

ANIMAL MANAGEMENT IN THE MEDIEVAL BANAT: FAUNAL REMAINS FROM THE SETTLEMENT AT THE PANČEVO – LIVADE SITE (SERBIA)

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Abstract: This paper presents the results of the faunal remains analysis from the medieval settlement of the Pančevo – Livade site, discontinuously occupied between the 8th and the 13th centuries. The animal remains represent food leftovers as indicated by the butchering marks and mortality profiles. Apart from mammalian remains, which are the most numerous, bird, micromammal, and mollusc remains are also present. Animal husbandry was of great significance to the economy, although not highly developed – domestic animal breeds were small and primitive. During the earlier phase of the settlement (8–9th centuries), domestic pig was the main source of meat, with cattle, sheep, goats, and horses herded as well. During the later phase of the settlement (10th–11th centuries), cattle were the most important among the domestic species. Pig continued to be the main source of meat, while the secondary products of cattle, sheep, and goats gained greater significance. Hunting played a somewhat more significant role in the economy of the later phase, as indicated by a greater number of hunted wild species – boar, red deer, and mallard.

Cuvinte-cheie: resturi faunistice, așezare medievală, Banat, economie, creșterea vitelor, vânatoare

Rezumat: Studiul de față prezintă rezultatele analizei arheozoologice asupra materialului faunistic din situl arheologic de la Pančevo – Livade, care prezintă o locuire discontinuă între secolele VIII–XIII. Resturile faunistice sunt reprezentate de deșeuri alimentare așa cum indică urmele de descărnare și profilurile de abataj. În afara resturilor de mamifere care sunt cele mai numeroase, sunt prezente de asemenea și oase de pasăre, micro-mamifere și scoici. Creșterea animalelor deține un loc important în economia nu foarte bine dezvoltată a comunității, speciile identificate având statură mică și caracteristici primitive. Pe durata locuirii mai timpurii a sitului (secolele VIII–IX), principala sursă de carne a constituit-o porcul domestic, dar sunt prezente și vitele și ovicaprinele. În timpul locuirii mai târzii (secolele X–XI), vitele devin specia cea mai importantă. Porcul continuă să fie principala sursă de carne, iar produsele secundare obținute de pe urma vitelor și ovicaprinelor cresc în importanță. Rolul vânătorii crește relativ în ponderea economică a acestei faze târzii, așa cum este indicat de numărul mai mare de specii sălbatice – porc mistreț, cerb și rață sălbatică.

INTRODUCTION¹

This paper presents the results of the archaeozoological analysis of the faunal material from the Medieval settlement at the Pančevo – Livade site. The degree of the archaeozoological research of Medieval settlements in the Serbian Banat is extremely low. Namely, the published results include those of archaeological sites Kopovo – *Sanad* (9th century) and Dobrica – *Velike njive* (9th–10th centuries), but archaeozoological data are modest and they consist of the lists of represented animal taxa in faunal samples². In the case of Jaruga – *Uljma* site (11th–13th centuries) there is more information about diet, animal husbandry, and hunting³. On the other hand, archaeozoological data for the sites Gornea – *Căunița de Sus* (8th century), Gornea –

Zomonite (8th–10th centuries), Gornea – *Țărmuri* (11th–13th centuries), Ilidia (11th–13th centuries), Moldova Veche – *Rât* (11th–13th centuries), Parța (11th–12th centuries), and Berzovia – *Pătruieni* (14th century) in Romanian Banat provide more information about characteristics of the faunal samples⁴. In archaeological literature, there are many irrelevant conclusions about animal husbandry, hunting, and fishing, made without prior animal bone analysis and interpretation of the results by archaeozoologists. Therefore, one of the goals of this research is to get an insight into the strategy of animal exploitation in the territory of Medieval Banat, but also a reconstruction of the diet and animal exploitation by the inhabitants of the settlement at the Pančevo – Livade site during this period.

¹ This paper presents a summary and a corrected version of the master thesis *Importance of animals in the economy of the 7 – 13th centuries settlement at the Pančevo – Livade site (southern Banat)*, defended on September 29, 2015, at the Department of Archaeology, Faculty of Philosophy, University of Belgrade.

² Blažić 2000.

³ Mladenović, Mladenović (in press).

⁴ El Susi 1996, p. 91–104.



Figure 1. The geographical position of the Pančevo – Livade site.

HISTORICAL AND ARCHAEOLOGICAL BACKGROUND

The Banat is part of the Pannonian Plain, a geographical region bordered by the Mureş River to the north, the Tisza River to the west, the Danube River to the south, and the Southern Carpathian Mountains to the east⁵. During the Migration Period (from the second half of the 4th until the end of the 9th century) various tribes have passed through and lived in this region⁶. Avar domination in this area marked the period between the 6th and the end of the 8th/beginning of the 9th century when the Second Khaganate was destroyed by the Franks from the West and the Bulgarians from the East⁷. After this event, the region between the Tisza River and the Southern Carpathian Mountains was under Bulgarian authority. Hungarian tribes began settling in this region at the end of the 9th century. This process ended after the victory of the Hungarians over Achutum, ruler of the Banat, at the beginning of the 11th century when the territory of the Hungarian state occupied the entire Pannonian Basin⁸. Although during the 12th and the first half of the 13th centuries, frequent conflicts on the Byzantine/Bulgarian-Hungarian border occurred⁹, the population of Southwestern Banat was considered to have a great economic prosperity, which is confirmed by historical sources as well. Namely, Joannes Kinnamos indicates that in this part of the Banat there were rich settlements with an extremely large number of inhabitants¹⁰. The economic prosperity of the settlements was disrupted by the Mongolian invasion of Europe between 1241 and 1242¹¹. Archaeological research has confirmed the great consequences of the Mongolian attacks, as almost all sites indicate an occupation *hiatus* during this period, and that, there were major changes in the material culture of these areas in the later periods¹².

The archaeological site *Livade* is located on the rim of a slightly elevated loess ridge, 6 km east of Pančevo and 6 km north-east of Starčevo, in southwestern Banat (Serbia) (Fig. 1). It stretches along the present-day road Pančevo – Kovin and along the bank of a channel which flows into the Nadel River about 500 m farther towards the west¹³. This site was detected during a field survey in 1971¹⁴, while the existence of the Medieval settlement was confirmed during the field survey in 2007¹⁵. Archaeological excavations were carried out in 1984 and between 2008 and 2013, organized by the National Museum Pančevo. It was indicated that on the left side of

the road Pančevo – Kovin there are remains of the Late Antiquity (the second half of the 4th century), as well as a Slavic necropolis from the Late Avar period (from the end of the 8th to the 9th century) and a Medieval settlement (8th–13th centuries, with several interruptions). Along the right side of the mentioned road, were identified a Medieval necropolis (10th–11th centuries), churches with necropolises (12th–15th centuries), as well as an ochre grave from the Yamnaya culture (Pit Grave culture) from the Eneolithic period¹⁶.

The Medieval settlement was excavated in 2008, 2010 and 2011 by archaeologists Jelena Đorđević and MA Vojislav Đorđević. The stratigraphy and the archaeological material suggest the existence of two main Medieval phases of occupation in this area. The first phase is related to a settlement dated to the 8th–9th centuries, while the second phase is associated with a settlement dated between the 10th and the beginning of the 11th century. In addition, during the 2010 excavation season, sparse archaeological evidence of occupation at this location that took place between the 12th and the 13th centuries was documented (one open-air kiln – structures 3/10 and 6/10)¹⁷.

Seven semi-dugout houses (structures 4/08, 6/08, 12/08, 2/10, 8/10, 9/10, and 6/11) could be attributed to the earlier phase of the habitation. These houses had almost square bases (dimensions vary between 2.5 × 3 m and 3.2 × 3.2 m) with floors made from compacted earth and small kilns on the northeastern corner. Other than the houses, two open-air kilns (structures 7/08 and 3/11) and one ditch (structure 2/11) were used during the period between the 8th and the 9th centuries (Fig. 2)¹⁸. Open-air kilns had access pits with square/trapezoidal bases and circular furnaces¹⁹.

Two semi-dugout houses (structures 8/08 and 9/08), two open-air kilns (structures 7/10 and 1/11), ditches [structures 5/08, 10/08 and 1/10 (remains of the same double trench), as well as the structures 4/10, 5/10 and 5/11] and one storage pit (structure 7/11) could be related to the later phase (Fig. 2). Houses from this phase had almost square bases (4.2 × 4.2 m and 5.4 × 4.4 m), kilns on the northeastern corner, and grain storage pits²⁰. Open-air kilns had oval access pits, while the position of the double trench suggests that it surrounded contemporaneous structures from the north, west, and south (Fig. 2)²¹.

⁵ Davidović *et alii* 2003.

⁶ Ostrogorski 1996.

⁷ Kovačević 1977, p. 146–147.

⁸ Rokai *et alii* 2002, p. 13–16, 23–26.

⁹ Dinić 1978, p. 94–95.

¹⁰ VIINJ 1971, p. 43–44.

¹¹ Rokai *et alii* 2002, p. 85.

¹² Radičević 2010, p. 49.

¹³ Đorđević, Đorđević 2012, p. 76 ; Đorđević, Đorđević 2018, p. 16.

¹⁴ Brmbolić 1991, p. 66; Barački, Brmbolić 1997, p. 226.

¹⁵ Đorđević, Đorđević 2012, p. 75; Đorđević, Đorđević 2018, p. 16.

¹⁶ Gačić 1985, p. 178–179; Bukvić 1988, p. 134–135; Đorđević, Đorđević 2018, p. 16–17.

¹⁷ Đorđević, Đorđević 2018, p. 16.

¹⁸ Đorđević, Đorđević 2012, p. 78–79; Đorđević, Đorđević 2018, p. 18.

¹⁹ Đorđević, Đorđević 2012, p. 83; Đorđević, Đorđević 2018, p. 18.

²⁰ Đorđević, Đorđević 2018, p. 20.

²¹ Đorđević, Đorđević 2012, p. 84.

The first Medieval settlement at the Pančevo – *Livade* site was founded at the southeastern border of the Avar territory, during the Second Avar Khaganate in the 8th century. It was a small, rural settlement, with modest archaeological material with characteristics of Slavic material culture. The precise moment of the abandonment of the settlement in the 9th century is unknown, but it probably occurred at the beginning of the 9th century, after the end of the Avar Khaganate²². The area was unoccupied until the 10th century when another

small, rural settlement was established. According to the discovery of the bronze byzantine anonymous A2 class follis forged between 976 and 1030/1035, it may be assumed that the duration of the settlement could have been related to the beginning of the 11th century²³. Its desertion could be connected to the conflict between King Stephen I of Hungary (1000–1038) and Achtum, ruler of the Banat. Some modest evidence suggests a habitation of this area during the 12th–13th centuries.



Figure 2. The settlement ground plan with structures from which analyzed faunal material comes from (structures from different habitation phases are shown in different colors; the ground plan was taken from field documentation and modified).

MATERIALS AND METHODS

During the excavation seasons between 2008 and 2011, 1970 animal remains were collected by hand. The overwhelming majority consisted of mammal remains (1940), but bird (23), micromammal (6) and shell (1) remains were also present (Table 1). The material was found in different structures, mostly in the semi-dugout houses, but also in open-air kilns, ditches, the double trench, and the storage pit. Animal bones were collected from both settlement phases. In some cases, it was possible to attribute the material to each phase, but some parts of the osteological material could not be precisely

dated. Therefore, it was altogether dated between the 8th and the beginning of the 11th centuries. One small sample came from the open-air kiln from the 12th–13th centuries.

The species identification and anatomical determination of the animal remains were carried out consulting relevant literature²⁴, and based on comparisons with specimens from the Archaeozoological Reference Collection of the Laboratory for Bioarchaeology, Faculty of Philosophy in Belgrade. Quantification is given by NISP (Number of Identified Specimens), DZ (Diagnostic Zones), and MNI (Minimal Number of Individuals). The NISP includes all specimens attributed to a particular taxon. The DZ was counted if there was preserved more than a half of

²² Kovačević 1977; Đorđević, Đorđević 2018, p. 19.

²³ Đorđević, Đorđević 2018, p. 21.

²⁴ Boessneck 1969; Boyd *et alii* 1994; Budras *et alii* 2009; Cohen, Serjeantson 1996; Frandson *et alii* 2009; Habermehl 1975; 1985;

Halstead *et alii* 2002; Hilson 2005; Johnstone 2004; Meadow, Uerpman 1991; Payne 1985; Peters 1998; Prummel, Frisch 1986; Prummel 1988; Schmid 1972; Zeder, Lapham 2010; Zeder, Pilaar 2010.

the alveoli for the 4th premolar in the upper and lower jaw, more than a half of the atlas, axis, articular end of the scapula, acetabulum, calcaneus, astragalus, proximal and distal epiphysis/metaphysis of long bones and the 3rd and the 4th metacarpal and metatarsal bone as well. This parameter was given by Watson²⁵ and it was modified according to the characteristics of the analysed faunal sample. The MNI was defined by Shotwell²⁶, and it was counted based on the most frequent element of a particular taxon, combined with age and sex differences within the most frequent element.

The determination of the age of death was based on the time of eruption and attrition of teeth²⁷, and the epiphyseal fusion²⁸. Age structure was expressed by the survivorship curve, based on the degree of epiphyseal fusion²⁹. Traces of taphonomic processes which include weathering, gnawing, burning, and traces of anthropogenic activities were recorded. Measurements were taken following the standards from von den Driesch³⁰. Withers heights for pig and sheep were calculated using the factors given by Teichert³¹.

Period	8–9th c.			10–11th c.			12–13th c.		
Taxon	NISP	NISP	%NISP	NISP	%NISP	NISP	NISP	%NISP	
<i>Bos taurus</i>	4	47	40.9%	88	40.2%	1	140	38.0%	
<i>Sus domesticus</i>	11	24	20.9%	28	12.8%	1	64	17.4%	
<i>Ovis aries</i>	4	7	6.1%	9	4.1%	/	20	5.4%	
<i>Capra hircus</i>	2	7	6.1%	5	2.3%	/	14	3.8%	
<i>Ovis/Capra</i>	6	15	13.0%	10	4.6%	/	31	8.4%	
<i>Equus caballus</i>	1	6	5.2%	37	16.9%	/	44	12.0%	
<i>Equus asinus</i>	/	/	/	2	0.9%	/	2	0.5%	
<i>E. caballus</i> x <i>E. asinus</i>	/	1	0.9%	2	0.9%	1	4	1.1%	
<i>Equus</i> sp.	2	3	2.6%	23	10.5%	/	28	7.6%	
<i>Canis familiaris</i>	/	1	0.9%	11	5.0%	/	12	3.3%	
<i>Sus scrofa</i>	/	3	2.6%	2	0.9%	/	5	1.4%	
<i>Cervus elaphus</i>	/	1	0.9%	/	/	/	1	0.3%	
<i>Vulpes vulpes</i>	1	/	/	/	/	/	1	0.3%	
<i>Lepus europaeus</i>	/	/	/	2	0.9%	/	2	0.5%	
Mammals identified to the species/genus level:	31	115	100.0%	219	100.0%	3	368	100.0%	
Large-sized mammals	80	232	/	241	/	3	556	/	
Medium-sized mammals	129	440	/	441	/	6	1016	/	
Micromammals	/	6	/	/	/	/	6	/	
Mammals, total:	240	793	/	901	/	12	1946	/	
<i>Gallus domesticus</i>	/	3	/	/	/	/	3	/	
<i>Anser domesticus</i>	/	1	/	1	/	/	2	/	
<i>Anas platyrhynchos</i>	/	8	/	/	/	/	8	/	
Aves	/	7	/	3	/	/	10	/	
Aves, total:	/	19	/	4	/	/	23	/	
<i>Unio</i> sp.	/	1	/	/	/	/	1	/	
TOTAL:	240	813	/	905	/	12	1970	/	

Table 1. Distribution (in NISP) of different animal taxa per settlement phase.

²⁵ Watson 1979.

²⁶ Shotwell 1955.

²⁷ Silver 1969; Grant 1982; Levine 1982.

²⁸ Silver 1969; Schmid 1972.

²⁹ Reitz, Wing 2008.

³⁰ Driesch 1976.

³¹ Teichert 1969; 1975.

FAUNAL COMPOSITION AND TAPHONOMY

Due to the high degree of fragmentation, out of 1970 specimens, only 382 were identified to the species/genus level (19%). Skeletal remains of domestic animals (95% NISP) form the majority of these finds (Table 1). Remains of domestic mammals included cattle (*Bos taurus*), sheep (*Ovis aries*), goats (*Capra hircus*), pigs (*Sus domesticus*), horses (*Equus caballus*), donkeys (*Equus asinus*), mules (*Equus caballus* x *Equus asinus*) and dogs (*Canis familiaris*), whereas, among the wild mammals, there were wild boar (*Sus scrofa*), red deer (*Cervus elaphus*), red fox (*Vulpes vulpes*) and hare (*Lepus europaeus*). Faunal remains of domestic bird consisted of domestic hen (*Gallus domesticus*) and domestic goose (*Anser domesticus*), while the mallard (*Anas platyrhynchos*) was the only species among the wild birds. Remains of bivalves were represented by river shells from the *Unio* genus (*Unio* sp.). Because of the great similarity in the skeleton structure of sheep and goats, and horses, mules, and donkeys as well, it was difficult to distinguish these species based on the osteological material. Therefore, such specimens were classified as *Ovis/Capra* and *Equus* sp. Some of the specimens were identified to the class level and they were placed into the large-sized and the medium-sized mammal categories (Table 1). Those were mainly small fragments of long bones, ribs, and vertebral bones, which probably belonged to cattle, sheep, goat or pig, but could not be attributed to them certainly. Likewise, some of the bird remains, and all of the micromammal remains were identified to the class level.

As mentioned, the fragmentation of the bones was substantial and whole bones represent only 5% of the sample. The fragmentation was the consequence of human activities such as breaking of the bones to obtain bone marrow and animal butchery. This is confirmed by the fact that the most numerous whole bones were tarsal bones and phalanges since these bones are not rich in meat and they are not suitable for processing. Traces of gnawing by carnivores and/or omnivores were present on 12.7% of specimens, whereas traces of gnawing by rodents were also noticed (6%). Bones with traces of combustion (2.9%) were present and indicate the preparation of food on the oven or kiln. Traces of weathering, like foliation and slight cracking of the bone, caused by exposure to atmospheric influences before burying in the sediment, were present on 21.4% specimens, suggesting that the bones were not quickly stored in sediment.

Earlier settlement phase (8th–9th centuries)

During the period between the 8th and 9th century, inhabitants of this settlement were herding pig, cattle,

sheep, goats, and horses. The usual wild species used in the diet were not present in the faunal assemblage, indicating that hunting was not of high significance. The only hunted species was red fox (one individual), which could have been hunted for fur or because it was a danger to domestic animals. There were 240 specimens that could be attributed to this phase with certainty, but only 31 were identified to the species/genus level (Table 1).

The majority of the faunal remains from the earlier phase of the settlement were found in the open kiln (structure 3/11). Secondly, animal bones came from the semi-dugout houses (structures 4/08, 6/08, 12/08, 2/10, 8/10, 9/10, and 6/11) and the ditch (structure 2/11) (Fig. 2, Table 2).

Later settlement phase (10th–11th centuries)

Out of 813 faunal remains attributed to this period, 128 specimens were identified to the species/genus level (16%). Within the osteological material, 15 different animal taxa were present. Among them, the most numerous were those of domestic mammals (cattle, sheep, goat, pig, horse, mule and dog), while remains of game (wild boar and red deer), domestic and wild birds (domestic chicken, domestic goose, and mallard), and bivalves (shell from the *Unio* genus) were less represented (Table 1).

Archaeozoological material was found in different structures – semi-dugout houses (structures 8/08 and 9/08), open-air kilns (structures 7/10 and 1/11), a double ditch (structure 1/10) and a ditch (structure 10/08) (Fig. 2, Table 3). The majority of the faunal remains derived from semi-dugout houses (69% NISP), since these structures were used as garbage pits after losing their initial function³².

Faunal material from the layers dated between the 8th and the beginning of the 11th century

The Medieval settlement at the Pančevo – *Livade* site is characterized by a complex stratigraphy. The houses of the later settlement were dug into the cultural layer of the earlier phase, while some of them were positioned over the earlier houses (Fig. 2). Therefore, in some areas, the archaeological material from both phases was mixed and those finds were widely dated between the 8th and the beginning of the 11th century. The highest amounts of archaeozoological material were found just in those layers.

Out of the 905 specimens, 220 (24%) were identified to the species/genus level. Aside from those species noticed in the earlier and later phases of the settlement (cattle, pig, sheep, goat, horse, mule, dog, goose, and wild boar), remains of donkey and hare were identified as well (Table 1).

³² Đorđević, Đorđević 2012, p. 78–79.

Faunal material from the 12th–13th centuries

During the archaeological excavations, only one open-air kiln (structure 3/10) consisting of an oval access pit (structure 6/10) and a circular-base furnace, attributed to the period between the 12th and the 13th century was

unearthed (Fig. 2). A modest faunal sample (12 specimens) was found on the floor of this kiln. Among the animal bones, the specimens identified to the class level (large-sized and medium-sized mammals), as well as remains of cattle, pig, and mule were present (Table 1).

Taxon	4/08	6/08	12/08	2/10	8/10	9/10	6/11	3/11	2/11	Total:
<i>Bos taurus</i>	/	/	2	/	1	/	/	1	/	4
<i>Sus domesticus</i>	/	/	2	/	1	/	3	5	/	11
<i>Ovis aries</i>	/	2	/	/	1	/	/	1	/	4
<i>Capra hircus</i>	/	/	/	/	/	1	/	1	/	2
<i>Ovis/Capra</i>	2	/	/	1	2	/	/	/	1	6
<i>Equus caballus</i>	/	/	/	/	/	/	/	1	/	1
<i>Equus sp.</i>	/	/	/	/	/	/	1	1	/	2
<i>Vulpes vulpes</i>	/	/	/	/	/	1	/	/	/	1
Total:	2	2	4	1	5	2	4	10	1	31

Table 2. Distribution (in NISP) of different animal taxa per structure during the 8th–9th centuries.

Taxon	8/08	9/08	10/08	1/10	7/10	1/11	Total:
<i>Bos taurus</i>	21	8	2	5	5	6	47
<i>Sus domesticus</i>	5	8	1	6	2	2	24
<i>Ovis aries</i>	3	3	/	/	/	1	7
<i>Capra hircus</i>	4	3	/	/	/	/	7
<i>Ovis/Capra</i>	5	6	/	3	1	/	15
<i>Equus caballus</i>	3	/	/	3	/	/	6
<i>E. caballus</i> x <i>E. asinus</i>	1	/	/	/	/	/	1
<i>Equus sp.</i>	2	/	/	1	/	/	3
<i>Canis familiaris</i>	/	/	/	/	/	1	1
<i>Gallus domesticus</i>	2	1	/	/	/	/	3
<i>Anser domesticus</i>	/	1	/	/	/	/	1
<i>Sus scrofa</i>	2	1	/	/	/	/	3
<i>Cervus elaphus</i>	/	/	/	/	1	/	1
<i>Anas platyrhynchos</i>	8	/	/	/	/	/	8
<i>Unio sp.</i>	1	/	/	/	/	/	1
Total:	57	31	3	18	9	10	128

Table 3. Distribution (in NISP) of different animal taxa per structure during the 10th–11th centuries.

RESULTS AND DISCUSSION

According to the available data, it could be assumed that animal husbandry had a very significant role in the economy of both phases of the settlement at the Pančevo – Livade site. Among the animal bones from the 8th–9th centuries the most numerous remains were those of pig (Tables 1 and 4). Other than pig, the inhabitants herded cattle, sheep, goats, and equids (only remains of a horse were confirmed). Since the sample is very small it is impossible to draw conclusions about the significance of the different animal species in the economy of this settlement phase.

During the 10th–11th centuries, the most important species was cattle, according to all quantification parameters (Table 5, Fig. 3). Based on NISP and DZ, the second most important species were the ovicaprines, while, according to the MNI, was the pig. Inhabitants of this Medieval settlement bred equids (horse and mule), dog, and domestic fowl (chicken and goose) as well. Aside from the mentioned domestic species, the remains of the donkey were present in the faunal sample from the layers dated between the 8th and the 11th century. At contemporaneous sites on the territory of northern Serbia and the Romanian Banat, the most important animals such as cattle, pigs, and ovicaprines were mainly herded. Among them, cattle were usually the most important

species. Remains of horse and dog were present at almost every archaeological site, while remains of donkey and mule were rare³³.

Taxon	NISP	%NISP	DZ	%DZ	MNI	%MNI
Cattle	4	13%	1	8%	1	10%
Pig	11	35%	4	31%	4	40%
Sheep	4	13%	1	8%	2	20%
Goat	2	6%	0	0%	1	10%
Sheep/Goat	6	19%	2	15%	0	0%
Horse	1	3%	1	8%	1	10%
Equids	2	6%	3	23%	0	0%
Red fox	1	3%	1	8%	1	10%
Total:	31	100%	13	100%	10	100%

Table 4. Distribution (in NISP, DZ, and MNI) of different animal taxa during the 8th–9th centuries.

Taxon	NISP	%NISP	DZ	%DZ	MNI	%MNI
Cattle	47	37%	17	29%	6	24%
Pig	24	19%	10	17%	5	20%
Sheep	7	5%	4	7%	2	8%
Goat	7	5%	5	8%	2	8%
Sheep/Goat	15	12%	4	7%	0	0%
Horse	6	5%	2	3%	2	8%
Mule	1	1%	0	0%	1	4%
Equids	3	2%	0	0%	0	0%
Dog	1	1%	1	2%	1	4%
Chicken	3	2%	3	5%	1	4%
Goose	1	1%	1	2%	1	4%
Wild boar	3	2%	0	0%	2	8%
Red deer	1	1%	0	0%	1	4%
Mallard	8	6%	11	19%	1	4%
Unio shell	1	1%	1	2%	0	0%
Total:	128	100%	59	100%	25	100%

Table 5. Distribution (in NISP, DZ, and MNI) of different animal taxa during the 10th–11th centuries.

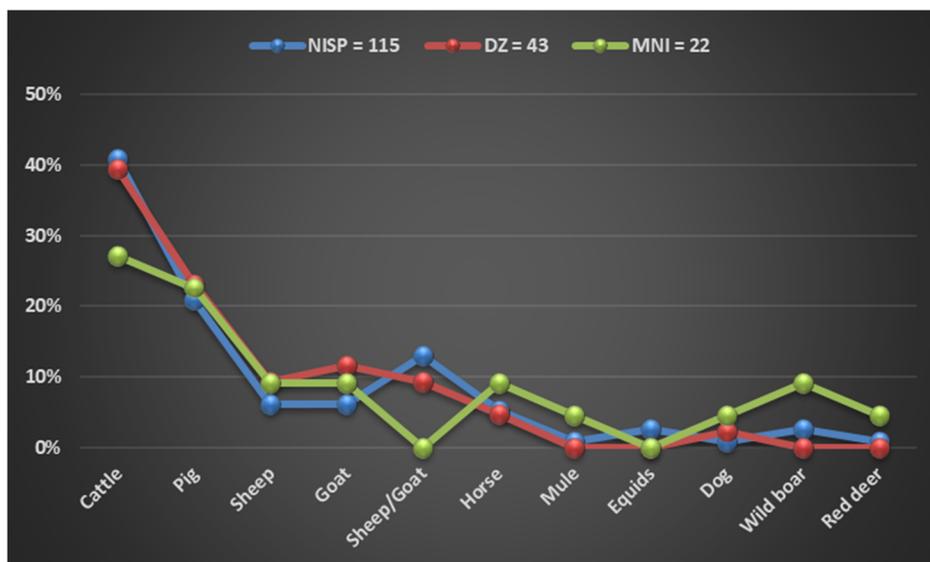


Figure 3. Relative distribution (in %NISP, %DZ, and %MNI) of different animal taxa during the 10th–11th centuries.

The distribution of skeletal elements of cattle, pig, and ovicaprines during the period between the 8th and the 13th century is shown in Table 6 and Fig. 4. Head parts were the most numerous in the case of all mentioned taxa. Namely, about a half (cattle – 44% NISP) or more (pig – 71% NISP; sheep/goat – 63% NISP) remains belonged to this category. Among them, the most numerous were teeth. Remains that belong to the lower part of the limbs were the second most numerous (range between 22% NISP of pig and 34% NISP of cattle). These anatomical regions are characterized by elements that carry a small

amount of meat. Body parts that provide more meat are located in the upper part of the limbs and the axial part of the skeleton. The skeletal elements of these two regions were less represented in the Pančevo – *Livade* faunal sample (range between 3% NISP of sheep/goat and 9% NISP of cattle). A lesser representation of the bones that carry high amounts of meat might indicate that they were discarded in other places, or it could have been the result of the high degree of fragmentation due to human activities such as animal butchery and breaking of the bones to extract the bone marrow.

³³ Mladenović, Mladenović (in press); Blažić 1995; 2000; 2005; Nedeljković 2009; Stanojević 1980; El Susi 1996; Stanc, Bejenaru 2008; Bejenaru *et alii* 2010.

Anatomical region	Element	Cattle	Pig	Ovis/Capra
Head	Cornus	3	/	1
	Cranium	3	/	/
	Praemaxilla	1	/	/
	Maxilla	3	9	/
	Mandibula	10	10	13
	Dentes	42	27	27
	Head total:	62	46	41
Axial	Vertebrae	3	/	/
	Pelvis	4	/	/
	Axial total:	7	/	/
Upper limb parts	Scapula	/	2	/
	Humerus	4	2	/
	Femur	1	/	2
	Upper limbs parts total:	5	4	2
Lower limb parts	Radius	8	1	2
	Ulna	5	1	1
	Radius + Ulna	1	/	/
	Tibia	2	2	4
	Fibula	/	3	/
	Carpalia	2	/	/
	Tarsalia	16	3	8
	Metapodium	11	4	3
	Sesamoideum	2	/	/
	Lower limbs parts total:	47	14	18
Phalanx	Phalanx I-III	19	/	4
TOTAL:		140	64	65

Table 6. Distribution (in NISP) of different skeletal elements of cattle, pig, and ovicaprine, during the 8th–13th centuries.

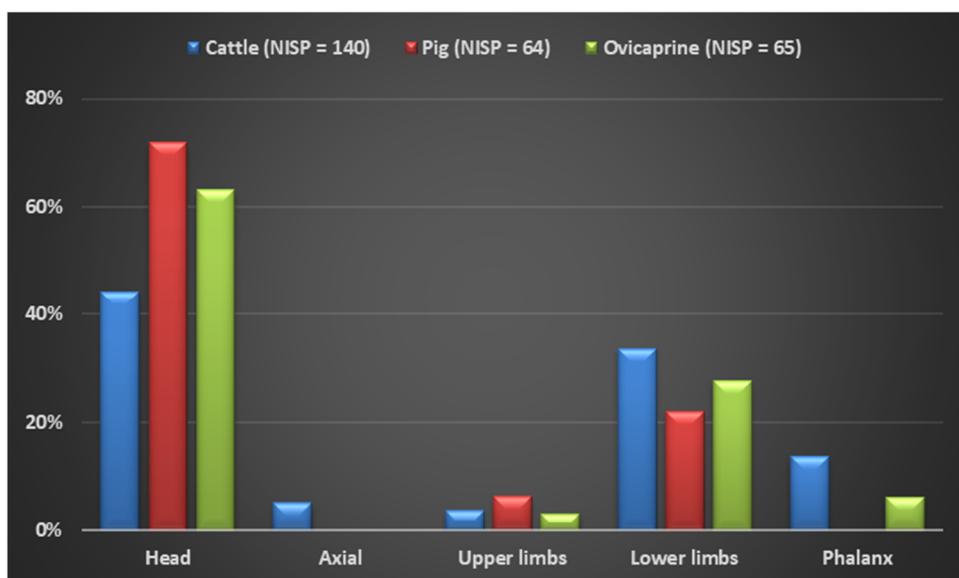


Figure 4. Relative distribution (in %NISP) of different skeletal parts of cattle, pig, and ovicaprine, during the 8th–13th centuries.

Butchering marks present on animal bones are a direct indicator of using meat in the diet, as well as using bones as raw material to produce tools. There were 68 specimens (3.5% NISP) in the Pančevo – *Livade* faunal assemblage with butchering activity traces. Marks were present on the bones of animals usually used in the diet such as cattle, pig, sheep, and goat, but also on the horse bones suggesting that, sometimes, horse meat was also consumed. Traces of butchering were inflicted by metal tools like small and big knives and cleavers/axes during the disarticulation of the carcass (Fig. 5), portioning, and filleting. The presence of small iron knives was confirmed among the archaeological finds from both settlement phases³⁴.

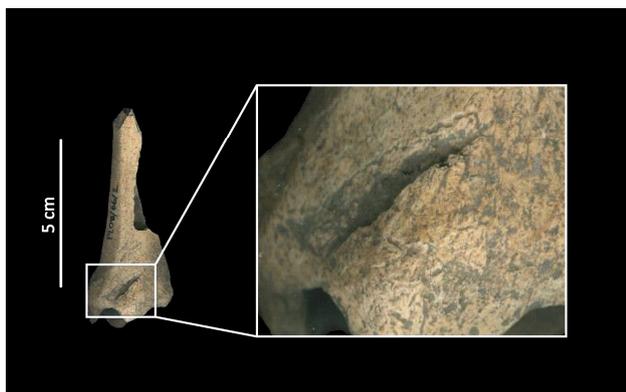


Figure 5. Butchering mark on the distal end of the right tibia of the pig (plantar).

Due to the many factors, such as constant wars and general poverty, a decrease in the size of domestic animals occurred during the Medieval period. Although animal husbandry was of a great significance to the inhabitants of the settlement on the Pančevo – *Livade* site, it was not a well developed activity since it was characterized by indigenous, small animal breeds. Because of the high degree of fragmentation, withers height was calculated only for two pig and two sheep specimens. Pig withers height, based on two astragali, is 65.6 cm and 66.9 cm, while sheep withers height is 55.7 cm (based on an astragalus) and 59.2 cm (based on a calcaneus) (Appendix Table 1). There is more information about pig withers height for the sites Gornea – *Căunița de Sus*, Gornea – *Zomonite*, and Moldova Veche – *Rât*, in the Romanian Banat, where withers height of pig ranges between 61.6 and 77.3 cm³⁵. It could be noticed that pigs in the Serbian and Romanian Banat were similar in size. The withers height of sheep in the Romanian Banat is known for the Ilidia site, and it is 62.3 cm (based on a metacarpus) and 62.4 cm (based on a metatarsus)³⁶. Although the samples are small, it might be assumed that sheep in Romania had higher values of the withers height

during the Medieval period, but this observation should be taken with caution. The values of the withers height of pig and sheep from the sites in the Banat fall within the typical range for the Medieval period in Central and Southeastern Europe³⁷.

The mortality data for cattle, pig, sheep, and goat based on the time of eruption and attrition of the teeth and epiphyseal fusion of long bones as well, are shown in Fig. 6 and 7, and Tables 7 and 8. Animal age of death indicates that cattle were primarily bred for meat since the higher percentage of subadult individuals was present in the Pančevo – *Livade* faunal assemblage. The presence of older animals suggests that secondary products were also used (milk and physical strength), while the remains of young individuals show that the meat of the calves was also used in the diet. Similar observations were made in the case of sheep and goats. Namely, a larger number of subadult individuals suggests that they were mainly kept for meat, while older individuals indicate the exploitation of secondary animal products (milk and wool/hair). The discovery of the spindle whorls³⁸ further testifies to the usage of sheep wool for clothing. Occasionally, the meat of the lambs and kids was used in the diet. Pigs were mainly slaughtered when they reached their optimal growth, when the yield of the meat was the biggest and when the latter was of the highest quality, between the first/second and the third year of age, respectively. The meat of piglets under a year was used in diet as well. This kind of mortality data for cattle, pig, sheep, and goat are usual for the Medieval settlements in the northern part of Serbia³⁹.

The time of the eruption and the attrition of the teeth suggests that horses between 4 and 9 years of age (three specimens) and between 11 and 15 years (six specimens) were present. The data on the epiphyseal fusion of the long and cranial bones indicate that individuals older than 15–18 months (two specimens), older than 3¹/₂ years (two specimens) and younger than 3¹/₂ years (two specimens) were present. In the case of the mule, one individual older than 13–15 months was present. According to the epiphyseal fusion of dog long bones, individuals younger than 8–12 months (three specimens) were present. The presence of adult chicken and goose suggests that these species were mainly kept for egg exploitation, but meat and feathers could be exploited as well.

Sex attribution could be made for one chicken and three pig specimens. Spur on tarsometatarsal bone suggests the presence of rooster, while the morphology of the pig canines indicates the existence of one male and two female individuals in the faunal assemblage from Pančevo – *Livade* site.

³⁴ Đorđević, Đorđević 2018, p. 19–21.

³⁵ El Susi 1996, p. 91–104.

³⁶ El Susi 1996, p. 94.

³⁷ Mladenović, Mladenović (in press); Bökönyi 1974.

³⁸ Đorđević, Đorđević 2018, p. 21.

³⁹ Mladenović, Mladenović (in press).

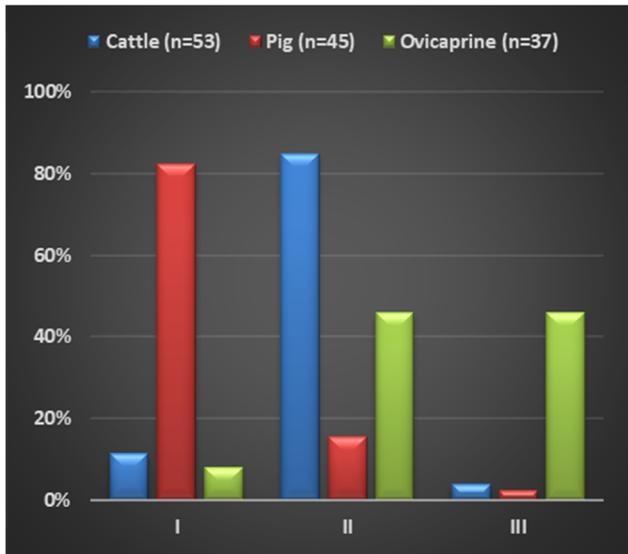


Figure 6. Mortality data of cattle, pig, and ovicaprines based on the time of eruption and attrition of the teeth (I: 3–18 months of age for pig and ovicaprines and 6–24 months of age for cattle; II: 18–30 months of age for pig and ovicaprines and 24–48 months of age for cattle; III: more than 30 months of age for pig and ovicaprines and more than 48 months of age for cattle).

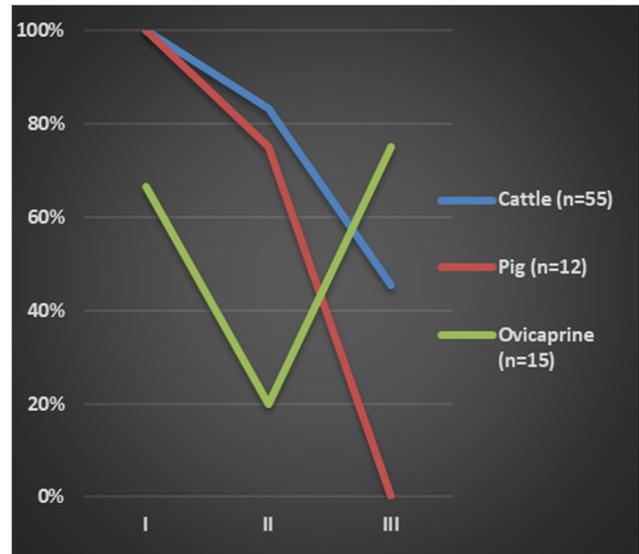


Figure 7. Survivorship curves of cattle, pig, and ovicaprines based on the time of epiphyseal fusion of long bones (I: 12 months of age for pig and ovicaprines and 24 months of age for cattle; II: 36 months of age for pig and ovicaprines and 42 months of age for cattle; III: more than 36 months of age for pig and ovicaprines and more than 42 months of age for cattle).

Species	Age groups	Period			Total:
		8–9th c.	10–11th c.	8–11th c.	
Cattle	I	1	5	1	6
	II	/	13	31	45
	III	/	/	2	2
	Total:	1	18	34	53
Pig	I	4	16	17	37
	II	/	5	2	7
	III	/	/	1	1
	Total:	4	21	20	45
Ovicaprines	I	/	3	/	3
	II	3	7	7	17
	III	3	7	7	17
	Total:	6	17	14	37

Table 7. Mortality data of cattle, pig and ovicaprines based on the time of eruption and attrition of the teeth per settlement phase (I: 3–18 months of age for pig and ovicaprines and 6–24 months of age for cattle; II: 18–30 months of age for pig and ovicaprines and 24–48 months of age for cattle; III: more than 30 months of age for pig and ovicaprines and more than 48 months of age for cattle).

Species	Age groups	8–9th c.		10–11th c.		8–11th c.		Total:
		Fused	Unfused	Fused	Unfused	Fused	Unfused	
Cattle	I	/	/	20	/	18	/	38
	II	/	/	1	1	4	/	6
	III	/	/	1	3	4	3	11
	Total:	/	/	22	4	26	3	55
Pig	I	/	/	1	/	4	/	5
	II	/	/	/	/	3	1	4
	III	/	1	/	1	1	/	3
	Total:	/	1	1	1	8	1	12
Ovicaprines	I	1	1	1	/	2	1	6
	II	/	1	/	1	1	2	5
	III	/	1	1	/	2	/	4
	Total:	1	3	1	1	5	3	15

Table 8. Mortality data for cattle, pig and ovicaprines based on the time of epiphyseal fusion of long bones per settlement phase (I: 12 months of age for pig and ovicaprines and 24 months of age for cattle; II: 36 months of age for pig and ovicaprines and 42 months of age for cattle; III: more than 36 months of age for pig and ovicaprines and more than 42 months of age for cattle).

Only five bones had some pathological changes suggesting that animal health was relatively good. Exostoses were noticed on the cranial border of one horse scapula and plantar side of one mule first phalanx. Since exostoses were not caused by the fracture of the bone, the reason for bone tissue accumulation might be a consequence of using these animals for agricultural work, pulling or carrying loads⁴⁰. Pathological changes such as irregular teeth attrition were noticed on the mandibles of cattle (the 4th permanent premolar (P₄) and the 1st molar (M₁)), and sheep (the 4th permanent premolar (P₄)). Irregular teeth attrition might be a consequence of inflammation, trauma, as well as losing teeth in the upper jaw. On one sheep mandible, teeth loss in the premolar region (P₂–P₄) caused by periodontal disease were noticed (Fig. 8). This kind of disease is one of the main causes for losing teeth during animal life and often appears when localized bacterial infection turns chronic⁴¹.



Figure 8. Periodontal disease in the premolar region on the left mandible of sheep (buccal).

Wild animal remains are rare among the faunal material from the Pančevo – *Livade* site. The red fox was the only wild species represented in the 8th–9th centuries sample (Table 4), suggesting hunting was of less importance to the economy since foxes could have been hunted to remove pests or maybe for fur. During the 10th–11th centuries, the number of hunted wild species increased lightly, as indicated by the presence of the remains of wild boar, red deer, and mallard (Table 5, Fig. 3). Although the distribution of the game was still modest, it appears that hunting gained in significance during the later phase. Aside from the mentioned wild animals, remains of a hare were discovered in the layers dated between the 8th and the 11th century. Despite the small sample size, it might be suggested that older individuals were predominately hunted. Unfortunately, information about the game remains from the other Medieval sites in Serbian Banat are lacking⁴². The higher representation of

wild animals was noticed at the contemporaneous sites in the Romanian Banat though, including remains of game not present at the Pančevo – *Livade* site (aurochs, roe deer, pine marten, badger, and beaver)⁴³.

A lack of fish remains in Pančevo – *Livade* faunal assemblage is surprising since the settlement was located near water. It could be assumed that the fish was part of the diet and the lack of their remains might be a consequence of the hand collecting of the faunal material. Remains of freshwater shell from the *Unio* genus suggest that bivalves might have contributed to the human diet as well (Tables 1 and 5).

It appears that inhabitants of both phases of the Medieval settlement at the Pančevo – *Livade* site exploited everything that (living or dead) animals could provide. The presence of the bone tools, such as awls, suggests the use of animal bones as raw material during the period between the 8th and the 11th centuries⁴⁴. Other than bones, shell valves were also used as tools as indicated by one *Unio* sp. valve with polished edges.

Faunal remains from both phases represent house waste. Material from the first phase was discovered on the floor of the houses and open-air kilns, as well as at the bottom of the ditches, associated with pottery dated to the 8th–9th centuries. Without doubt, these finds belong to the mentioned period, since structures of the later settlement were built above them, and they were not in use during the later phase. The material discovered in the open-air kilns and ditches of the later phase were found in association with pottery fragments dated between the 10th and the beginning of the 11th century. As mentioned before, a high amount of animal bones unearthed in two houses represent waste, discarded in these structures after their desertion. Apart from the archaeozoological material, there was an abundance of pottery fragments in the backfilling layer of these structures, as well as the fragments of the same vessels thrown away in each of these two pits. This fact is important because the discovery of the above-mentioned bronze follis in the 9/08 house indicates that the material from these structures belongs to the period before the interruption of the occupation of this area at the beginning of the 11th century⁴⁵.

According to the historical and archaeological records, the first Medieval rural settlement at the Pančevo – *Livade* site was founded during the Second Avar Khaganate. The archaeozoological data suggest that during this period settlement was not well developed economically which might be explained by insecure times in the Pannonian plain. The foundation of the second rural settlement occurred in the 10th century and its occupation was marked by more peaceful times in southwestern

⁴⁰ Bartosiewicz 2013, p. 105–129.

⁴¹ Bartosiewicz 2013, p. 171–182.

⁴² Blažić 2000.

⁴³ El Susi 1996, p. 91–104; Stanc, Bejenaru 2008.

⁴⁴ Đorđević, Đorđević 2018, p. 19–21.

⁴⁵ Đorđević, Đorđević 2012, p. 79.

Banat. Therefore, the economic development of this settlement was more prosperous as indicated by the archaeozoological data. Even though the faunal samples for both phases were small, it might be assumed that animal husbandry had a significant role in the economy of the inhabitants of both settlements. Although remains of game are rare in both phases, their representation and variety of hunted species during the second phase suggests a somewhat higher contribution to the economy of the settlement. The faunal sample from the 12th–13th centuries was too small for drawing any conclusions.

The results of the archaeozoological analyses of the faunal remains from the sites in the Serbian and the Romanian Banat suggest some similarities and differences in animal exploitation during the Medieval period. Namely, animal husbandry played a significant role in the economy of the inhabitants of the settlements in both parts of the Banat. Cattle were usually the most important species, followed by pig or ovicaprines, according to the site⁴⁶. Since information about the game for the Serbian Banat is missing (except for the Pančevo – Livade site), similarities or differences in a variety of hunted animal species could not be observed. However, it might be noticed that hunting had a significant role in the economy of the settlements located in the Romanian Banat where the representation of game remains is relatively high (about 12–39% NISP)⁴⁷. Remains of molluscs and birds were present in both parts of the Banat, while remains of fish were discovered in the Romanian Banat only⁴⁸.

CONCLUSION

Faunal material from the Pančevo – Livade site is mostly represented by kitchen waste with a high degree of fragmentation. Although the sample is small, it could be concluded that during the Medieval period the economy of both phases of the Medieval settlement was based on animal husbandry. Aside from the most important species economically (cattle, pig, sheep, and goat), remains of a dog, equids (horse, mule, and donkey) and domestic fowl (chicken and goose) were also present. Ruminants and pigs were mainly bred for meat production given the prevalence of subadult individuals. The presence of adult individuals suggests that secondary products of cattle, sheep, and goat were also exploited, but in smaller quantities. The presence of few game remains suggests that wild animals played an insignificant role in the economy and diet of the inhabitants of both phases of the Medieval settlement.

The results of the archaeozoological analysis of the faunal material from the territory of southwestern Banat are very limited. The need for this type of research is high,

as well as for a wider consideration of economic strategies of the settlements based on information provided by, often neglected, bioarchaeological material. Therefore, the results of the analysis of the faunal remains from the Pančevo – Livade site are important for understanding the animal use strategies of the inhabitants of this settlement in particular but also provide an insight on the animal exploitation strategies of the populations settled on the territory of the southwestern Banat during the Medieval period.

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⁴⁶ El Susi 1996, p. 91–104.

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⁴⁸ El Susi 1996, p. 91–104.

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Appendix Table 1
Bone measurements according to the standardized system of A. von den Driesch (in mm; measurements name abbreviations are given in Driesch (1976);
WH – withers height)

Bos taurus

Period	Element	Inv. No.	32	33	34	36	45	46
10 th –11 th centuries	Cranium	PL/08/64/1	195.1	212.8	138.3	73.4		
	Cornus	PL/10/5/2				43.5	39.7	

Period	Element	Inv. No.	LD4	BD4	LP4	BP4	LM1	BM1	LM2	BM2	LM3	BM3	LP	LM	LPM
10 th –11 th centuries	Maxilla	PL/08/36/3	21.5	19.3											
		PL/08/73/6					23.6	19.9	25.1	18.1	26.1	15.3		76.6	
		PL/08/42/2			12.4	17.2	18.4	20.6	20.1	20.7					
8 th –11 th centuries		PL/11/45/1				20.8	16.5	22.5	18.7	30.2	17.8		73.8		
10 th –11 th centuries	Mandibula	PL/08/43/6			16.1	12.1	20.6	12.6					43.2		
		PL/10/53/4					22.8	15.1	26.2	16.1	40.1	18.1		98.4	
		PL/10/56/9			17.1	11.6	18.6	14.1	22.5	14.1	34.4	13.5	45.6	81.1	126.8
8 th –11 th centuries		PL/11/6/1			15.9	9.9	18.6	12.6	21.8	31.5	14.7		73.3		

Period	Element	Inv. No.	1	2	3	4	5	6	11	12	13	14	15a	15b	15c
8 th –11 th centuries	Mandibula	PL/10/56/9	322.3	356.2	95.2	231.5	231.2	270.5	76.2	124.4	150.6	192.4	66.8	45.2	33.2
		PL/10/53/4											64.2	52.2	

Period	Element	Inv. No.	PL	GLPa	BPacr	BPtr	BFcr	HFcr
8 th –11 th centuries	Cervical	PL/11/6/3	44.1					
		PL/11/28/7		88.5	63.8			
	Thoracic	PL/10/56/8			87.4	30.1	37.1	

Period	Element	Inv. No.	GLPe	GL	Bp	Dp	SD	Bd	Dd	
10 th –11 th centuries	Metacarpus	PL/08/43/1			48.1	28.9				
		PL/10/52/1			51.9	32.8				
		PL/10/60/1			55.1	26.7				
8 th –11 th centuries		PL/08/14/1	56.1		28.4	31.5	24.1	27.2	21.3	
		PL/08/66/1	50.2		25.4	28.9	23.2	27.3	21.2	
		PL/10/42/1	52.8							
		PL/10/46/1	50.2		24.2	25.5	20.6			
		PL/11/21/1	51.4			25.7	20.1	23.9	16.3	
		PL/11/54/2						27.1	20.3	
10 th –11 th centuries	Phalanx I	PL/08/73/2	65.2				23.3	27.3	20.9	
		PL/08/73/3			27.7	32.2	22.8			
		PL/08/81/3	51.9		25.1	29.1	21.2	23.7	16.3	
		PL/08/38/2	48.7					22.9	19.2	
		PL/08/39/2	49.6					22.8	24.8	20.1
		PL/08/43/3	47.9			24.5	28	21.1	25.4	17.5
		PL/08/60/1		35.5	25.1	26.7	20.5	21.8	26.3	
	Phalanx II	PL/08/75/1		38.6	26.6	30.3	21.6	23.5		

Ovis aries

Period	Element	Inv. No.	43	LP4	BP4	LM1	BM1	LM2	BM2	LM3	BM3	LP	LM
10 th –11 th centuries	Cornus	PL/08/73/4	64.1										
		PL/08/43/5		7.2	4.9	7.8	6.9	10.7	7.7	21.4	7.3		43.4
		PL/11/75/1				17.3	7.9						32.7
8 th –11 th centuries	Mandibula	PL/08/42/4		9.6	6.2							22.9	
		PL/08/47/2		8.7	6.6	10.1	7.4						
		PL/10/42/4				10.9	7.1						

Period	Element	Inv. No.	Bp	Dp	SD	Bd	Dd	GLI	GLm	DI	Dm	GL	AP	ML	H	GL	DLS	MBS	WH (in cm)
8 th –11 th centuries	Tibia	PL/10/8/3			14.2	27.1	22.1												
	Astragalus	PL/08/46/3				16.9		26.6	25.2	15.8	15.3	54.9	25.2	18.5					55.7
10 th –11 th centuries	Calcaneus	PL/08/78/1												14.7					59.2
	Centrotarsals	PL/11/61/1											20.8	21.9					
8 th –11 th centuries	Phalanx II	PL/10/42/6											20.8	23.7	13.1				
	Phalanx III	PL/10/45/2	13.1	13.2	11.2	12.6	9.3								26.3				
8 th –9 th centuries	Phalanx III	PL/08/80/2														22.1		4.1	

Capra hircus

Period	Element	Inv. No.	3	5	6	12	13	14	15a	15b	15c	LD4	BD4	LP4	BP4	LM1	BM1	LM2	BM2	LM3	BM3	LP	LM	LPM
8 th –11 th centuries	Mandibula	PL/08/70/2	51.6	115	132.4	65.8	69.9	87.3	34.3	21.9	16.9			6.4	5.7	8.7	6.5	12.9	8.2	22.8	8.7	18.6	45.7	64.8
		PL/08/73/9											12.7	6.4			12.4	7.9	16.1	8.1				

Period	Element	Inv. No.	GLPe	Bp	Dp	SD	Bd	Dd	Bfd	GLm	DI	Dm	AP	ML
10 th –11 th centuries	Radius	PL/08/43/2					27.5	19.6	23.7					
	Astragalus	PL/08/81/2				13.4				27.2	16.1	16.7		
8 th –11 th centuries	Calcaneus	PL/10/53/2											22.3	16.7
	Metatarsus	PL/08/76/1		21.5	19.7									
8 th –11 th centuries	Phalanx I	PL/10/6/3	33.7	10.8	13.4	9.2	10.1	8.9						

Ovis/ Capra

Period	Element	Inv. No.	LP4	BP4	LP	BPC	AP	ML	H	Bp	Dp	SD	Bd	Dd
10 th –11 th centuries	Mandibula	PL/08/73/10	8.5	7.6	24.2									
	Ulna	PL/08/41/5				16.9							24.4	17.1
	Tibia	PL/08/41/4												
8 th –11 th centuries	Tarsale 4+5	PL/08/27/1				21.6	16.1	27.1						
8 th –9 th centuries	Metatarsus	PL/08/45/1								21.7				
	Phalanx II	PL/11/6/5							10.9	11.5	9.9	9.7	7.5	

Equus caballus

Period	Element	Inv. No.	34	36	37	GL	BFCr	HFcr	BFcd	GLF	LAPa	SBV	GLPa	BPacr	PL
10 th –11 th centuries	Cranium	PL/08/41/1	83.8	34.7	43.2										
8 th –11 th centuries	Atlas	PL/10/58/2				87.4	88.6		78.8	81.2					
10 th –11 th centuries	Axis	PL/10/9/2					76.6		45.6		95.2	42.8			
8 th –11 th centuries	Cervical	PL/08/17/4					34.8	39.3					99.8	80.6	
10 th –11 th centuries	Lumbal	PL/10/9/3					40.8	37.4							34.7

Period	Element	Inv. No.	SLC	GLP	LG	BG	Bd	Dd	BFd	BT	LA	LAR	LS	SB	LFO
8 th –11 th centuries	Scapula	PL/11/30/1	60.2	89.1	53.9	48.1									
	Humerus	PL/08/22/1				83.7									
		PL/10/56/1				84.4		76.6							
8 th –9 th centuries	Radius	PL/11/51/1				69.5	46.3	61.3							
10 th –11 th centuries	Pelvis	PL/10/9/1									74.4	65.1	125.6	25.3	61.3

Period	Element	Inv. No.	Bp	BFp	SD	Bd	Dd	BFd	GH	GB	LmT	GL
10 th –11 th centuries	Astragalus	PL/11/28/4						59.1	62.1	67.1	62.9	
		PL/11/71/1						52.6	59.6	53.6	61.2	
8 th –11 th centuries	Phalanx II	PL/08/20/1	50.4	30.4	40.6	44.8	27.9					48.6

Equus caballus x *Equus asinus*

Period	Element	Inv. No.	Bp	BFp	Dp	SD	Bd	Dd	BFd	GL
10 th –11 th centuries	Phalanx I	PL/08/73/1	51.6	48.4	36.2	33.8	44.7	43	42.3	85.7

Equus sp.

Period	Element	Inv. No.	BFCr	HFcr	GLPa	BPacr	Dp	SD	Bd	Dd	BFd	Dd	Bd	BFd	GL	
8 th –11 th centuries	Cervical	PL/11/29/1	30.2	37.1	88.7	86.1										
		PL/08/4/1					49.4		74.2	46.7	63.5					
8 th –9 th centuries	Radius	PL/11/48/2														
10 th –11 th centuries	Ulna	PL/11/73/1														
	Tibia	PL/08/23/2						25.1								
8 th –11 th centuries	Tarsale 3	PL/10/1/3													47.8	
	Phalanx III	PL/10/5/1											78.8	62.8	25.4	64.8

Canis familiaris

Period	Element	Inv. No.	GL	GB	BFcr	HFcr	BFcd	GLF	LAd	GLPa	BPacr	PL	H	SD	Dp	Bd	Dd
8 th –11 th centuries	Atlas	PL/10/56/3	37.3	72.9	38.9		29.9	31.5	15.9				25.5				
	Cervical	PL/10/33/2			15.4	11.4				25.5	31.2	14.5					
	Humerus	PL/10/33/6												11.7			
	Metacarpus IV	PL/10/33/7													11.5		
	Metatarsus III	PL/10/33/8														8.4	11.2

Vulpes Vulpes

Period	Element	Inv. No.	Bp	Dp
8 th –9 th centuries	Humerus	PL/10/59/2	17.2	22.3

Lepus europaeus

Period	Element	Inv. No.	Bp	Dp	SD
8 th –11 th centuries	Radius	PL/11/18/2	9.9	6.5	
	Metatarsus III	PL/08/2/1	5.6	9.5	4.1

Gallus domesticus

Period	Element	Inv. No.	Dic	Bd	Dd	SC
10 th –11 th centuries	Scapula	PL/08/36/2	11.6			
	Femur	PL/08/81/6		13.5	13.1	
	Tarsometatarsus	PL/08/36/1				6.1

Anser domesticus

Period	Element	Inv. No.	DIA
10 th –11 th centuries	Pelvis	PL/08/81/5	12.1

Anas platyrhynchos

Period	Element	Inv. No.	Dic	Bp	Dp	SD	Bd	GL	BF	Bb	Lm
10 th –11 th centuries	Coracoides	PL/08/39/3						47.7	18.5	20.1	45.5
		PL/08/39/4						48.2	18.1		44.7
	Scapula	PL/08/39/5	11.1								
	Humerus	PL/08/39/6		19.8		7.1	13.4	88.9			
	Ulna	PL/08/39/7		20.9		6.3	14.1	90.6			
	Radius	PL/08/39/8		8.4	8.8	5.2					
	Carpometacarpus	PL/08/39/9				3.1	6.8	72.5			
		PL/08/39/10		12.7		9.1	55.2				

ABREVIERI / ABRÉVIATIONS / ABBREVIATIONS

- AAC – Acta Archaeologica Carpatica, Kraków
ACMI – Anuarul Comisiunii Monumentelor Istorice, București
ACSS – Ancient Civilisations from Scythia to Siberia, Leiden
ActaArch – Acta Archaeologica. København
ActaArchHung – Acta Archaeologica Academiae Scientiarum Hungaricae, Budapest
AJA – American Journal of Archaeology, Boston
Alba Regia – Alba Regia. Annales Musei Stephani regis, Székesfehérvár
Altertum – Das Altertum, Deutsche Akademie der Wissenschaften zu Berlin Sektion für Altertumswissenschaft Akademie der Wissenschaften der DDR Zentralinstitut für Alte Geschichte und Archäologie, Berlin
Aluta – Aluta. Revista Muzeului Național Secuiesc Sfântu Gheorghe
AM – Mitteilungen des Deutschen Archäologischen Instituts, Athenische Abteilung, Berlin
AMI(T) – Archäologische Mitteilungen aus Iran (und Turan)
ANRW – *Aufstieg und Niedergang der römischen Welt. Geschichte und Kultur Roms im Spiegel der neueren Forschung*, Berlin – New York, 1972–1998
Antaeus – Antaeus. Communicationes ex Instituto Archaeologico Academiae Scientiarum Hungaricae, Budapest
Antiquity – Antiquity. A Review of World Archaeology, Durham, UK
Anuarul MJIAP – Anuarul Muzeului Județean de Istorie și Arheologie Prahova, Ploiești
AnUCraiova – Analele Universității din Craiova
AnUVT – Annales d'Université "Valahia" Târgoviște, Section d'Archéologie et d'Histoire
Apulum – Acta Musei Apulensis. Muzeul Național al Unirii, Alba Iulia
ARA – Annuaire Roumain d'Anthropologie
ArchBulg – Archaeologia Bulgarica, Sofia
ArchÉrt – Archaeologiai Értesítő. A Magyar Régészeti és Művészettörténeti Társulat tudományos folyóirata, Budapest
ArchHist – Archeologia Historica, Brno
ArchKorr – Archäologisches Korrespondenzblatt, Mainz
ArchRozhledy – Archeologické Rozhledy, Praha
Area – Area, Royal Geographical Society, London
ArheologijaSofia – Arheologija. Organ na Archeologičeskija Institut i Muzej, Sofia
ArhMold – Archeologia Moldovei, Iași
ArhVestLjubljana – Arheološki vestnik. Inštitut za arheologijo ZRC SAZU, Ljubljana
ASC – Archeologica Slovaca Catalogi, Bratislava
AVANS – Archeologické Vyskumy a Nálezy na Slovensku, Nitra
BARIntSer – British Archaeological Reports. International Series, Oxford
BARSupSer – British Archaeological Reports. Supplementum Series, Oxford
BASOR – Bulletin of the American Schools of Oriental Research, University of Chicago
BCH – Bulletin de Correspondance Hellénique, Athènes-Paris
BiblIstrPont-SA - Biblioteca Istro-Pontică. Seria Arheologie. Institutul de Cercetări Eco-Muzeale „Gavrilă Simion”, Tulcea
BiblMemAnt – Bibliotheca Memoriae Antiquitatis, Piatra-Neamț
BiblMusNap – Bibliotheca Musei Napocensis, Cluj-Napoca
BiblMuzNaț-SCP – Biblioteca Muzeului Național – Seria Cercetări Pluridisciplinare, București
BiblThrac – Bibliotheca Thracologica, București
BiEtud IFAO – Bibliothèque d'étude, Institut français d'archéologie orientale, Le Caire
BMJT – Buletinul Muzeului Județean Teleorman, Alexandria
Bonner Jahrbücher – Bonner Jahrbücher des Rheinischen Landesmuseums in Bonn, Bonn
BSA – British School at Athens, Athens
BSNR – Buletinul Societății Numismatice Române, București
CA – Cercetări arheologice, București
Caiete ARA – Caietele ARA, Revistă de Arhitectură, Restaurare și Arheologie, Asociația ARA, București
CAPH – Cemeteries of the Avar Period (567–829) in Hungary, Budapest
Carpica – Carpica. Complexul Muzeal „Iulian Antonescu” Bacău, Bacău

- CCA – Cronica Cercetărilor Arheologice din România, București
- CCDJ – Cultură și Civilizație la Dunărea de Jos, Călărași
- CIAnt – Classical Antiquity, University of California, Berkeley
- Collegium Antropologicum – Collegium Antropologicum. Journal of the Croatian Anthropological Society
- Crisia – Crisia. Muzeului Țării Crișurilor, Oradea
- Dacia – Dacia (Nouvelle Série). Revue d'archéologie et d'histoire ancienne. Académie Roumaine. Institut d'archéologie « V. Pârvan », Bucarest
- DMÉ – A Debreceni Déri Múzeum Évkönyve, Debrecen
- Documenta Praehistorica – Documenta Praehistorica, University of Ljubljana, Faculty of Arts, Department of Archaeology, Ljubljana
- Drobeta – Drobeta. Muzeul Regiunii Porțile de Fier, Drobeta-Turnu Severin
- EphemNap – Ephemeris Napocensis. Academia Română, Institutul de Arheologie și Istoria Artei, Cluj-Napoca
- ERAUL – Études et Recherches archéologiques de l'Université de Liège
- eTopoi – Journal for Ancient Studies, Berlin
- EurAnt – Eurasia Antiqua. Deutsche Archäologisches Institut, Berlin
- Expedition – Expedition. The Magazine of Archaeology, Anthropology
- FAH – Fontes archaeologici Hungariae, Budapest
- FolArch – Folia Archaeologica. A Magyar Nemzeti Múzeum Évkönyve. Annales Musei Nationalis Hungarici, Budapest
- Gallia – Gallia. Archéologie de la France antique
- Germania – Germania. Anzeiger der Römisch-Germanischen Kommission des Deutschen Archäologischen Instituts, Frankfurt
- Gladius – Gladius. Estudios sobre armas antiguas, armamento, arte militar y vida cultural en Oriente y Occidente, España
- GNMP – Glasnik Narodnog muzeja Pančevo, Pančevo
- GSAD – Glasnik Srpskog arheološkog društva, Beograd
- Gymnasium – Gymnasium. Zeitschrift für Kultur der Antike und humanistische Bildung
- Habis – Habis. Arqueología, filología clásica, Universidad de Sevilla
- Hesperia – Hesperia. Journal of the American School of Classical Studies at Athens, Cambridge
- Historia – Historia. Zeitschrift für Alte Geschichte, Franz Steiner Verlag, Stuttgart
- Histria archaeologica – Histria archaeologica. Časopis Arheološkog muzeja Istre, Pula, Croatia
- HMÉ – A Hajdúsági Múzeum Évkönyve, Hajdúböszörmény
- IAA Reports – Israel Antiquities Authority Publications, Israel
- Ialomița – Ialomița. Studii de cercetări de arheologie, istorie, etnografie și muzeologie, Slobozia
- IARPotHP – International Association for Research on Pottery of the Hellenistic Period e. V.
- IJA – International Journal of Archaeology
- IJO – International Journal of Osteoarchaeology, Journal online
- Iran – Journal of the British Institute of Persian Studies
- Istros – Istros, Muzeul Brăilei, Brăila
- IzvestijaSofia – Izvestija na Nacionalnija Arheologičeski Institut, Sofia
- JAMÉ – A nyíregyházi Jósa András Múzeum Évkönyve, Nyíregyháza
- JAS – Journal of Archaeological Science
- JDAI – Jahrbuch des Deutschen Archäologischen Instituts, Deutsches Archäologisches Institut, Berlin
- JEMAHS – Journal of Eastern Mediterranean Archaeology and Heritage Studies, Pennsylvania State University
- JFA – Journal of Field Archaeology
- JHRE – Journal of Housing and Rural Environment, Iran
- JNES – Journal of Near Eastern Studies
- JPMÉ – A Janus Pannonius Múzeum Évkönyve, Pécs
- JRGZM – Jahrbuch des Römisch-Germanischen Zentralmuseums Mainz, Mainz
- Klio – Klio. Beiträge zur Alten Geschichte, Berlin
- Kühn-Archiv – Kuhn-Archiv. Arbeiten aus dem Landwirtschaftlichen Institut der Universität Halle
- MAIASK – Materialy po arheologii i istorii antichnogo i srednevekovogo Kryma, Moskva – Tyumen – Nizhnevartovsk
- MAInstUngAK – Mitteilungen des Archäologischen Instituts der Ungarischen Akademie der Wissenschaften, Budapest
- MAN – MAN. Journal of the Royal Anthropological Institut, London
- Marisia – Marisia. Studii și materiale. Arheologie – Istorie – Etnografie. Târgu Mureș
- MCA – Materiale și Cercetări Arheologice, București
- MEFRA – Mélanges de l'École française de Rome. Antiquité, Roma

- MFMÉ-SA – A Móra Ferenc Múzeum Évkönyve – *Studia Archaeologica*, Szeged
- MHÁS – Magyarország honfoglalás kori és kora Árpád-kori sírleletei, Miskolc–Budapest–Szeged–Szombathely
- Minerva – *Minerva. Revista de filología clásica*, Universidad de Valladolid
- Monographie du CRA – *Monographie du Centre de Recherches archéologiques*, Valbonne
- MÓTK – Magyar Őstörténeti Témacsoport Kiadványok. Magyar Tudományos Akadémia Bölcsészettudományi Kutatóközpont, Budapest
- Mousaios – *Mousaios. Buletinul Științific al Muzeului Județean Buzău*
- MR – *Magyar Régészet. Online Magazin (Archaeolingua)*
- NM – *Natura Montenegrina*, Podgorica
- Oltenia – *Oltenia. Studii și Comunicări*, Craiova
- Padusa – *Padusa. Bolletino del Centro polesano di studi storici, archeologici et etnografici*, Rovigo
- PamArch – *Památky Archeologické*, Praha
- Peuce – *Peuce, Studii și cercetări de istorie și arheologie*, Institutul de Cercetări Eco-Muzeale, Tulcea
- Phoenix – *Phoenix. The Journal of the Classical Association of Canada*
- Pontica – *Pontica. Studii și materiale de istorie, arheologie și muzeografie*, Muzeul de Istorie Națională și Arheologie Constanța
- PZ – *Prähistorische Zeitschrift*, Berlin-Mainz
- Quaternary International – *Quaternary International. The Journal of the International Union for Quaternary Research*
- RA – *Revue Archéologique*, Paris
- Radiocarbon – *An International Journal of Cosmogenic Isotope Research*, Cambridge
- RÉL – *Revue des études latines*
- RMM.MIA – *Revista Muzeelor și Monumentelor, seria Monumente Istorice și de Artă*, București
- RMV – *Rad muzeja Vojvodine*, Novi Sad
- RT – *Régészeti Tanulmányok. A Közép-Duna-medence honfoglalás- és kora Árpád-kori sírleletei*, Budapest
- RVM – *Rad vojvođanskih muzeja*, Novi Sad
- SAM – *Studia Archaeologica et Mediaevalia*, Bratislava
- Sargetia – *Sargetia. Acta Musei Devensis, Buletinul Muzeului județean Hunedoara*, Deva
- SAP – *Studia ad Archaeologiam Pazmaniensia. A PPKE BTK Régészeti Tanszékének kiadványai*, Budapest
- SCA – *Studii și Cercetări de Antropologie*, București
- SCIV(A) – *Studii și Cercetări de Istorie Veche (și Arheologie)*, București
- SCN – *Studii și Cercetări de Numismatică*, București
- SlovArch – *Slovenská Archeológia*, Nitra
- SP – *Studii de Preistorie*, București
- Starinar – *Starinar. Arheološki institut Beograd*
- StCl – *Studii Clasice*, București
- Studia Hercynia* – *Studia Hercynia*, Univerzita Karlova
- Studia praehistorica* – *Studia praehistorica*, National Institute of Archaeology with Museum, Sofia
- Študijné zvesti – *Študijné zvesti. Archeologického ústavu Slovenskej akadémie vied*, Nitra
- Syria – *Syria. Revue d'art oriental et d'archéologie*
- Th-D – *Thraco-Dacica*, București
- Tisicum – *A Jász – Nagykun – Szolnok Megyei Múzeumok Évkönyve*, Szolnok
- TNYSc – *Transactions of the New York Academy of Sciences*, New York
- Transilvania – *Transilvania. Centrul Cultural Interetnic Transilvania*, Sibiu
- TRW – *Transformation of the Roman World*, Leiden
- TYCHE – *TYCHE. Beiträge zur Alten Geschichte, Papyrologie und Epigraphik*
- Tyrageia – *Tyrageia. Anuarul Muzeului Național de Istorie a Moldovei*, Chișinău
- VAH – *Varia Archaeologica Hungarica V. Redigit Csanád Bálint. Publicationes Instituti Archaeologici Academiae Scientiarum Hungaricae*, Budapest
- Valachica – *Valachica. Studii și cercetări de istorie și istoria culturii*, Complexul Muzeal Național Curtea Domnească Târgoviște
- VAMZ – *Vjesnik Arheološkog muzeja u Zagrebu*, Zagreb
- ŽA – *Živa Antika / Antiquité Vivante. Društvo za antički studii na SRM, Seminar na klasična filologija, Filozofski fakultet*, Skopje
- ZAM – *Zeitschrift für Archäologie des Mittelalters*, Bonn
- ZfA – *Zeitschrift für Archäologie*, Berlin
- Ziridava – *Ziridava. Studia Archaeologica. Complexul Muzeal Arad*

ZMS – Zbornik muzeja Srema, Sremska Mitrovica

ZNM Beograd – Zbornik Narodnog Muzeja, Beograd