

Different types of animal economy at Bakr Awa, Iraq, in the Bronze Age

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Abstract: *The aim of the paper is to present results of the archaeozoological analysis of animal bone remains and to reconstruct animal exploitation segment of the economy of the people living in Bakr Awa during different phases of the Bronze Age. In the Early Dynastic period, the remains of sheep and goat accounted for the majority of the material identified to a genus/species (NISP, 74.1%). Based upon age-of-death, the ovicaprines were killed, above all, for meat. There is preferential selection for the proximal part of the hind limb. Apart from small ruminants, there were also remains of cattle and more rarely equids. In the Akkadian period, new elements emerged in the economy, namely, pig and poultry breeding as well as wild animal hunting. The type of economy shifted from nomadic to more sedentary, pastoral, lasting from the Akkadian period to the end of the Late Bronze Age.*

Key words: nomadism; pastoralism; animal economy; Iraq; Bronze Age

Introduction

The site of Bakr Awa is located in the Iraqi part of Kurdistan, approximately 70km to the southeast of Sulaimaniyah, not far from the city of Halabja, near the Iranian border (Figure 1). It includes the citadel and lower city, where human occupation lasted from the Bronze Age to the Islamic period. The first excavations were performed in 1960 and 1961 by the Directorate General of Antiquities in Iraq and the next between 2010 and 2014 by the archaeological mission of the University of Heidelberg under the supervision of Professor P. Miglus (Miglus et al. 2011, 2013). During the latter, more than 20,000 animal bone remains were discovered and subjected to archaeozoological analysis. The aim of the following paper is to present the results regarding the non-human osteological material showing post-consumption characteristics from layers and features dated to the Early, Middle and Late Bronze Age.

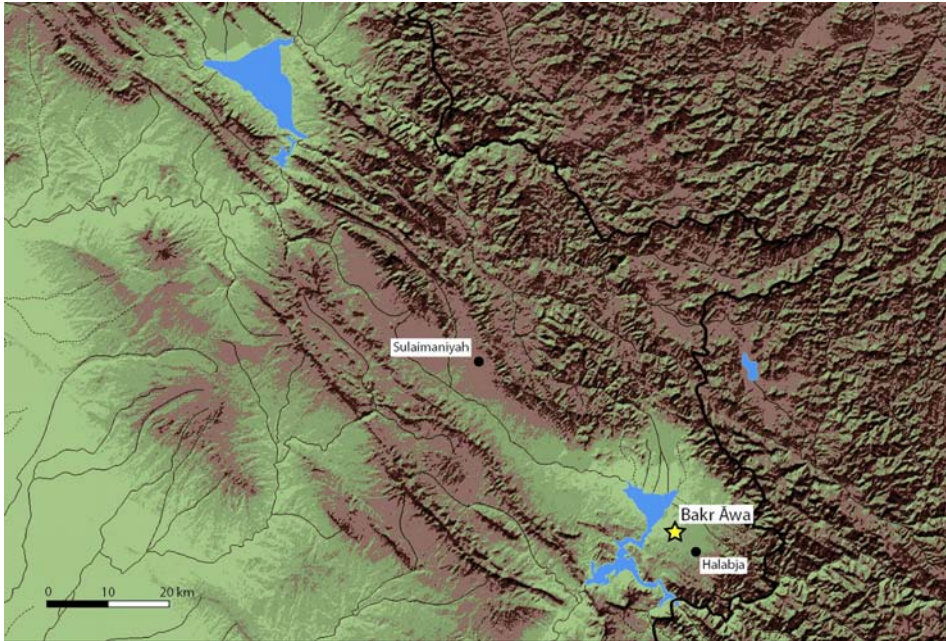


Figure 1. Location of Bakr Awa.

Material and methods

The faunal material was collected from stratigraphic layers and features dated to different phases of the Bronze Age which were excavated in two trenches (numbers 1 and 2), located in the lower city. The material was collected manually. No sieving was performed. The following chronological horizons were distinguished: the Early Bronze Age (EBA, 3000–2000 BC), including the Early Dynastic (ED) period, intermediate Early Dynastic-Akkadian period (ED-Akkad), the Akkadian (Akkad) period and materials from the late phase of the Early Bronze Age (EBA late), the Middle Bronze Age (MBA, 2000–1600 BC, including intermediate Isin-Larsa (IsLa), Old Babylonian (OB) period and materials generally dated to the Middle Bronze Age) as well as the Late Bronze Age (LBA, 1600–1200 BC). Part of the material was found at levels which were not assigned to one of the chronological phases (EBA-MBA and MBA-LBA). That part of the material was only shown in general quantitative statistics and ignored in detailed analysis (see **Supplementary Data, Table 1**).

The chronological phases differed as to the share of animal material which they contained. Most of the remains came from the Early and Middle Bronze Age (EBA: n=1178, 793 identified; MBA: n=1237, 844 identified) and a more detailed analysis was possible for that period. The fewest remains were recovered from the material

dated to the LBA (n=195, 124 identified), which resulted in obtaining little information regarding that phase. The material recovered from different chronological phases showed comparable state of preservation. Excavations are still in progress and the analysis of the material could make it possible to study economy in more detail, for instance, to perform socio-topographic analysis.

Post-consumption character of the animal bone deposits is indicated by their state of preservation (very fragmented, bones split into flaky pieces, a variety of skeletal elements represented) and the marks on the surfaces of some bones showing preparation of meat for consumption and culinary processing. In all Bronze Age layers, 2724 bone fragments and 81 snail shell fragments were found (**Supplementary Data, Table 1**). The latter will be the subject of separate expert analyses. 1838 bone remains were identified to zoological taxon and anatomical element, which amounted to 67.5%.

Bone remains were identified through a detailed zooarchaeological analysis using a variety of atlases (Krysiak et al. 2007, Popesko 2007). Sheep and goat were distinguished on the basis of criteria described by Schramm (1967), and Zeder and Lapham (2010). Bird remains were identified by Teresa Tomek with the help of the osteological bird collection of the Institute of Systematics and Evolution of Animals, Polish Academy of Sciences in Cracow, using available identification keys (Bacher 1967, Erbersdobler 1968, Kraft 1972, Bocheński & Tomek 2009, Tomek & Bocheński 2009).

Quantification

For the analysis of the bone material, the number of identified specimens (NISP) method was applied. Identified remains were divided into the following groups: fish, birds and mammals. The last group was divided into wild mammals—hunted animals and domestic mammals—livestock, equids and canids (it is not always possible to determine if the equids and canids found in the material were wild or domestic). Percentages of bone remains of each group and of livestock species were calculated separately for each chronological phase. The percentages shown below indicate the shares of the four groups within the mammal assemblage. Relative percentages of livestock species have been compared against the whole livestock sample. Zoological distribution was compared between different chronological phases of the Bronze Age, and also specifically within the EBA.

Anatomical analysis

The analysis of anatomical distribution was calculated for the remains of cattle, sheep and goat (jointly) and pig from the EBA and MBA. Due to the low number of remains, it was not performed for the LBA. For sheep and goat, it was done twice. First, for all the bone fragments found in all the EBA layers and features for a general picture, and then second, for remains found in the individual ED and Akkadian layers.

The purpose of such a procedure was to check potential differences between those periods. For the purpose of the anatomical distribution analysis, osteological elements of each species were divided into parts of high and low quality for consumption. High quality parts included the thorax (vertebrae and ribs), the proximal part of the forelimb (scapula, humerus, radius and ulna) and of the hind limb (pelvis, femur, tibia and possibly fibula). Low quality parts included bones of the head (skull, mandible and teeth) and distal parts of both limbs (carpus, tarsus, metacarpus and metatarsus, phalanges). Shares of both groups were calculated for each species. The values were compared with model anatomical distribution for ruminants and pig (Lasota-Moskalewska 2008).

Aging

Age was estimated on the basis of epiphyseal fusion (Kolda 1936) and dental eruption and wear (Lutnicki 1972, Payne 1987, Grant 1982). In the case of numerous remains of livestock, shares of animals killed at a young age, before reaching morphological maturity, were calculated. The calculation was made for the three phases of the Bronze Age. In the case of sheep/goat remains, there were additional calculations for four periods within the Early Bronze Age (ED, ED-Akkad, Akkad, EBA late). The numbers of fragments for ED-Akkad and EBA late were below 100, therefore, the results could be less reliable. Due to a low number of teeth, it was impossible to distinguish accurate age classes of individuals selected for slaughtering; therefore, a general division into young and adult animals was applied. The category of young includes individuals killed before the age of morphological maturity.

Sexing

Animal sex was estimated on the basis of features of sexual dimorphism (Lasota-Moskalewska 2008). In the case of pig, the distinctive feature was the shape of tusks and their alveoli. For cattle, proportions of metapodial bones were taken into consideration (Całkin 1969). The sexing of goats was identified on the basis of the shape of horn cores. Female birds were identified on the basis of the presence of medullary bones (Bocheński et al. 2000: 41).

Measurements

Measurements were taken using von Driesch's methods (1976). Breadth measurements of cattle and pig bones were shown on the 100-point scale (Lasota-Moskalewska 1984, Lasota-Moskalewska et al. 1987). Some length measurements were used to calculate withers height, Fock's coefficients were used for cattle (1966), Teichert's coefficients for sheep and goat (1969, after Driesch & Boessneck 1974), Koudelka's

coefficients for dog (after Driesch & Boessneck 1974). Marks on the bone surfaces formed due to taphonomic factors were also described.

Results

Animal bone remains dated to the Early Bronze Age

Species diversity. The layers and features dated to the Early Bronze Age yielded 1178 bone fragments. 793 were identified taxonomically and anatomically, which accounted for 67.3%. The majority of the remains belonged to mammals (Table 1), only three belonged to birds, possibly to domestic chicken, among which one individual was identified as female (there are two bones that probably come from one female) (Table 2). The bird bones were comparable with the size of a *Gallus gallus bankiva* male, however, since the sexual dimorphism in chickens is also shown in the body size, it can be concluded that the individual represented a breed larger than *G. gallus bankiva* (Figure 2).

Table 1. Taxonomic identification (NISP) of animal remains at the site of Bakr Awa (abbreviations: ED – Early Dynastic period; Akkad – Akkadian period; EBA – Early Bronze Age; MBA – Middle Bronze Age; IsLa – Isin-Larsa period; OB – Old Babylonian period; LBA – Late Bronze Age).

| Taxon | ED | ED-Akkad | Akkad | EBA (late) | Total EBA | |
|-----------------|-----|----------|-------|------------|-----------|--------|
| Cattle | 48 | 9 | 69 | 1 | 127 | 17.3% |
| Sheep/goat | 133 | 85 | 227 | 38 | 483 | 65.8% |
| Sheep | 3 | 1 | 4 | 1 | 9 | 1.2% |
| Goat | 1 | 3 | 6 | | 10 | 1.2% |
| Pig | | 6 | 85 | 14 | 105 | 14.3% |
| Livestock total | 185 | 104 | 391 | 54 | 734 | 100.0% |
| Equid | 4 | 2 | 6 | | 12 | |
| Canid | | | 17 | | 17 | |
| Wild mammal | 1 | | 21 | 1 | 23 | |
| Bird | | | 1 | 2 | 3 | |

Mammals were mainly represented by domestic animal bones (92.9%), the other groups, wild mammals (2.9%), equids and canids (2.1% each) were found in lower number (Table 1). The canid remains were mostly represented by dog and by fewer bones of unidentified species, possibly golden jackal. There are 17 bone fragments representing the canids, therefore their percentage was not calculated for statistical reasons. Talus and calcaneus of dog were measured (Supplementary Data, Table 2). The equids were represented by individuals of different sizes. The lack of osteometric data makes it impossible to identify them to a specific taxon. Nevertheless, on the

basis of the different sizes, it could be expected that the species included donkeys, onagers, horses, and their hybrids. Age was estimated in the case of one bone fragment and one tooth. Fragment of the bone of the forearm belonged to a young individual, below 3 years of age, and the mandibular incisor to one aged approximately 20 years. Remains of wild mammals mostly belonged to medium-sized ruminants—red deer or fallow deer, less frequently to gazelle of unidentified species. Talus and phalanx I of gazelle were measured (Supplementary Data, Table 2). As far as livestock is con-

Table 1. (continued)

| Taxon | IsLa/OB | OB | MBA | Total MBA | Total LBA |
|-----------------|---------|-----|-----|-----------|-----------|
| Cattle | 7 | 72 | 7 | 86 | 11.9% |
| Sheep/goat | 26 | 343 | 45 | 414 | 57.4% |
| Sheep | | 13 | | 13 | 1.8% |
| Goat | | 17 | 8 | 25 | 3.5% |
| Pig | 19 | 150 | 14 | 183 | 25.4% |
| Livestock total | 52 | 595 | 74 | 721 | 100.0% |
| Equid | | 46 | 2 | 48 | |
| Canid | | 65 | | 65 | |
| Wild mammal | | 4 | 1 | 5 | |
| Bird | 1 | 3 | | 4 | |
| Fish | 1 | | | 1 | |

Table 2. Bird remains at Bakr Awa (according to T. Tomek). Abbreviations: GL – maximum length; Bp – maximum breadth of the proximal end; Bd – maximum breadth of the distal end; SD – minimum breadth of diaphysis. All measurements in mm.

| No | Chronology | Taxon | Element | Side | Part | Sex | Comments |
|----|-------------|-------------------------------|-----------|------|-------|-----|----------------|
| 1 | EBA (Akkad) | <i>Gallus gallus</i> | coracoid | R | whole | | |
| 2 | EBA (late) | <i>Gallus gallus</i> | femur | L | whole | F | medullary bone |
| 3 | EBA (late) | <i>Gallus gallus</i> | tbt | L | whole | F | medullary bone |
| 4 | MBA (OB) | <i>Gallus gallus</i> | ulna | R | whole | | miniature size |
| 5 | MBA (OB) | <i>Gallus gallus</i> | radius | R | whole | | miniature size |
| 6 | MBA (OB) | <i>Ciconia ciconia</i> | ulna | R | prox | | |
| 7 | MBA | cf. <i>Anas platyrhynchos</i> | mandibula | L | | | |

Table 2. (continued)

| No | GL | Bp | Bd | SD |
|----|-------|---------|-------|-----|
| 1 | 51.8 | 8.4 | 10.8 | |
| 2 | >67.2 | >15.2 | >13.8 | 6.4 |
| 3 | >97.5 | 11.6 | >10.4 | 5.9 |
| 4 | 60 | 8.1 | 8.5 | 5.3 |
| 5 | 53.9 | 4.8×4.8 | 5.8 | 2.9 |

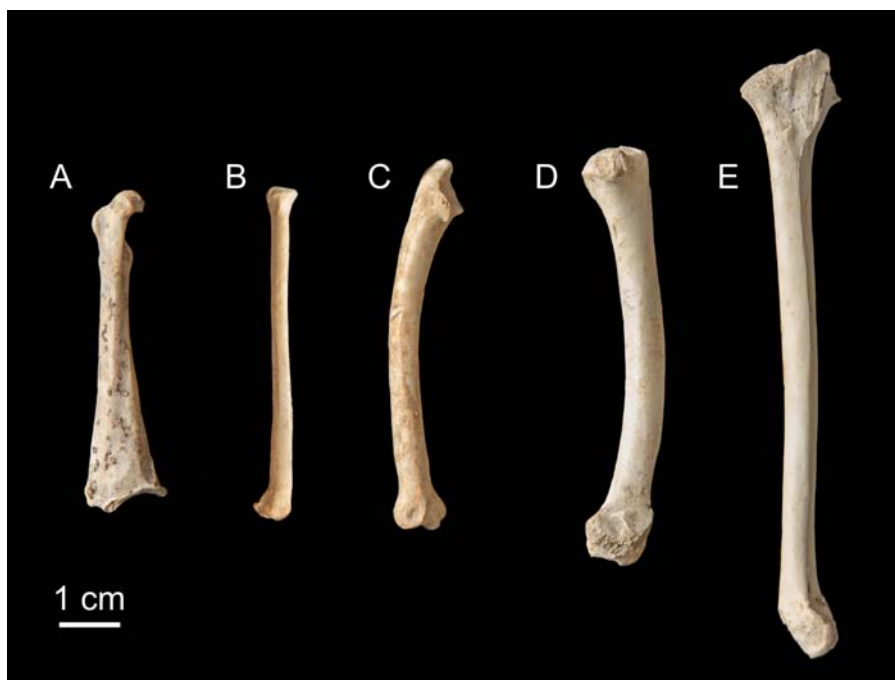


Figure 2. *Gallus gallus* remains from Bakr Awa; a – coracoid; b – radius; c – ulna; d – femur; e – tibiotarsus. Photo by P. Wojtal.

cerned, there were mostly remains of sheep/goat (68.4%), followed by cattle (17.3%) and pig (14.3%). It must be emphasized that the latter first appeared in the layers dated to the Akkadian period.

Species diversity in different periods of EBA. The layers of the Early Dynastic period yielded 344 bone fragments, 190 (55.2%) of which were identified. They belonged mostly to domestic mammals, very few to equids and a single fragment to a wild mammal—gazelle. Domestic mammals were dominated by sheep/goat and the other remains belonged to cattle.

625 bone remains come from the Akkadian period, 435 (69.8%) of which were identified as belonging to mammals and one bone belonging to domestic chicken. Mammals were mostly represented by livestock, followed by remains of wild mammals, canids and equids. Domestic animals included small ruminants with a slight dominance of goat, followed by previously absent pig and cattle.

Comparison of the zoological distribution between the Early Dynastic and Akkadian periods shows more diversification during the latter phase. There were significantly more remains of wild animals and canids. Moreover, pig was recorded, a species absent in the earlier material.

Anatomical distribution of livestock species. Comparison of anatomical distribution of cattle with the model distribution indicated a shortage of thorax bones and a slight surplus of proximal parts of the forelimb and hind limb (Table 3). In case of sheep and goat, comparison with the model distribution indicates an underrepresentation of thorax bones and a surplus of proximal parts of both limbs (Table 4). During the Early Dynastic period the disproportion between the percentage of the proximal part of the forelimb and hind limb has been noted. Bones of the forelimb were represented in a lower number than the bones of the hind limb. The share of the former was close to the model one, while there was a surplus of the latter. During the Akkadian period, there was a slight surplus of the proximal parts of both limbs in comparison with the model distribution. As far as pig is concerned, the comparison with the model distribution indicated a surplus of head bones and proximal parts of both limbs, and a slight underrepresentation of thorax bones (Table 5).

Table 3. Anatomical distribution of cattle remains in the Early and Middle Bronze Age at Bakr Awa.

| Body part | EBA | | MBA | | Model |
|--------------------|-----|-------|-----|-------|-------|
| | n | % | n | % | |
| Head | 35 | 27.6 | 12 | 14.0 | 20 |
| Thorax | 27 | 21.3 | 19 | 22.1 | 43 |
| Proximal forelimb | 19 | 15.0 | 10 | 11.6 | 5 |
| Distal forelimb | 6 | 4.7 | 6 | 7.0 | 8 |
| Proximal hind limb | 8 | 6.3 | 15 | 17.4 | 3 |
| Distal hind limb | 14 | 11.0 | 18 | 20.9 | 7 |
| Phalanges | 18 | 14.2 | 6 | 7.0 | 14 |
| Total | 127 | 100.0 | 86 | 100.0 | 100 |

Table 4. Anatomical distribution of sheep and goat remains in the Early and Middle Bronze Age at Bakr Awa.

| Body part | ED | | Akkad | | EBA | | MBA | | Model |
|--------------------|-----|-------|-------|-------|-----|-------|-----|-------|-------|
| | n | % | n | % | n | % | n | % | |
| Head | 39 | 28.5 | 81 | 34.2 | 169 | 33.7 | 92 | 20.4 | 20 |
| Thorax | 40 | 29.2 | 60 | 25.3 | 124 | 24.7 | 111 | 24.6 | 43 |
| Proximal forelimb | 18 | 13.1 | 35 | 14.8 | 78 | 15.5 | 95 | 21.0 | 5 |
| Distal forelimb | 4 | 2.9 | 3 | 1.3 | 9 | 1.8 | 9 | 2.0 | 8 |
| Proximal hind limb | 33 | 24.1 | 42 | 17.7 | 99 | 19.7 | 95 | 21.0 | 3 |
| Distal hind limb | 2 | 1.5 | 7 | 3.0 | 11 | 2.2 | 30 | 6.6 | 7 |
| Phalanges | 1 | 0.7 | 9 | 3.8 | 12 | 2.4 | 20 | 4.4 | 14 |
| Total | 137 | 100.0 | 237 | 100.0 | 502 | 100.0 | 452 | 100.0 | 100 |

Age and sex. The share of cattle bones belonging to young individuals was 6.3%. It is not possible to establish the age of killing. The material yielded few parts which qualified for determination of the sex, there were two fragments which came from males and one belonging to a female.

The percentage of young sheep and goat for the EBA was 9.6%. For assemblages dated to the ED and Akkadian periods it was 15.2% and 7.2% respectively. There were slightly more animals killed between the 1st and 2nd years of age than those killed younger than 1 year old. At the turn of the ED and Akkadian periods the share of bones of young animals was 9.0% and for the late phase of the EBA it was 5.1%, so it can be concluded that in time the share of young sheep and goat decreased from 15.2% to 5.1%.

In the case of pig, the share of bones of young animals was 31.4%, and it was noticed that the most frequently killed animals were above 2 years of age, slightly less frequently approximately 2 years old and the least frequently around 1 year old and younger. On the basis of one fragment of mandible it can be concluded that it belonged to a female.

Morphology. Layers dated to the ED and Akkadian periods yielded 10 fragments of cattle bones that were measured (**Supplementary Data, Table 2**). They represented *Bos taurus brachyceros* morphological type, medium-sized individuals, of withers height between 102 and 130cm. In one case, on the basis of the length of a metacarpal bone, withers height was calculated and it was 115.8cm.

Four distal epiphyses of tibiae and the tali of two goats were measured, and also breadth of the distal end of humerus and talus bone of sheep. On the basis of the latter, withers height was calculated at 68.5cm. It means that it belonged to a small form, similar to Asiatic mouflon.

Table 5. Anatomical distribution of pig remains in the Early and Middle Bronze Age at Bakr Awa.

| Body part | EBA | | MBA | | Model |
|--------------------|-----|-------|-----|-------|-------|
| | n | % | n | % | |
| Head | 36 | 36.4 | 60 | 32.8 | 20 |
| Thorax | 19 | 19.2 | 22 | 12.0 | 34 |
| Proximal forelimb | 18 | 18.2 | 41 | 22.4 | 4 |
| Distal forelimb | 4 | 4.0 | 8 | 4.4 | 10 |
| Proximal hind limb | 11 | 11.1 | 22 | 12.0 | 3 |
| Distal hind limb | 8 | 8.1 | 14 | 7.7 | 9 |
| Phalanges | 3 | 3.0 | 16 | 8.7 | 20 |
| Total | 99 | 100.0 | 183 | 100.0 | 100 |

Thirteen fragments of pig bones were measured (**Supplementary Data, Table 2**). In one case it was possible to calculate withers height, which was 69.8cm, so the individual was a medium-sized animal.

Animal bone remains dated to the Middle Bronze Age

Species diversity. 1237 bone fragments were discovered in the layers and features dated to the Middle Bronze Age, 844 (68.2%) of which were identified. The remains belonged mainly to mammals (**Table 1**), there were few birds and one fragment of unidentified fish. Two out of the four bird bones belonged to domestic chicken. The other two came from duck and white stork (**Table 2**). Mammals were mostly represented by livestock, dog and equids, with few wild animals. Among wild mammals there were only single remains of red deer or fallow deer and gazelle. Talus bone of gazelle was measured (**Supplementary Data, Table 2**). Equids were represented by fairly small individuals, more or less the size of donkey or onager. In the case of dog, five long bones were measured and on the basis of four of them, withers height was calculated. It was between 46.0 and 48.5cm. Remains of livestock consisted mainly of sheep/goat bones, with slightly more goat and were followed by pig and finally cattle.

Anatomical distribution of livestock. All parts of the body were represented in the case of cattle. The disproportion between the share of the distal part of the forelimb and hind limb is evident. There was also a slight shortage of head bones and a bit bigger shortage of thorax bones (**Table 3**). In sheep and goat there was a surplus of distal parts of both limbs, however it did not lead to a disproportion in quantitative representation (**Table 4**). Underrepresentation of thorax bones was also indicated. In pigs there was a surplus of head bones and the proximal part of the forelimb, and a shortage of thorax bones (**Table 5**).

Age and sex. The percentage of young animals in the case of cattle was 5.8%. Some fragments were found which indicated individuals of approximately 3.5 years old and between 4 and 5 years old. Sex was not estimated. The share of young sheep and goat was 13.0%. The most frequent killing age was between 2 and 3 years old, more rarely younger ones, up to 1 year old (ratio of 1:3). Sex was estimated in one case—a fragment of horncore belonged to a male. Young pigs reached 17.5%, animals over 2 years old were killed twice as often as younger ones, below 1 year old. Sex was estimated for five individuals, three fragments belonged to females, two specimens belonged to males.

Morphology. Eleven cattle bone fragments were measured (**Supplementary Data, Table 2**). Twelve fragments of sheep bones were measured and on the basis of the length of metacarpal and metatarsal bones, withers height was calculated—52.9 and 61.9cm. This indicates that they belonged to the small form. 18 fragments of pig bones were measured and they belonged to the small and medium-sized types. On

the basis of the length of metatarsal bone withers height was calculated—77.5cm and it also belonged to a medium-sized individual.

Animal bone remains dated to the Late Bronze Age

Species diversity. This chronological phase yielded the smallest assemblage. 195 bone fragments were discovered, including one fish vertebra. A total of 124 specimens that represented 63.6% of the remains were identified (Table 2). Most specimens belonged to domestic mammals, followed by equids, with the fewest frequencies represented by wild mammals. Among the latter, red deer and gazelle bones were found. Measurements were taken of the breadth of the proximal end of red deer radius and of the distal end of gazelle tibia (Supplementary Data, Table 2).

Age and sex. Two cattle elements belonged to animals killed at a young age. Two elements belonged to females. 13 fragments of sheep and goat belonged to young individuals, approximately half of them around 1 year old and the rest between 1 and 3 years old. Sex was not estimated. Nine bones of pig belonged to young animals, almost all of them below the age of 1 year old. One fragment belonged to a female.

Butchering and culinary processing marks

Surfaces of some of the bones displayed traces left after culinary processing. They were mostly results of activities related to the preparation of meat for consumption which involved dividing the meat together with bones into smaller fragments which were subsequently processed at a high temperature, mainly roasted, less frequently boiled. Chopping marks were found on different long bones of both limbs. The most frequent butchering technique was longitudinal chopping (about 20%) and could potentially indicate the intention to extract the marrow. Chopping marks were less frequent on scapula or pelvis specimens. Vertebrae and ribs were split into smaller pieces. On the basis of the marks noticed on the vertebrae, it seems that carcasses were divided along the length of the body and not across. Roasting can be inferred as some fragments were burned black. Boiling can also be confirmed by the presence of remains with high porosity and grey colour of the surface (Binford 1981).

Discussion

Domestic species were the basic resource in animal economy at the settlement of Bakr Awa. Livestock was dominated by small ruminants. Sheep and goat accounted for 65% of the remains in the EBA and MBA, decreasing to 50% in the LBA. Raising of cattle and pigs was another part of the animal economy. Cattle are represented in all of the chronological phases, representing 17.5% on average. The earliest remains of pig were discovered in the layers dated to the Akkadian period, they were absent in

the material from the ED period. Initially, the share of the species was relatively low reaching approximately 14%, and then, with time it continued growing, from 25% in the MBA to nearly 30% in the LBA. The appearance of pig remains indicates a very important change in economic activity of the inhabitants of the settlement. From the point of view of archaeozoological studies it can be assumed that in the ED period the place was populated by nomadic people whose main economic activity was breeding small ruminants, reaching 70% of the remains. Cattle supplemented such a herd and there were very rarely equid remains. The lack of bones of wild animals suggests a lower interest in hunting.

From the Akkadian period, the people began to lead a more sedentary life. Above all, as indicated by pig remains—pigs are not well-adapted to walking long distances and are not suited to a lifestyle involving constant movement. Additionally, hunting, especially for red deer and fallow deer, became more important for economies. It was also during this period that bones of birds, possibly domestic chicken, first appeared. This is a significant fact as it would be one of the oldest finds of the species in Mesopotamia. The earliest ones discovered so far include the remains from Tell Sweyhat in Syria and Korucutepe in Anatolia (Serjeantson 2009: 271). The species identification and chronology will be further confirmed by planned genetic tests and C14 dating.

Sheep and goat are still the basic breeding species, however, husbandry style changed from nomadic to pastoral. It means that the grazing grounds of big and small ruminants were in the vicinity of the settlement, where some people were occupied with raising pigs and poultry, and possibly growing of crops. Nomadism was connected to migration of people due to economic and social necessity (Gross 2006, Kruk & Milisauskas 1999). The best suited animals for such a lifestyle are sheep and goat, but also cattle, as they are herd animals, very well-adapted to even long trips. In the case of sheep and goat, they can often thrive in difficult environmental conditions, without access to good quality forage and fresh water. The animals can feed on dry plants and can even stop eating and drinking for two days (Lasota-Moskalewska & Szymczak 2009). All the species reproduced once a year, in spring, and the newborn individuals were almost immediately self-reliant after a few hours following birth (Komosińska & Podsiadło 2002), which made it possible to move around freely.

The nomadic character of economic activity in the Early Dynastic period at Bakr Awa is confirmed not only by results of zoological analyses but also by data related to anatomical and age analyses of small ruminants. During that period, there was a surplus of the proximal part of both limbs in the case of sheep and goat, and it was noted that the remains of the hind limb were more than twice as numerous as of the forelimb. The surplus is a result of dividing the carcass into smaller parts, most probably during the preparation of meat for consumption. The surplus of the hind

limb over the forelimb is characteristic of nomadic people, among whom that part of the carcass was most highly valued (Lasota-Moskalewska, unpublished). In the remaining chronological phases (the Akkadian period and the MBA) there was also a surplus of bones belonging to the proximal parts of both limbs, however, there were no disproportions between percentages of the forelimb and hind limb, which indicates a non-nomadic lifestyle. Another argument in favour of the nomadic type of economy in the ED period is provided by the results of age analysis of small ruminants. The share of animals killed at a young age is very high and reaches 15.2%. It means that the people frequently killed young animals, possibly to obtain a lot of meat for consumption, and they were not interested in exploitation of the animals for secondary products. An economy aiming at production of meat is typical of nomadic and pastoral communities (Lasota-Moskalewska & Szymczak 2009). This situation changed in time and the share of killed young animals decreased steadily from 15.2% in the ED period, to 9% in the intermediate ED-Akkadian period, and then to 7.2% in the Akkadian period, and to 5.1% in the late phases of the EBA. It is an unequivocal sign of the intention to exploit animals in a more versatile manner, not only in order to obtain meat for consumption but also secondary products such as milk and wool. The fall in the percentage of young sheep and goat is correlated with the appearance of pig in the faunal assemblages as a species which supplied meat, beginning in the Akkadian period. The share of young pigs calculated for the remains from the EBA layers reached 31.4%, thus it was close to the most frequent percentage found at archaeological sites and was justified in terms of economy. Pigs yield more meat at a younger age compared to other livestock species. Pigs can produce litters of offspring twice a year and they are fit to be slaughtered for meat as early as one year old (Prawocheński 1958: 170). In such circumstances, the interest in the meat of small ruminants decreased and they started to be used for secondary products.

The situation changed again in the MBA. It was noted that the percentage of young sheep and goats rose again to 13% with a fall in the share of young pigs to 17.5%. Raising of pigs changed in character from breeding the animals exclusively for meat to breeding for meat and fat. It required a slightly longer period of keeping them in order to obtain lard and the shortage of meat resulting from that was supplemented by killing small ruminants. The raising of cattle, both in the EBA and MBA, was aimed at herd stability, i.e. the balanced proportion of killed individuals and the ones selected for further breeding and exploitation for secondary products (Lasota-Moskalewska 2008). This observation is implied by the share of bones of young animals which reached approximately 6% in both chronological phases.

Anatomical distribution of cattle and pig remains examined for the EBA and MBA showed that there was an underrepresentation of thorax bones in both periods. A similar phenomenon was noted for bones of small ruminants. It seems that it

could be the result of taphonomic factors. Vertebrae and ribs are anatomical elements which are generally not so well preserved as, for instance, long bones. It is related, among other factors, to the density of the elements. It is understood that different factors damage skeletal remains more easily with the increase of the surface to volume ratio (Lyman 1984: 275).

Moreover, these were the fragments which are quite intensively divided into smaller parts, which is proven by the chopping marks preserved on many vertebrae and ribs. In the case of the latter, it was most often the chopping from one side, less frequently from both sides. Longitudinal chopping was more frequent in the case of vertebrae, less frequently they were chopped transversely. Apart from the shortage of thorax bones in the remains of cattle and pig, a surplus of bones from the proximal parts of both limbs was noted. It was probably related to the common practice of dividing elements of the carcass showing high quality in terms of meat into small pieces during the culinary processing. This is confirmed by the presence of marks observed on surfaces of many bones which displayed marks of longitudinal chopping and less often also transverse chopping. In the material dated to the EBA and MBA there were phalanges of all the livestock species, which suggests that both the slaughtering and carcass dressing were performed within the populated area.

Additionally, in the case of cattle remains dated to the Middle Bronze Age, there was a surprising surplus of the bones of the hind limb, both proximal and distal part. It is not known what caused that discrepancy, most probably, the anatomical part was brought from the outside of the settlement. Nevertheless, it is not possible to indicate the origin and reason for the surplus. Perhaps future research conducted at the settlement and nearby sites will indicate new possible interpretations.

As far as pig remains are concerned, apart from the already mentioned underrepresentation of thorax remains and surplus of proximal parts of both limbs, a slight surplus of head remains was noted. It implies consumption of pig head, which was a phenomenon confirmed at a lot of sites in different climate zones, and indirectly shows relatively low material status of the people who were forced to eat that rather unattractive part of the pig. The overrepresentation of head bones can, to a certain degree, result from the fact that the skull and mandible are split into many parts during their deposition in the soil and the inclusion of teeth, which are normally very well preserved, into the head remains.

Sheep raised by the people living at the Bakr Awa settlement in the Akkadian period belonged to the small form, resembling the Asiatic mouflon, of approximately 65cm at the withers. The lack of osteometric data from the layers corresponding with other chronological phases means that the morphological type in the other Bronze Age periods cannot be established. More data is available for goat remains. Measurements taken for the EBA and MBA confirm that a small form was raised then, below

69cm tall. Goats from Bakr Awa showed size variety—between 55 and 66cm tall, however, all measurements were related to the small form. The morphological types of sheep/goat correspond with the ones generally found in Mesopotamia.

Pigs, both in the EBA and MBA, represent a fully domesticated form and belong to small and medium-sized morphological types, whose withers height fell between 65 and 77cm. The pig population was well cross-bred and quite homogeneous, no changes in the size of this species were noted within the period of time taken into consideration.

A different situation was observed in the case of cattle, whose morphological type was reconstructed for three chronological phases of the Bronze Age. In all the phases, the individuals belonged to the *Bos taurus brachyceros* type, however, reduction of the body size was recorded. In the EBA and MBA almost all animals belonged to the medium-sized morphological type, with withers height reaching between 110 and 130cm. In the EBA, very few smaller individuals were noted and their withers height was approximately 106cm. The most significant change happened in the LBA, when a very low number of animals belonged to the medium-sized form and most represented the small form, of withers height reaching between 94 and 108cm. In the first two phases of the Bronze Age, the population was well cross-bred and homogeneous, in the LBA, body size of cattle decreased significantly. It could have been caused by a couple of factors. One was possibly related to husbandry activities and selection of smaller individuals for breeding. The other, more likely theory, is associated with unfavourable changes in the climate and environment which affected the possibility of feeding herds of cattle and thus led to the natural reduction of body size of that livestock species. The LBA was the time of climatic changes resulting from a sudden decrease of precipitation in the region of the Near East and thus the drying of the climate (Roberts et al. 2011).

Among the remains of domestic animals, apart from the most frequent mammals, there were also some bones representing poultry. They were found in the material from the layers dated to the EBA and MBA. Two of them probably belonged to domestic chicken and represented parts of the wing. They were slightly bigger than bones of *Gallus gallus bankiva* and came from a female. Based on these observations, it can be postulated that the individuals were bred at the settlement with the objective of obtaining eggs for consumption or for reproduction. Breeding of poultry did not play any significant role but rather supplemented the benefits of raising mammals. This is proven by the low percentage of the remains of these animals.

Remains of domestic animals that were not kept for economic reasons included a rather limited number of fragments of dog. Osteometric data indicate that they belonged to medium-sized individuals, reaching withers height of 45cm. In all the chronological phases of the Bronze Age, bone remains of equids were recorded at the

site of Bakr Awa. Their percentage was always relatively low, nevertheless, it increased systematically from 2.1% in the EBA to 5.7% in the MBA and to 7.2% in the LBA. The group of equids could possibly consist of bones of different species: horses, onagers, probably also donkeys and individuals resulting from crossbreeding of horses and donkeys. Due to the fact that it was impossible to confirm if the bones belonged to the wild or domesticated form, it is not known what forms were represented in the herds and if the animals were raised or hunted as wild, for example, in order to obtain meat. The problem is further complicated by the lack of osteometric data necessary to calculate withers height. It is only known that the bones represented different morphological types, showing different sizes, with some individuals close to horse and others close to donkey in terms of body size. Limited data regarding age indicate that the individuals were mostly adult, older than 15 years. Only one bone belonged to an individual killed at a young age, below 3 years old. Thus it seems very likely that the animals were domesticated or at least tame and exploited for secondary products, most probably for transport. Such a possibility is confirmed by cuneiform texts from Mesopotamia (Ismail et al. 1996: 112) dated to the times corresponding with the ED period. The texts report teams of donkeys pulling ploughs and other equids (most likely hybrids of horse and donkey) pulling vehicles. The age of the animals and written sources are arguments in favour of exploitation of equids for the secondary products, however, no marks or pathological changes which could prove the use for traction were found on the bones.

Wild mammal hunting supplemented the benefits of raising livestock and poultry, beginning from the Akkadian period. It did not play a leading role, which is confirmed by a very low share of remains of those animals, amounting to approximately 3%. The species hunted for meat were mostly fallow deer, red deer and gazelles. There were also very few remains probably belonging to golden jackal, however, as a carnivore it was rather not hunted for meat. There was a single fragment of a bird belonging to white stork. The duck bone found in the material could represent either wild or domesticated form. Due to a very low number of wild animal bones it was impossible to study anatomical distribution, age or sex of the hunted animals.

Conclusion

On the basis of the results of this archaeozoological analysis it can be concluded that the basic animal management activity in Bronze Age Bakr Awa was raising livestock which changed its character significantly at the turn of the ED and Akkadian periods in the EBA. The people led a primarily nomadic life in the ED period. Herds consisted of two species of small ruminants—sheep and goat, supplemented with cattle and to a lesser degree, equids. Sheep and goats were raised mainly for meat, with the most exploited cut of meat being the proximal part of the hind limb. Beginning from

the Akkadian period, animal management tended towards a more pastoral sedentary form. The main animals exploited in this period remains sheep and goat, followed by cattle, with the raising and exploitation of pigs beginning in this time and becoming more significant over time. Pigs were kept mainly for meat. From that time on, breeding of domestic animals was supplemented with wild animal hunting of species such as fallow deer, red deer and gazelle.

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