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Title: **Animal bone remains from Tell Arbid (season 2009) — Archaeozoological analysis**

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Keywords: animal economy, caprines, pigs, cattle, Tell Arbid, Syria

SYRIA

ANIMAL BONE REMAINS FROM TELL ARBID (SEASON 2009)
ARCHAEOZOOLOGICAL ANALYSIS

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Abstract: The paper presents the results of archaeozoological analysis of bone remains from the 2009 season of excavations at Tell Arbid (in northeastern Syria). Animal husbandry proved to have been at the core of the animal economy at the site from the beginning of the 3rd millennium BC through modern times. The chief species at the start were small ruminants (50–80% of bones in the assemblage), supplemented later with pig (10–35%) and cattle (5–20%). Hunting and gathering mollusks were of minor importance. Equids were represented among bone remains from all periods. In the Khabur Ware period there was a shift in the animal economy from a stationary one based mainly on breeding pigs to pastoralism characterized by a growing share of small ruminants.

Keywords: animal economy, caprines, pigs, cattle, Tell Arbid, Syria

The examined osteological material comes from a sector of excavations on the southern side of the mound at Tell Arbid, a site in northeastern Syria, with occupation spanning a period from the beginning of the 3rd millennium BC through modern times. The results discussed in this paper are based solely on material excavated in the 2009 season (which was the penultimate season of work at the site so far, and the last one from which the archaeozoological material has been analyzed). The wider range of osteological material involving the results from various areas at the site was the subject of earlier studies (Piątkowska-Małecka, Koliński 2006 and Piątkowska-Małecka, Smogorzewska 2010). The Sector W trench in 2009 covered an area of approximately 300 m^2 (approximately 0.25% of the main tell) and produced both well dated and mixed layers. Dated layers can be referred to a site periodization, developed on the grounds of excavations carried out by a Polish team from the PCMA since 1996, extending from the Ninevite 5 phase (Period VIIC, corresponding to Early Jezirah [EJ] II in the Syrian Jezirah periodization), through Early Dynastic III (Period VIIB = EJIII) and Akkadian (Period VIIA = EJIV), to the Khabur Ware period (Period V = Old Jezirah [EJ] III).

The animal bone material represented all periods, including two transitional phases recognized in the archaeological record: VIIC/VIIB corresponding to Early Dynastic III/Ninevite 5 and VIIA/VI corresponding to Akkadian/post-

Akkadian. Material from the Hellenistic period through the Islamic age and modern times was treated as one group (Modern = M) and so were the remains from mixed layers (MIX), which, however, were not included in the archaeozoological analysis except for the main taxa. Bone remains from the Akkadian period were also excluded from the study because of the small sample.

In terms of provenance, the Ninevite 5 period remains from Sector W excavated in 2009 (both the late phase with late excised pottery and the earlier phase with incised and excised pottery) came from architectural vestiges of diverse nature: dwelling rooms and courtyards beside structures related to the so-called Southern Temple (see, e.g., Bieliński 2010: 548–554, 2012: 530–533; 2013 in this volume). Animal bone remains from the EDIII strata came from structures sealing Ninevite 5 remains, whereas most of the material from the Khabur Ware and modern periods was recovered from pits dug into 3rd millennium BC layers.

MATERIAL AND METHODS

2381 mammal bone fragments were found in all layers, together with two bird bone remains and 12 mollusk fragments [***Table 1***]. The 1272 mammal bone remains that were identified anatomically and by zoological taxa accounted for 53.4% of the entire bone assemblage. The preservation of the material was poor overall, the bones being severely crushed and fragmented.

The identified animal remains were broken down by chronological phases and grouped as follows: bred species (cattle, pig, sheep and goat), equids (without distinguishing between domesticated and wild forms) and other, including wild animals, birds and mollusks. Percentages of particular species were calculated for the bred species.

An anatomical analysis of the bones was performed for species, for which the remains exceeded or equaled 100 items for any given period [***Table 2***]: pig, sheep and goat remains from the Ninevite 5 period layers and sheep and goat bones from the EDIII period layers. Specific bones were attributed to one of seven skeleton parts: head (skull bones and teeth), trunk (fragments of vertebrae and ribs), proximal parts of the forelimb (scapulae, humeri, radii and ulnae) and hind limb (pelves, femora, tibiae and fibula), distal parts of the forelimb and hind limb (carpal and metacarpal bones, tarsal and metatarsal bones) and digital bones. Percentages of particular bones were calculated and then compared with the model distribution (Lasota-Moskalewska 2008).

The age and sex of the animals was assessed. The age of animals from bred species was reconstructed based on the fusion of long bone bases with shafts (Kolda 1936) and dental development (Lutnicki 1972). Animal sex was identified on the basis of male and female distinguishing features.

To reconstruct animal morphology the bones were measured using the unified Driesch method (von den Driesch 1976) [***Table 3***].

In the case of cattle, pig and horse remains, osteological measurements of some bones were converted into points using the 100-point scale method (Lasota-Moskalewska 1984; Lasota-Moskalewska

Table 1. Zoological distribution of post-consumption animal bone remains from Tell Arbid (season 2009) by chronological phases

ZOOLOGICAL IDENTIFICATION	VIIC	VIIC/B	VIIB	VIIA	VIIA/VI	V	M	MIX
Cattle	10 (3.2%)	7 (4.6%)	26 (12.3%)	3	2 (1.7%)	8 (9.9%)	18 (21.4%)	13
Pig	113 (36.7%)	65 (43.0%)	71 (33.5%)	6	21 (17.6%)	6 (7.4%)	7 (8.3%)	42
Sheep/Goat	185 (60.1%)	79 (52.3%)	115 (54.2%)	13	96 (80.7%)	67 (82.7%)	59 (70.2%)	146
Equid	3	–	13	1	1	17	53	4
Camel	–	–	–	–	–	–	1	–
Deer	–	1	–	–	–	–	–	–
Bird	1	–	–	–	1	–	–	–
Mollusk	10	1	–	–	1	–	–	–
Not identified	223	178	261	8	75	54	142	168

Table 2. Anatomical distribution of sheep, goat and pig bone remains from the Ninevite 5 (VIIC) and EDIII (VIIB) periods

CHRONOLOGY	VIIC		MODEL	VIIC		VIIB		MODEL
OSTEOLOGICAL CHARACTERISTIC	PIG			SHEEP/ GOAT		SHEEP/ GOAT		
	n	%	%	n	%	n	%	%
Head	62	54.9	20	61	33.0	52	45.2	20
Trunk	11	9.7	34	60	32.4	20	17.4	43
Forelimb, proximal part	11	9.7	4	23	12.4	20	17.4	5
Forelimb, distal part	6	5.3	10	5	2.7	1	0.9	8
Hind limb, proximal part	5	4.4	3	22	11.9	11	9.6	3
Hind limb, distal part	9	8.0	9	10	5.4	5	4.3	7
Digital bones	9	8.0	20	4	2.2	6	5.2	14
Total	113	100.0		185	100.0	115	100.0	

et alii 1987; Kobryń 1989). Pig and sheep withers heights were calculated based on bone length using Teichert's coefficients, while those of horses were done according to Kiesewalter's coefficients (von den Driesch, Boessneck 1974) and those of goat according to Shramm's coefficients (1967).

All marks on the bones were also observed and described.

Table 3. Bone dimensions by period and zoological taxa

CHRONOLOGY	ZOOLOGICAL IDENTIFICATION	OSTEOLOGICAL CHARACTERISTICS	MEASUREMENT	MM	NUMBER OF POINTS/ WH (CM)
VIIC	Cattle	Digital bone III	GL	47	–
	Pig	Scapula	SLC	20	20
		Radius	Bp	24, 25	10, 12
	Sheep	Talus	GLI-Bp	31-20	WH=70.3
	Goat	Metacarpal bone	Bp	25	–
	Equid	Scapula	SLC	58	–
		Radius	Bp	(72)	–
VIIC/VIIB	Pig	Scapula	SLC	20	20
		Humerus	Bd-BT	34-29	18
		Radius	Bp	24, 25	10, 12
	Sheep	Talus	GLI-Bp	32-20	WH=72.6
	Goat	Horn core	Measurement of the basis	115	16
		Radius	Bp	32, 35	–
VIIB	Cattle	Tibia	Bp	100	100
		Digital bone I	GL-Bp-Bd-SD	54-28-25-25	36
		Digital bone II	GL	40, 49	–
	Pig	Humerus	Bd-BT	30-29	12
		Radius	Bp	22	8
	Sheep	Talus	GLI-Bp	29-18	WH=66.0
	Goat	Talus	GLI-Bp	30-22	–
		Metatarsal bone	GL-Bp-Bd-SD	143-28-31-13/12	82/WH=76.4
	Equid	Scapula	SLC	60	–
		Pelvis	LA	65	–
		Tibia	Bp	72	0

Table 3. (continued)

CHRONOLOGY	ZOOLOGICAL IDENTIFICATION	OSTEOLOGICAL CHARACTERISTICS	MEASUREMENT	MM	NUMBER OF POINTS/ WH (CM)
		Digital bone II	GL-Bp-Bd-SD	48-48-44-42	50 (KP)
VIIA	Cattle	Digital bone I	GL-Bp-Bd-SD	64-30-30-26	60
	Equid	Digital bone I	Bp	51	–
VIIA/VI	Pig	Calcaneus	GL	65	0/WH=60.7
	Sheep	Humerus	GL-GLC-Bp-Bd-SD	148-137-48-35-32-16/18	WH=63.3
	Goat	Radius	GL-Bp-Bd-SD	166-34-31-17/10	WH=66.1
		Pelvis	LA	27	–
V	Cattle	Pelvis	LA	63	–
	Equid	Radius	Bd	71	40
		Digital bone II	GL-Bp-Bd-SD	50-52-48-44	40 (KP)
M	Cattle	Talus	GLI-GLm-Bd	69-64-49, 57-25-21-22	58, 28
		Digital bone II	GL	34	–
	Pig	Radius	Bp	24	10
	Sheep	Talus	GLI-Bp	29-21	WH=65.7
	Equid	Scapula	SLC	98	–
		Metacarpal bone	GL-LI-Bp-Bd-SD	224-221-48-48-38/25, 217-212-47-33/25	46, 38/ WH=143.6, 139.1
		Talus	GH-GB	59-63	–
		Metatarsal bone	GL-Bp-SD	250-45-31/28	34
		Digital bone I	GL-Bp-Bd-SD	85-55-44-34	KP

GL – greatest length, GLI – greatest lateral length, GLm – greatest length of medial part of astragalus, LI – lateral length, Bp – greatest breadth of proximal part, Bd – greatest breadth of distal part, BT – greatest breadth of humerus trochlea, SD – smallest breadth of shaft, LA – length of glenoidal cavity of pelvis, SLC – smallest length of callum scapula, GH – maximum height of equid talus bone, GB – maximum width of equid talus bone, KP – proximal part of forelimb

RESULTS

NINEVITE 5 (= VIIC)

Mammal bone fragments from Ninevite 5 period layers amounted to 534, supplemented with one bird bone fragment and 10 mollusk shell fragments. Of the mammal bones 311 fragments, accounting for 58.2% of the assemblage, were identified anatomically and by taxa. Most of the bones represent bred species, mostly sheep and goat (60.1%), followed by pig (36.7%) and cattle (3.2%). Three bone fragments belonged to equids.

An anatomical analysis attributed over half of the pig bone remains to head parts (54.9%), that is, to less prized parts of the carcass. Other body parts were represented by uniform percentages: from 4.4% for proximal parts of hind limbs to 9.7% for the trunk and proximal parts of forelimbs. Comparison with the model anatomical distribution of pig bone remains revealed a surplus of head parts. For sheep and goat, head parts (33.0%) and trunk parts (32.4%) prevailed, followed by proximal parts of fore- and hind limbs (12.4% and 11.9% respectively). Fewer distal parts of fore- and hind limbs, as well as digit bones were identified (less than 6% of the bone assemblage). Compared to the standard model for caprids there was a surplus of proximal parts of fore- and hind limbs.

Pigs slaughtered at a young age accounted for 17.7% of the studied sample. With regard to small ruminants the proportion of young animals reached 20.5%. Three of the pig bones were identified as coming from female individuals. Eight fragments of bones belonging to cattle, pig, sheep/goat and equids were measured. Three recalculated pig bone measurements gave 10, 12 and 20 points on a 100-point scale, indicating that the animals were domesticated and small-sized. Sheep withers height based on talus bone length was 70.3 cm. This individual would have been a large-sized sheep of urial-like type.

TRANSITIONAL NINEVITE 5/EDIII (= VIIC/VIIB)

330 bone remains of mammals and a mollusk fragment were recovered from transitional Ninevite 5/EDIII period layers. Of the mammal bones 152 fragments were identified anatomically and by taxa (46.1%). Most bones represented bred species, mostly sheep and goat (52.3%), followed by pig (43.0%) and cattle (4.6%). A deer metatarsal bone fragment was also identified.

Both for sheep/goat and for pig the percentage of animals slaughtered at a young age reached 13%. One fang of a female pig was identified. Also a fragment of a goat horn core belonging to a male individual was recorded. The results of pig bone measurements converted to points gave 10, 12, 18 and 20 points, meaning that the remains represented domesticated animals of small size. Converted goat horn core measurement corresponding to 16 points indicated a small goat. Sheep withers height was calculated at 72.6 cm based on the length of the talus bone.

EARLY DYNASTIC III (= VIIB)

Of the 486 mammal bone remains from EDIII layers 225 fragments were identified by taxa (46.3%). Domesticated animals prevailed, sheep and goat reaching 54.2% of the sample, followed by pig (33.5%) and cattle (12.3%). 13 bone remains belonged to equids.

Anatomical analysis of the sheep and goat bone remains revealed that head parts were the most common (45.2%), followed by more valuable carcass parts of the trunk (17.4%) and proximal parts of forelimbs (17.4%) and hind limbs (9.6%). Digital and metapodial bones were less numerous. Compared to the model anatomical distribution there was a surplus of head parts and proximal parts of fore- and hind limbs.

Young sheep and goat constituted 14.8% of the identified bone assemblage, whereas the percentage of young pigs reached 9.8%. Three fragments of cattle bones represented animals slaughtered at a young age. A fragment of cattle mandible with growing M2 belonged to an individual 15–18 months old at death. Bone remains with male or female distinguishing features were not recorded.

Two measurements of cattle bones could be converted to the point scale, giving results at 100 and 36 points. This represents cattle of the *primigenius* and *brachyceros* types respectively. Two measurements taken for pig bones suggest that pigs were domesticated and small-sized. Withers heights of sheep and goat reached 66.0 and 76.4 cm respectively, indicating that small sheep of the mouflon type and large goats were present at the site. Two values, 0 and 50 points, were obtained for equids, translating into withers heights for the animals of approximately 110 cm and 135 cm. Judging by withers height, the former could have been a donkey or onager and the latter (about 130 cm and more) a horse.

TRANSITIONAL AKKADIAN/ POST-AKKADIAN (= VIIA/VI)

195 bone fragments of mammals were recorded in transitional Akkadian/post-Akkadian period layers, along with one bird bone fragment and one mollusk fragment. 120 identified mammal bone fragments accounted for 61.5% of the assemblage. Most of the bones represented bred species: sheep and goat (80.7%), pig (17.6%) and cattle (1.7%). One bone fragment belonged to an equid.

Among the sheep and goat bone remains, 13.5% represented animals slaughtered at a young age. A fragment of a fang belonged to a male pig. Withers heights were calculated for pig, sheep and goat. The results: 60.7 cm for pig, 63.3 cm for sheep and 66.1 cm for goat, indicated that all the species were represented by small-sized animals.

KHABUR WARE (= V)

152 bone remains of mammals were found in Khabur Ware period layers, 98 fragments of which were identified (64.5%). Most of the bones represented bred species, mainly sheep and goat (82.7%), followed by cattle (9.9%) and pig (7.4%). 17 bone fragments belonged to equids. Single bone fragments belonged to cattle, as well as sheep and goat slaughtered at a young age. A fragment of a horn core came from a female sheep.

Two values on the point scale for cattle and one for equids, all calculated as 40 points, indicate a withers heights of approximately 130 cm. In the case of the equid, it could have been a small or medium-sized horse.

MODERN LAYERS (= M)

Of the 280 bone remains of mammals from modern layers, 138 fragments were identified by taxa (49.3%). They represented bred species: sheep and goat constituting 70.2% of the assemblage, followed by cattle

(21.4%) and pig (8.3%). 53 bone remains belonged to equids and one to camel.

Among the equid bone remains 10 represented animals slaughtered at a young age. The age at death of one individual was estimated at between five and seven years. Single identifiable bone remains of cattle, sheep and goat also represented young animals.

Measurement of 11 bone fragments of animals of various species (mainly equids) resulted in withers height calculated at 139 cm and 143.5 cm; a third measurement of an equid converted to points suggested a small-sized animal with a withers height no larger than 130 cm. These bone remains belonged most probably to horses. Two measurements for cattle, 28 and 58 points, pointed to the *Bos taurus brachyceros* type. The width of the proximal part of a pig's radius bone, corresponding to 10 points, suggested a domesticated animal of small size. Withers height of sheep calculated as 65.7 cm based on the length of a talus bone pointed to a mouflon-like type.

MARKS ON ANIMAL BONES

Some marks related to meat processing were observed on bones from different-period assemblages. Traces of charring and blackening were the most numerous, occurring on anatomically varied bone remains of animals representing bred species. Marks of this kind show that meat was roasted while still on the bone. Boiling meat (and bones) was less common, as indicated by a lower number of bones with grayish and porous surface.

INTERPRETATION

Archaeozoological analysis of bone remains from the excavations in 2009 at Tell Arbid demonstrated animal husbandry to have been at the core of the animal economy on the site from the beginning of the 3rd millennium BC through modern times. Hunting wild animals was of no significance. Except for a single metatarsal bone of deer obtained from EDIII/ Ninevite 5 period layers, no other wild animal bones were identified. Mollusks played a minor role. The Ninevite 5 period layers produced the most shells with single examples being recorded from transitional Ninevite 5/EDIII and Akkadian/post-Akkadian phases. It cannot be determined whether mollusks were locally available or imported from elsewhere as their detailed identification was not possible. Had they been gathered in the close vicinity of the site, they could have been used for feeding pigs — pig bone remains were commonly represented in the assemblage.

Two species of small ruminants, goat and sheep, played the main role in the settlement's animal economy, exceeding 50% of the bone remains in each period. Their importance increased over time, growing from approximately 50% in the earlier periods (Ninevite 5 and EDIII) to 80% by the end of the 3rd millennium BC (transitional Akkadian/post-Akkadian period), as well as in later periods (Khabur Ware and modern periods). This suggests a change in the animal economy in the end of the 3rd millennium BC. From this period on, there was a shift from a stationary economy based mainly on pig breeding and aimed at a quick acquisition of meat to a pastoral economy, which focused on small ruminants and equids. This change can be explained in terms of more arid

conditions in the region (Bryson, Bryson 1997).

In the earlier periods, goat and sheep raised at Tell Arbid provided mostly meat, as indicated by the young age at death of the animals (approximately 15%). Data available for late periods were insufficient. Morphological analysis proved that both small and large types were attested among sheep and goats. With regard to goats, small-sized animals were present in transitional Ninevite 5/EDIII, Akkadian/post-Akkadian period layers, whereas goats of a large size were attested in EDIII period layers. Large-sized sheep of an urial-like type with a withers height of over 70 cm were present in Ninevite 5 and transitional Ninevite 5/EDIII period layers. The existence of small individuals of a mouflon type with a withers height under 70 cm was confirmed in the EDIII, Akkadian and post-Akkadian periods, as well as in modern layers. A small variety of sheep was common in the ancient Near East (Lasota-Moskalewska *et alii* 1998). The large variety was distributed over an area stretching from Iran to Kashmir. Large-sized sheep at Tell Arbid could have been brought from the east or it could have been the result of cross-breeding between domesticated sheep and wild species of the urial type.

Raising pigs supplemented small ruminants breeding in the animal economy on Tell Arbid. The percentage of pig bone remains reached 35% in the Early Bronze Age (Ninevite 5, EDIII, Akkadian/post-Akkadian periods) and fell to 10% in the Middle Bronze Age (Khabur Ware period). The presence of some pig bone remains in the modern period can be explained either by residuality of the archaeological material or by the fact that pig meat was still being consumed sporadically.

In the Ninevite 5 and EDIII phases pigs were raised for a relatively long time. The percentage of slaughtered young pigs in these periods reached 13% and was lower than the average value for most sites which is 30%. This implies that pigs were being raised for fat and not just meat. Morphological analysis indicates that in all periods pig was represented by a domesticated type of small size with withers height of 60 cm. No transitional types or hybrids of pig and boar were attested in the bone assemblage. Indirectly, this can suggest that pigs were raised in closed areas.

Regardless of the chronological period, cattle was of little importance in the animal economy at Tell Arbid. Even so, the percentage of cattle bone remains gradually increased over time, ranging from 5% in the 3rd millennium BC through 10% in the Khabur Ware period to over 20% in modern times. As sex and age could not be estimated from the remains, the issue of whether cattle were raised for meat or for secondary products could not be settled. A morphological analysis of cattle bone remains from the EDIII period and modern layers demonstrated that there were two varieties, *Bos taurus brachyceros* and *Bos taurus primigenius*, in the earlier period, but only the former survived into the modern age. Small-sized individuals predominated, their withers height ranging from 110 cm to 130 cm. The presence of large-sized cattle at Tell Arbid can be explained by crossbreeding with the auroch, but also by the possibility of cattle of this kind being brought in from more remote areas. The paucity of measurable bones of these animals precludes a decisive interpretation of this issue.

The analysis of the distribution of bone parts of sheep, goat and pig

from Ninevite 5 and EDIII periods suggests that the slaughter, carving, and consumption of animals took place within the boundaries of the settlement. This has been suggested by the presence of all of the elements of the skeleton, including digital bones, which usually remain at the place of carving. Surpluses of skull bones were observed in the case of pig bone remains from Ninevite 5 period layers and of sheep and goat bone remains from the EDIII period. The significant quantity of skulls indicates a predilection for meat from the head, while the high number of head bones could be explained by their strong fragmentation. Next in terms of quantity were the trunk and proximal parts of fore- and hind limbs, which were prized parts of the carcass. Surpluses of proximal parts of sheep and goat fore- and hind limbs were recorded in Ninevite 5 and EDIII layers. They can be explained by the custom of chopping these prized parts of the carcass into smaller pieces that were subsequently subjected to thermal processing.

Bone remains of equids were found in the post-consumption deposits in all periods, except for the transitional Ninevite 5/EDIII. Their number increased regularly over time, peaking in assemblages from the modern layers. The category could have comprised onagers, horses and donkeys. However, it is impossible to determine whether they were wild, tamed or domesticated. A morphological analysis of the remains demonstrated the presence of animals of various size. In the EDIII and Khabur Ware phases, individuals with a height of 130 cm in the withers were attested. A smaller size of animals, 110 cm high in the withers, was also observed among the remains from the EDIII period. Modern layers yielded remains of larger-sized equids, with a height in the withers of approximately 140 cm, along with smaller-sized individuals. The larger equids could have been small and middle-sized horses, and those of a smaller size donkeys and onagers.

CONCLUSIONS

The results of the analysis of animal bone remains from excavations carried out in 2009 in Sector W on Tell Arbid suggest that sheep and goat husbandry played a major role in the animal economy at Tell Arbid. These results are generally in accordance with previous studies on animal remains from Tell Arbid. The results of the 2009 season support the view that sheep and goat were the main source of meat for the inhabitants of the settlement; this was supplemented with pork and beef. The dominance of small ruminants at Tell Arbid tallies with a pastoral economy practiced throughout the Near East. Sheep and goats are well-adjusted to seasonal wandering and their dietary requirements are rather low. The high percentage of pig bone remains in the earlier phases of occupation on the site can be explained by an increased consumption demand for meat — compared to other animals pigs are much more abundant providers in this respect. Moreover, the species is omnivorous and easy to breed close to a settlement. A marked increase in the importance of caprines and a concomitant decline in pig numbers can be observed in the transitional Akkadian/post-Akkadian and Khabur Ware periods, that is in the end of the 3rd millennium BC and the first centuries of the 2nd millennium BC.

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