses indicates that a considerable portion of the herd at Tell Ghanem al-Ali was slaughtered after the animals reached their optimal age for meat production between 2–4 years [Helmer, Gourichon and Vila 2007; Uerpmann 1973]. About 60% of the fused elements belongs to individuals older than 2 years. The existence of adults could be interpreted as the result of secondary product exploitation at the site.

Fig. 11 demonstrates the distribution of skeletal elements of sheep and goats within the excavated structures. Since skeletal elements with both high and low meat values are present at the settlement, it suggests that the animals which comprised this sample were slaughtered within the settlement. The abundance of cranium and lower feet elements might indicate that low meat elements were discarded between the structures.

The predominance of sheep and goat fragments at the excavated trenches, as well as the presence of animals of different ages, suggests that caprine herd was the basis of the economical production system at the site. Larger animals like cattle contributed with their secondary recourses, such as dairy products and traction power, beside their high protein values. Domestic ass also was exploited in order to assist products distribution activities. We do not have clear evidence for the consumption of domestic ass as a meat resource. Yet, evidence of domestic ass meat exploitation in the Jazira region was reported by Vila [1998]. The inhabitants of the site possibly had a direct control on the caprine herd, or they had a close contact with pastoral herders who provided the population at Ghanem al-Ali with the entire herd of live stock, while they kept cattle and pigs within or close to the structure area.

Exploitation of Wild Animal Resources

The Early Bronze Age economy focused on raising domestic animals as the main source of animal products, but still the hunting of wild species continued to support the subsistence strategies at many sites within northern Mesopotamia [Weber 2006; Zeder 1988; Vila 1998; Clason and Buitenhuis 1997]. At Tell Ghanem al-Ali a similar trend is observed in wild species formed about 16.5% of the total assemblage (Fig. 3). The hunting of wild Asiatic ass in the Jazira area is well documented through the faunal analysis and pictorial evidence retrieved from other Bronze Age sites in the area [Oates 2003; Oates, Molleson and Soltysiak 2008]. Gazelle is the second exploited wild game in the assemblage followed by the cervids and smaller mammals, which suggests that the inhabitants of the site had an easy access to wild recourses, probably due the proximity of the settlement to the steppe around the Jabel Bishri area. These recourses were exploited to provide a diversity of raw materials, such as antlers and leather, beside their dietary values.

Conclusion

The examination of the faunal remains of Tell Ghanem al-Ali shows the prevalence of economical activities that relate to the socio-economical systems observed at other sites situated in the Jazera area (Fig. 12). Dietary strategies concentrated on herding sheep and goats, while cattle came in the third place. Equid formed a substantial portion of the identified species at the settlement, and it contributed to the economy of the settlement as both domestic and wild resources. The number of the pigs at the settlement was limited. This pattern of exploitation corresponds to the strategies identified within the group of middle Euphrates settlements such as Tell es-Sweyhat and Umm el-Marra [Buitenhuis 1985; Weber 1997: 2006; Weiss, Courty, Wetterstrom, Guichard, Senior, Meadow and Curnow 1993]. Based on the size of the site we could conclude that the settlement served as a small village or a small post in a strategic location which facilitated the exploitation of domestic and wild recourses. At this stage of the research, it is not possible to evaluate the function of the settlement. However, the analysis of faunal remains from the site indicates the possibility of slaughtering ovicaprid individuals within the site as well as the use of wild animals as meat supplement and source of raw materials, which suggests local consumption of acquired products. The distribution of faunal assemblage within the exposed layers at the site did not reveal the existence of specialized economic activities that could be interpreted as a result of the establishment of complex socio-cultural relations which started to emerge within several settlements in northern Mesopotamia to pave the way to the formation of early urban states within the region.

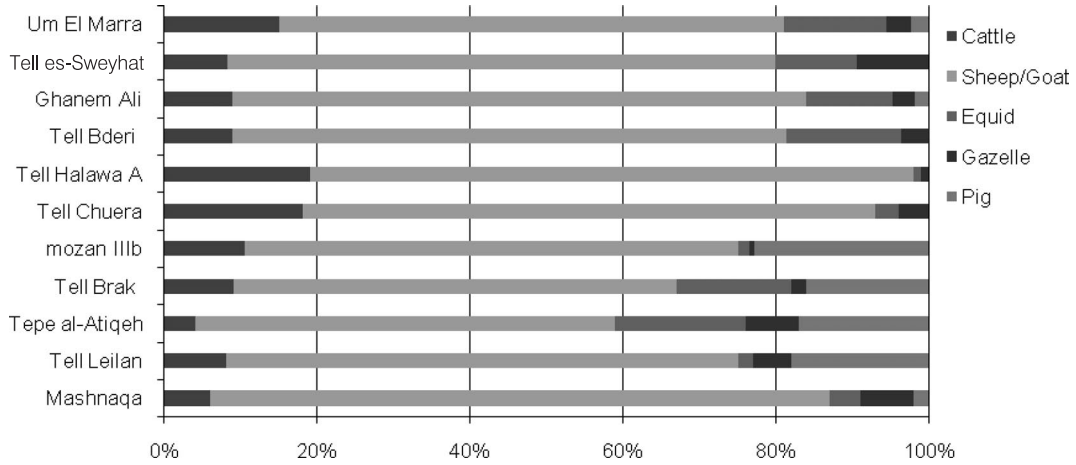

Fig. 12 Distribution of Major animal taxa of northern Mesopotamian faunal assemblages.

Appendix: Tell Ghanem al-Ali's skeletal element measurements

Bos taurus

Element		min	$\bar{x}$	max	σ	No
Humerus	BT		59.1			1
Radius	Bp		103.2			1
Ph1	Bp	25.7	25.9	26.1	0.28	2
	SD	21.8	21.85	21.9	0.07	2
	Dp	27.4	27.6	27.9	0.35	2

Equus asinus

Element		min	$\bar{x}$	max	σ	No
Scapula	SLC		51			1
	GLP		74.9			1
	LG		48.3			1
Radius	1		296.3			1
	2		285.5			1
	3		33.1			1
	4		68.8			1
	5		62.3			1
	6		30.8			1
	7		63			1
	8		51			1
	9		30			1
	10		23			1
	11		13.4			1
Astragalus						
	1		48.8			1
	2		46.8			1
	3		47.9			1
	4		22			1
	5		39.4			1
	6		25.6			1
Tibia	7	32.8	33.55	34.3	1.06	2
	8	50.2	50.6	51	0.57	2

Equid

Element		min	$\bar{x}$	max	σ	No
Ph1	1		70.3			1
	2		64.1			1
	3		23.1			1
	4		36.3			1
	5		26.2			1
	6		34.8			1
	7		41.9			1
	8		36.8			1
	9		60			1
	14		33.1			1
Ph3	1		36.08			1
	2		51.3			1
	3		36			1
	4		53.3			1
	5		23.5			1
	6		35.7			1

Capra hircus

Element		min	$\bar{x}$	max	σ	No
Humerus	Bd		36.2			1
	BT		34.1			1
Radius	Bp	31.5	32.95	34.4	2.05	2
Tibia	Bd		25.9			1
Metatarsus	Bd		33.8			1
	Dd		18.4			1
Astragalus	GLI		27.2			1
	GLm		27.8			1
	DI		18.1			1
	Dm		15.7			1
	Bd		17.4			1
Ph1	GL		36.1			1
	Bp		11.8			1
	SD		9.7			1
	Bd		11.2			1
	Dp		14.2			1
	Dd		9.2			1
Ph2	GI	23.4	24.15	24.9	1.06	2
	Bp	10.7	11.8	12.9	1.56	2
	SD	7	8.13	9.4	1.21	3
	Bd	7.7	9	10.2	1.25	3
	Dp	11.6	12.65	13.7	1.48	2

Ovis aries

Element		min	$\bar{x}$	max	σ	No
Scapula	SLC	16.4	19.4	22.4	2.5	4
	GLP	30	32	35.4	2.9	3
	LG	24.9	26.1	28	1.3	4
	BG	17.7	19.5	20.7	1.6	3
Humerus	Bp		37.8			1
	Bd	29.9	33.3	37.3	3.3	7
	BT	29.3	32.5	36.6	2.97	7
Radius	Bp	32.2	34.15	36.1	2.76	2
	SD	15	16.3	17.6	1.83	2
	Bd		28.7			1
Ulna	BPC		20.3			1
	DPA		27.8			1
Metacarpus	GL		149.1			
	Bp	20.7	20.95	21.2	0.35	2

	SD		12.9			1
	Bd	22.6	23.7	24.9	1.63	2
	Dd	16.3	16.35	16.4	0.07	2
Femur	Bp			51		1
	BT			22.5		1
Tibia	Bd	23.3	25.56	28.6	1.98	5
	Dd	21.4	22.55	23.7	1.62	2
Metatarsus	GL		145.6			1
	Bp	22.6	24	25.4	1.98	2
	SD	13.6	14	14.4	0.57	2
	Bd	25.3	26.77	28.1	1.43	4
	Dd	17.3	18.05	18.8	0.65	4
Astragalus	GLI	26.9	28.38	30	1.27	4
	GLm	25.1	26.98	29.1	1.47	5
	DI	14.8	16.12	16.9	0.97	4
	Dm	15	16.6	17.2	0.9	5
	Bd	17.5	18.8	19.3	0.73	5
Ph1	GL	40.3	41.05	41.8	1.06	2
	Bp	14	14.3	14.6	0.42	2
	Dp	15.5	16.05	16.6	0.77	2
	SD	11.4	11.6	11.8	0.28	2
	Bd	12.1	13.06	13.7	0.85	3
	Dd	11.1	12.2	13.1	1.01	3
Ph3	DLS	28.1	30.35	32.6	3.18	2
	LD	21.1	23	24.9	2.69	2
	MBS	4.9	5.15	5.4	0.35	2

Gazella spp.

Element		min	$\bar{x}$	max	σ	No
Radius	Bp	25.5	27.4	28.6	1.66	3
Metacarpus	Bd		24.1			1
	Dd		15.7			1
Ph1	GI		36.9			1
	Bp		10.7			1
	SD		7.7			1
	Bd		10.1			1
	Dp		13.6			1

Lepus capensis

Element		min	$\bar{x}$	max	σ	No
Ph1	GL	16.1	16.58	18.3	1.8	5
	Bp	3.5	4	4.5	0.38	5
	Bd	2.8	3.04	3.1	0.15	5

For abbreviation see Von den Driesch 1967.
The method of equid measurements in this appendix are in accordance with Eisenmann 1986.

Radius
1= Greatest length, 2= Lateral length, 3= Smallest Breadth, 4= Proximal breadth, 5= Proximal articular breadth, 6= Proximal articular depth, 7= Distal breadth, 8= Distal articular breadth, 9= Greater distal articular depth, 10= Breadth of radial condyle, 11= Breadth of ulnar condyle.

Astragalus
1= Greatest length, 2= Medial length of trochlea, 3= Greatest Breadth, 4= Trochlear breadth, 5= Distal articular breadth, 6= Distal articular depth, 7= Medial depth.

Tibia
7= Distal breadth, 8= Distal depth

First phalanges
1= Greatest length, 2= Anterior length, 3= Smallest breadth, 4= Proximal breadth, 5= Proximal depth, 6= Distal supra-articular breadth, 7= Greatest length of trigonum phalangis, 8= Smallest length of trigonum phalanges, 9= Posterior length, 10= Medial supratuberosital length, 11= Lateral supratuberosital length, 12= Medial infratuberosital length, 13= Lateral infraatuberosital length, 14= Distal articular breadth.

Third phalanges
1= Anterior length, 2= Greater anteroposterior diameter, 3= Height, 4= Greatest breadth, 5= Articular anteroposterior diameter, 6= Distal circumference.

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