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# RECONSTRUCTING ANCIENT HUMAN DIET BY VALUING ANIMAL REMAINS: ARCHAEOZOOLOGICAL DATA CONCERNING THE MULTICULTURAL SITE OF VEȚEL-LUNCĂ (HUNEDOARA COUNTY, ROMANIA)

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**Abstract.** Vețel-Luncă is a multicultural site discovered during excavations carried out in 2007–2012, on the territory of Vețel village, in Hunedoara County, Romania. The animal remains discovered in the archaeological site belong to the Chalcolithic, Bronze Age, Iron Age and Post Roman times. Archaeozoological material is described mainly in terms of frequencies, selection by age and sex, and size of animals. Animal husbandry played an important role in the settlement's economy, domestic mammals varying as frequency from 74% in the Post Roman period to 88% in Iron Age. Hunting was also a significant activity, as it is shown in the Late Bronze Age sample, where the wild mammal remains have a frequency of 17%, and in the Post Roman level with about 26% of the total identified mammals.

**Keywords:** *animal remains, Chalcolithic, Bronze Age, Iron Age, Post Roman*

## 1. INTRODUCTION

The archaeological multicultural site of Vețel-Luncă was discovered during excavations carried out in 2007–2012, on the territory of Vețel village, from the eponymous commune, in Hunedoara County, Western Romania (Fig. 1). The site comprises several cultural levels with materials belonging to Chalcolithic, Bronze Age, Iron Age, and Postroman times. The site is located on a southern terrace of Mureș river, about 500 m west of the Roman camp of Micia, being delimited in prehistory by three watercourses: in the north Mureș river, in the east Herepeia brook, and in the west Vețel brook. The course of the Herepeia brook was diverted close to the Mureș stream, currently cutting the northeast corner of the site. The Vețel brook course was diverted in the 19th century, now flowing into the Mureș at about 250 m further west. The two streams formed higher terraces towards the site, and in the opposite parts – lower areas, probably swampy. The ancient settlements extended precisely on these high terraces, the site taking the shape of the letter “U”; the surface of this archaeological site is of almost 10 acres<sup>1</sup>.

<sup>1</sup> BARBU/BARBU 2012, 27.

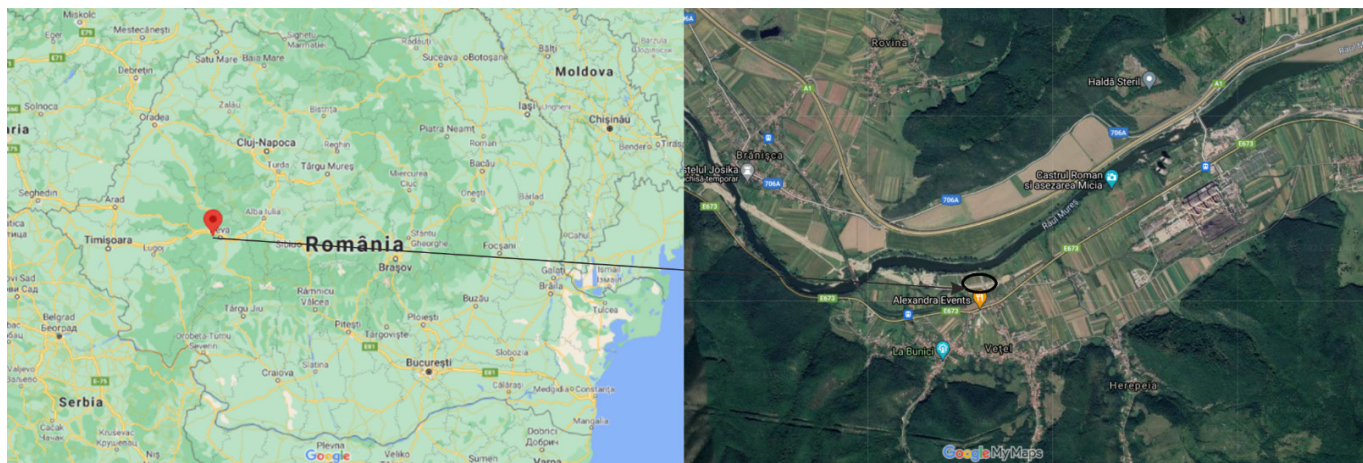


Fig. 1. Location of Vețel-Luncă site. Source: Google Maps.

## 2. MATERIAL AND METHODS

The material analysed in this paper is represented by faunal remains recovered from archaeological contexts of Chalcolithic (Tiszapolgár culture), Late Bronze Age (phase I = LBA I, and II= LBA II), Iron Age, and Post Roman, during the excavations carried out in the years 2018–2020.

The used methods consisted in anatomical and taxonomical identifications, quantification by NISP (number of identified specimens) and MNI (minimum number of individuals), estimations of age at death and sex, osteometry, and statistical analysis (i.e., taxa frequency, Shannon-Weaver diversity index, and correspondence analysis). It was possible, also, to calculate the withers height for some species using the coefficients as following: Fock coefficients for cattle, Harcourt coefficients for dog, and Teichert coefficients for wild boar.

Age at death was estimated based on the degree of epiphyseal fusion<sup>2</sup>, tooth eruption sequences<sup>3</sup>, and tooth wear<sup>4</sup>. The limit between immature and mature for the main domestic mammals is set to 2.5 years for cattle, 1.5 years for sheep/goat and 13 months for pig<sup>5</sup>. Estimation of sex was based on the size and morphometrical differences at metapodium, horn core or canine tooth<sup>6</sup>.

In the paleoecological evaluation, the following groups of animals (ecological groups) were considered: forest species (red deer, wild boar), skirt species (roe deer), steppe species (hare), euritope species (wolf), and aquatic species (freshwater mussel, fish).

To evaluate features of animal exploitation, the Shannon-Weaver diversity index was used, which is also referring to richness (i.e., number of taxa in a given sample), and evenness/equitability (i.e., uniformity of the taxa distribution in the sample)<sup>7</sup>.

Based on taxa frequency, the correspondence analysis was performed using XLSTAT Version 2021.1 software. This method of statistical analysis was used to determine the associations of taxa within the studied periods.

<sup>2</sup> BARONE 1976.

<sup>3</sup> SCHMID 1972.

<sup>4</sup> GRANT 1982.

<sup>5</sup> UDRESCU/BEJENARU/HRISCU 1999.

<sup>6</sup> REITZ/WING 2008.

<sup>7</sup> VANDERWARKER 2010.

## 3. RESULTS

### Chalcolithic (Tiszapolgár culture)

The Chalcolithic sample of Tiszapolgár culture comes from a single archaeological complex (C391), and it comprises only four isolated molars of cattle (*Bos taurus*), for which it was estimated a minimum number of three individuals.

### Late Bronze Age, phase I (LBA I)

The LBA I sample contains 1671 faunal remains coming from mammals in a proportion of approx. 54%, mollusks about 46%, birds 0.3%, and fish 0.12%. The identified mollusks are attributed to the *Unio* genus.

Domestic mammals show the high frequency with approx. 65% NISP of the identified mammals, followed by the unidentifiable mammals with approx. 25%, and the wild mammals with approx. 10%.

Animal husbandry was a very important activity to assure animal protein in human diet, domestic mammals summing 581 skeletal remains and representing approx. 87% NISP of the identified mammals. The identified domestic species are *Bos taurus* (cattle), *Ovis aries* (sheep), *Capra hircus* (goat), *Sus domesticus* (pig), *Equus caballus* (horse), *Equus asinus* (donkey), and *Canis familiaris* (dog). The most numerous remains belong to cattle (45.29%), followed by sheep/goat (21.82%) and pig (15.25%). Less significant among domestic mammals are the horse (2.69%), dog (1.64%), and donkey (0.15%). For the dog, there were identified 9 skeletal fragments plus 6 remains coming from two distinct individuals (noted as 2 specimens in the quantification table: respectively, an axis vertebra and a mandible from one individual discovered in feature C319; a skull, a radius, an ulna, and a humerus from the other individual discovered in feature C245) (Table 1).

As MNI (Table 1), for pig there was estimated a minimum number of 10 individuals, representing approx. 24%. Cattle and sheep/goat follow, each with minimum 7 individuals estimated (approx. 17%). With a total of 4 estimated individuals, dog occupies the third place followed by horse and donkey with a minimum of one individual estimated for each (Table 1).

Hunting seems to have had less importance for the LBA I community, the wild species representing 13% NISP of

**Table 1.** Quantification of mammal remains from the LBA I sample (NISP=number of identified specimens, MNI=minimum number of individuals).

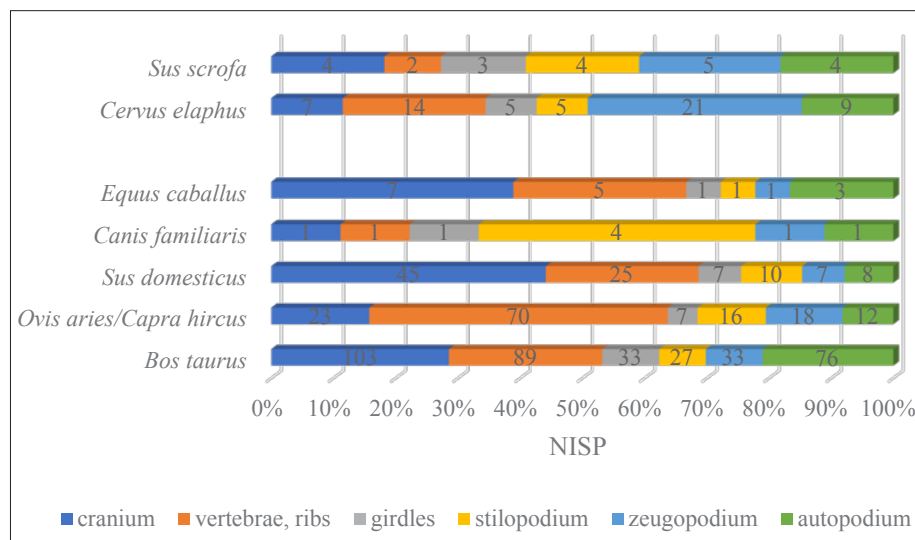
Species		NISP	NISP%	MNI	MNI%
<i>Bos taurus</i>	Cattle	303	45.29	7	17.07
<i>Ovis aries/Capra hircus</i>	Sheep/Goat	146	21.82	7	17.07
<i>Sus domesticus</i>	Pig	102	15.25	10	24.39
<i>Equus caballus</i>	Horse	18	2.69	1	2.44
<i>Equus asinus</i>	Donkey	1	0.15	1	2.44
<i>Canis familiaris</i>	Dog	11 (9+2*)	1.64	4 (2+2*)	9.76
<b>Domestic mammals</b>		<b>581</b>	<b>86.85</b>	<b>30</b>	<b>73.17</b>
<i>Cervus elaphus</i>	Red deer	61	9.12	6	14.63
<i>Sus scrofa</i>	Wild boar	22	3.29	2	4.88
<i>Capreolus capreolus</i>	Roe deer	2	0.30	1	2.44
<i>Lepus europaeus</i>	Hare	2	0.30	1	2.44
<i>Canis lupus</i>	Wolf	1	0.15	1	2.44
<b>Wild mammals</b>		<b>88</b>	<b>13.15</b>	<b>11</b>	<b>26.83</b>
Total identified mammals		669	100	41	100

\* 6 skeletal remains from two individuals were considered as 2 specimens/fragments to avoid overestimation of the species

the identified mammals. The wild mammals found in the sample: *Cervus elaphus* (red deer), *Sus scrofa* (wild boar), *Capreolus capreolus* (roe deer), *Lepus europaeus* (hare), and *Canis lupus* (wolf). The most frequent are red deer with about 9%, and wild boar with about 3%. Roe deer and hare have less than 1% NISP of the total identified mammals (Table 1). Considering the MNI, red deer and wild boar are the most frequent species with 6, and 2 respectively estimated individuals. For the rest of wild species there was estimated only one individual by each, representing 2.44% of the total estimated MNI (Table 1).

Fragments from all skeletal groups are presented in the sample, showing that the analyzed material comes from domestic use, and the primary and secondary butchering were made in proximity of the settlement (Fig. 2).

growth, yielding the optimal quantity of meat after the age of 13 months. The horse and donkey skeletal remains belong to mature individuals, which were mainly raised for traction power or equitation, but in some cases, they could have been used in alimentation as it is proofed by the butchery traces identified on some bone fragments. Dog, considered as species with no direct importance in economy, being raised mostly for protection, is represented by both immature and mature individuals (Table 2). The wild species were hunted at mature ages (Table 2) for having a maximum yield of meat quantity and maybe as a rule of game exploitation. It is possible that the wolf was hunted to eliminate its predatory effect or for fur, but it seems was also used in alimentation given the cutting mark identified on the fragment of left coxal.



**Fig. 2.** Skeletal frequency for mammals identified in the LBA I sample.

Estimation of ages at death (Table 2) shows that cattle and sheep/goat were sacrificed as mature animals, being mainly exploited for secondary products (e.g., milk, wool, etc.). Pig was exploited only for primary products, such as meat or fat, even it was predominantly sacrificed at mature age, which could be explained by a primitive type with slow

**Table 2.** Estimation of ages at death in the LBA I sample (MNI=minimum number of individuals).

Species	Immature (MNI)	Mature (MNI)
<i>Bos taurus</i>	1	6
<i>Ovis aries/Capra hircus</i>	1	6
<i>Sus domesticus</i>	2	8
<i>Equus caballus</i>	0	1
<i>Equus asinus</i>	0	1
<i>Canis familiaris</i>	1	3
<i>Cervus elaphus</i>	1	5
<i>Sus scrofa</i>	0	2
<i>Capreolus capreolus</i>	0	1
<i>Lepus europaeus</i>	0	1
<i>Canis lupus</i>	0	1

The repartition on classes of the estimated ages at death for the main domestic species was based on tooth eruption, tooth wear and epiphyseal fusion stages (Table 3). Thus, for cattle was estimated one juvenile individual sacrificed between 12–18 months, two subadult individuals of 2–2.5 years and four adult individuals (one of 2.5–4 years, and



**Table 3.** MNI repartition on age classes, in the LBA I sample.

Taxon	<1 year	1-2 years	2-3 years	2-4 years	>3 years	>4 years	Total individuals
<i>Bos taurus</i>	0	1	2	1	0	3	7
<i>Ovis aries/Capra hircus</i>	1	2	3	0	1	0	7
<i>Sus domesticus</i>	1	4	3	0	2	0	10

three over 4 years). For sheep/goat the age at death was estimated for seven individuals: one immature sacrificed at 3 months, and six mature individuals of over 1.5 years. In pig, the age at death was estimated for ten individuals, from which only one juvenile of 6–9 months. Seven individuals were sacrificed at an age between 13 months to 3 years, and two individuals at the age of over 3 years.

Sex estimation indicates in cattle four females and one male, which is further evidence that cattle were used mainly for secondary products, such as dairy products. In sheep there were identified only two females, this species also being exploited for dairy products. Three males were estimated for pig, and a male and a female for wild boar (Table 4).

**Table 4.** Sex estimation in the LBA I sample.

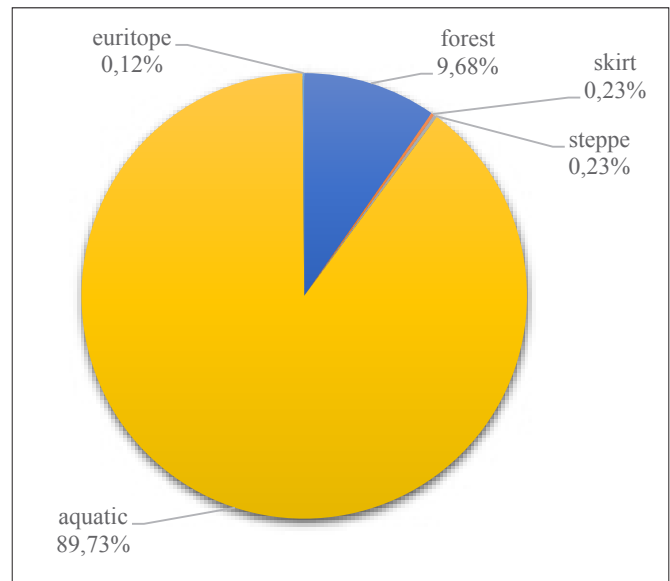
Taxon	Male (MNI)	Female (MNI)
<i>Bos taurus</i>	1	4
<i>Ovis aries</i>	0	2
<i>Sus domesticus</i>	3	0
<i>Sus scrofa</i>	1	1

The withers height in cattle, based on metatarsal bones of four females and one male, varies from 109.14 cm to 141.77 cm, with a mean of 117.6 cm (Table 5). The absence of castrated individuals could be caused by the relatively small sample. For dog it was estimated a withers height of 38.12 cm based on a radius with diaphyseal index of 7.14, indicating an individual with submedium size and medium robustness. The withers height of wild boar was estimated at 87.14 cm based on a metatarsus IV (Table 5).

**Table 5.** Estimations of withers height, in the LBA I sample.

Taxon	Anatomical element	GL (mm)	Bp (mm)	SD (mm)	Bd (mm)	Sex	Withers height (mm)	Mean (mm)
<i>Bos taurus</i>	metatarsus	265	41	22.5	46	F	1417.75	1175.85
<i>Bos taurus</i>	metatarsus	212	48	29	57.5	M	1176.6	
<i>Bos taurus</i>	metatarsus	204	41	23	45	F	1091.4	
<i>Bos taurus</i>	metatarsus	205	41	23.5	49	F	1096.75	
<i>Bos taurus</i>	metatarsus	205	42,5	22.5	46.5	F	1096.75	
<i>Canis familiaris</i>	radius	126	12	9	17	-	381.17	-
<i>Sus scrofa</i>	metatarsus	99	-	13.5	18	-	871.36	-

Evaluating the palaeoenvironment for the LBA I settlement, based on the NISP frequencies of ecological groups, it seems that forests predominated, with open spaces and a rich hydrographic network provided by the Mures River and its tributaries (Fig. 3).



**Fig. 3.** Taxa grouping (NISP%) from ecological point of view, in the LBA I sample.

**Late Bronze Age, phase II (LBA II)**

The LBA II sample comes from five archaeological complexes and comprises 143 faunal remains, mainly consisting of mammal skeletal fragments (96.5% of the total sample). Five river mussel valves (*Unio* sp.) were also found, representing 3.5% of the total sample.

Among the mammal remains, those of domestic species are prevailing, accounting for approx. 62% of these (Table 6).

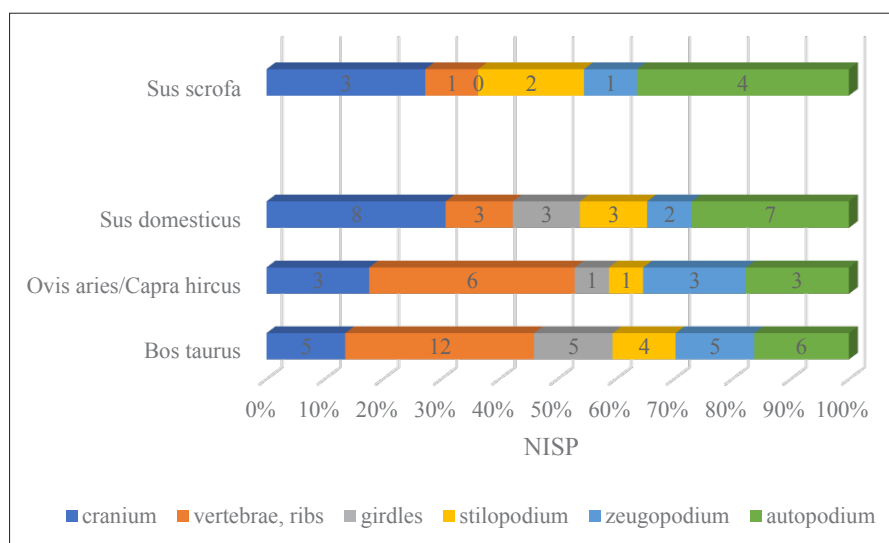
They are followed by unidentified mammals by species with a frequency of approx. 25%, and then by wild mammals, making up 13%.

The domestic species exhibit the highest frequency, about 83% NISP of the identified mammals, suggesting that animal husbandry provided the largest amount of meat within the settlement.

The identified domestic mammals include *Bos taurus* (cattle), *Ovis aries* (sheep), *Capra hircus* (goat), *Sus domesticus* (pig), *Equus caballus* (horse), and *Canis familiaris* (dog). Among these species, cattle are the most abundant, accounting for approx. 36% NISP, followed by pig with 25%, and sheep/goat with about 16%. The least common species are the horse, with approx. 5%, and the dog, making up 1% (Table 6).

**Table 6.** Quantification of mammal remains in the LBA II sample (NISP = number of identified specimens, MNI = minimum number of individuals).

Species		NISP	NISP %	MNI	MNI %
<i>Bos taurus</i>	Cattle	37	35.58	3	25.00
<i>Ovis aries/Capra hircus</i>	Sheep/Goat	17	16.35	2	16.67
<i>Sus domesticus</i>	Pig	26	25.00	2	16.67
<i>Equus caballus</i>	Horse	5	4.81	1	8.33
<i>Canis familiaris</i>	Dog	1	0.96	1	8.33
<b>Domestic mammals</b>		<b>86</b>	<b>82.69</b>	<b>9</b>	<b>75.00</b>
<i>Cervus elaphus</i>	Red deer	7	6.73	1	8.33
<i>Sus scrofa</i>	Wild boar	11	10.58	2	16.67
<b>Wild mammals</b>		<b>18</b>	<b>17.31</b>	<b>3</b>	<b>25.00</b>
Total identified mammals		104	100	12	100
Unidentified mammals		34	-	-	-
Total mammals		138	-	-	-



**Fig. 4.** Skeletal frequency for mammals in the LBA II sample.

In terms of MNI, cattle predominate with a minimum of 3 estimated individuals, followed by sheep/goat and pig with 2 individuals each. For horse and dog there was estimated one individual each (8.33%).

Wild mammal remains have a frequency of approx. 17% NISP of the total identified mammals, indicating that hunting was a relatively significant occupation among the inhabitants of the LBA II settlement. They preferred to hunt large species, like wild boar (about 11% NISP), and red deer (7% NISP). Wild boar predominates also as MNI (about 17%), followed by red deer (8.33%) (Table 6).

As Figure 4 shows, the identified remains come from all skeletal regions, proving their domestic origin and, also that butchering took place in or near the settlement.

Cattle and sheep/goat were sacrificed at mature ages, and they were primarily exploited for dairy products or wool. They were butchered for meat only once they reached maturity. Pig also was sacrificed at a mature age, possibly because it was later reaching an optimal meat quantity. Horse was generally used for traction power or riding purposes, but some cutting traces on tibia and femur could indicate the use consume of its meat. Wild species were preferred to be hunted at mature ages, mainly to obtain a higher quantity of meat and other products (Table 7).

**Table 7.** Estimation of ages at death in the LBA II sample (MNI=minimum number of individuals).

Species	Immature (MNI)	Mature (MNI)
<i>Bos taurus</i>	1	2
<i>Ovis aries/Capra hircus</i>	0	2
<i>Sus domesticus</i>	0	2
<i>Equus caballus</i>	0	1
<i>Canis familiaris</i>	0	1
<i>Cervus elaphus</i>	0	1
<i>Sus scrofa</i>	1	1

Based on the tooth wear, it was possible to determine the age classes for the main domestic species at the time of sacrifice. For cattle, the butchering age was estimated for only one immature individual, under 1 year old. In the case of sheep/goat, the age of death was estimated for two individuals, one butchered between 2–3 years and the other over 3 years old. The age at death in pig was estimated between 1–2 years old for one individual and over 3 years old for other individual (Table 8). Sex was estimated for only one individual of pig and other of wild boar, both identified as males.

The estimation of withers height was only feasible for swine. Therefore, for pig, the withers height was determined based on two calcanei, one astragalus and one metacarpus IV, ranging from 70.32 cm to 84.33 cm, and a mean of 77.51 cm. In the case of wild boar, the withers height was estimated based on a metatarsus IV, a metatarsus III and an astragalus, with values varying from 82.99 cm to 91.56 cm, and a mean of 90.28 cm (Table 9).

**Table 8.** MNI repartition on age classes, in the LBA II sample.

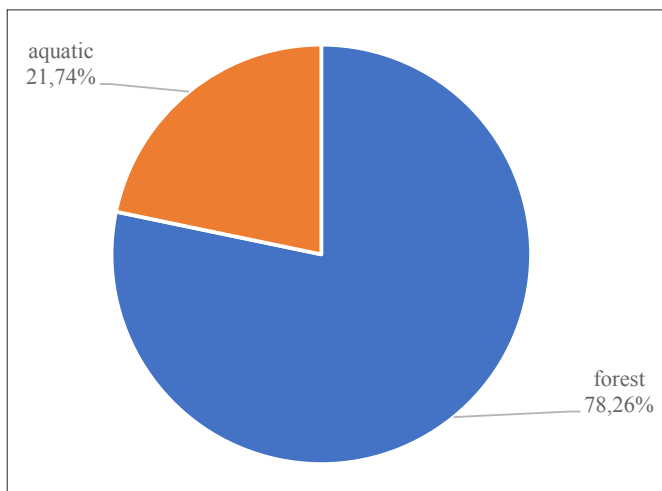
Taxon	<1 year	1–2 years	2–3 years	2–4 years	>3 years	Total individuals
<i>Bos taurus</i>	1	0	0	0	0	1
<i>Ovis aries/Capra hircus</i>	0	0	1	0	1	2
<i>Sus domesticus</i>	0	1	0	0	1	2

**Table 9.** Estimations of withers height, in the LBA II sample.

Taxon	Anatomical element	Greatest length (mm)	Withers height (mm)	Mean (mm)
<i>Sus domesticus</i>	calcaneus	85	819.9	775.09
<i>Sus domesticus</i>	calcaneus	87.5	843.25	
<i>Sus domesticus</i>	astragalus	38	703.2	
<i>Sus domesticus</i>	metacarpus IV	72.5	734.03	
<i>Sus scrofa</i>	metatarsus IV	104	915.56	902.85
<i>Sus scrofa</i>	metatarsus III	95	829.9	
<i>Sus scrofa</i>	astragalus	49	900.1	

According to ecological groups' frequencies, the palaeoenvironment during LBA II period was predominated by forests (there were identified remains of wild boar and red

deer), but also by a rich aquatic network as it is proved by the *Unio* shells. (Fig. 13).



**Fig. 5.** Taxa grouping (NISP%) from ecological point of view, in the LBA II sample.

**Iron Age**

The Iron Age assemblage comprises only 19 faunal remains, all of which belong to mammals. The identified domestic species include *Bos taurus* (cattle), *Ovis aries* (sheep), *Capra hircus* (goat) and *Sus domesticus* (pig). Domestic cattle predominate with about 53% NISP, followed by sheep/goat with approx. 24%, and pig with approx. 12%. As MNI, both cattle and sheep/goat are the most frequent with about 29% each. For pig, a minimum of one individual was estimated, representing about 14% of the total estimated MNI (Table 10).

**Table 10.** Quantification of mammal remains in the Iron Age sample (NISP=number of identified specimens, MNI=minimum number of individuals).

Species		NISP	NISP %	MNI	MNI %
<i>Bos taurus</i>	Cattle	9	52.94	2	28.57
<i>Ovis aries/ Capra hircus</i>	Sheep/Goat	4	23.53	2	28.57
<i>Sus domesticus</i>	Pig	2	11.76	1	14.29
<b>Domestic mammals</b>		<b>15</b>	<b>88.24</b>	<b>5</b>	<b>71.43</b>
<i>Cervus elaphus</i>	Red deer	1	5.88	1	14.29
<i>Sus scrofa</i>	Wild boar	1	5.88	1	14.29
<b>Wild mammals</b>		<b>2</b>	<b>11.76</b>	<b>2</b>	<b>28.57</b>
Total identified mammals		17	100	7	100
Unidentified mammals		2	-	-	-

Wild species have approx. 12% NISP, hunting being a quite significant activity. The identified wild species are *Cervus elaphus* (red deer) and *Sus scrofa* (wild boar), each representing approx. 6% of the identified mammals. Only a minimum of one individual was estimated for each species (Table 10).

According to the estimated ages of death (Table 11), it could be assumed that Iron Age community from the Veșel-Luncă applied a mixed exploitation for cattle and sheep/goat. Pig was mainly utilized for its primary products, but it was butchered at mature age. Hunting activities were centered on mature animals (Table 11).

**Table 11.** Estimation of ages at death in the Iron Age sample (MNI=minimum number of individuals).

Species	Immature (MNI)	Mature (MNI)
<i>Bos taurus</i>	1	1
<i>Ovis aries/Capra hircus</i>	1	1
<i>Sus domesticus</i>	1	0
<i>Cervus elaphus</i>	0	1
<i>Sus scrofa</i>	0	1

The only wild species identified were red deer and wild boar, indicating that the forest environment was still present in the area during the Iron Age period.

**Post Roman**

The Post Roman sample, dated to the 4th–5th centuries CE, consists of 113 faunal remains, of which 99.12% belong to mammals, and 0.88% to mollusks. Mollusks are represented by only one fragment shell of freshwater mussel (*Unio* sp.).

Domestic mammals predominate with approx. 54% NISP, followed by unidentified mammals with approx. 28%, and wild mammals with 19%.

Animal husbandry is suggested as the most important activity by the frequency of domestic mammals that is 74% NISP of the identifiable mammals. The identified domestic species include *Bos taurus* (cattle), *Ovis aries* (sheep), *Capra hircus* (goat), *Sus domesticus* (pig) and *Canis familiaris* (dog). Cattle are the most prevalent, accounting for approx. 41%, followed by pig with 22%, sheep/goats with approx. 10%, and dogs with 1.23%. As MNI, pigs are the most frequent with minimum 3 estimated individuals, followed by cattle and sheep/goat with minimum 2 estimated individuals each, and by dog with only one estimated individual (Table 12).

**Table 12.** Quantification of mammal remains in the Post Roman sample (NISP=number of identified specimens, MNI=minimum number of individuals).

Species		NISP	NISP %	MNI	MNI %
<i>Bos taurus</i>	Cattle	33	40.74	2	15.38
<i>Ovis aries/Capra hircus</i>	Sheep/Goat	8	9.88	2	15.38
<i>Sus domesticus</i>	Pig	18	22.22	3	23.08
<i>Canis familiaris</i>	Dog	1	1.23	1	7.69
<b>Domestic mammals</b>		<b>60</b>	<b>74.07</b>	<b>8</b>	<b>61.54</b>
<i>Cervus elaphus</i>	Red deer	16	19.75	3	23.08
<i>Sus scrofa</i>	Wild boar	4	4.94	1	7.69
<i>Lepus europaeus</i>	Hare	1	1.23	1	7.69
<b>Wild mammals</b>		<b>21</b>	<b>25.93</b>	<b>5</b>	<b>38.46</b>
Total identified mammals		81	100	13	100
Unidentified mammals		31	-	-	-

In this sample, wild mammals represent approx. 26% NISP of the identified mammals, indicating that hunting played a more significant role. The identified wild mammals are: *Cervus elaphus* (red deer), *Sus scrofa* (wild boar), and *Lepus europaeus* (hare). Red deer is the most representative wild species, accounting for approx. 20% NISP and around 23% MNI. It is followed by wild boar (5% NISP, 8% MNI), and hare (1% NISP, 8% MNI) (Table 12).

Skeletal frequency for mammals identified in the

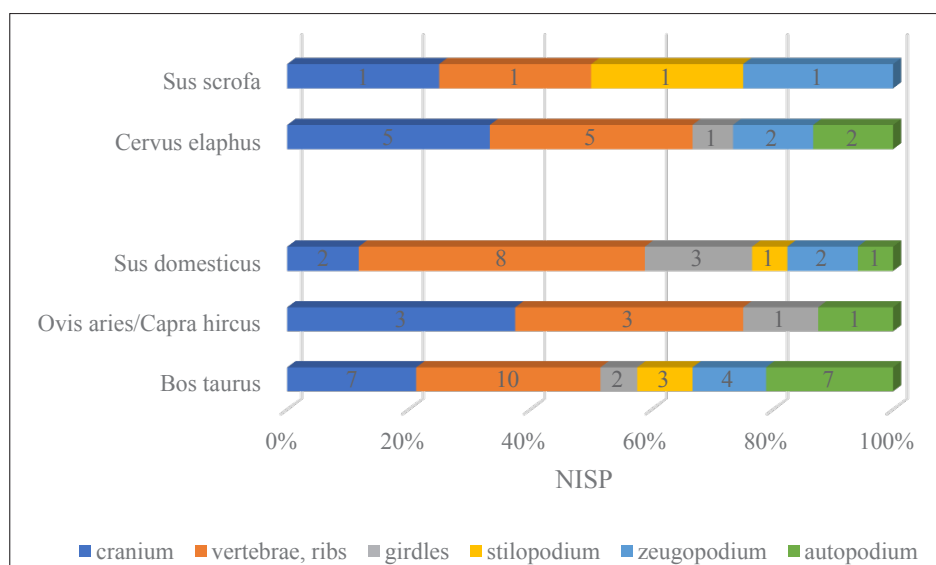


Fig. 6. Skeletal frequency for mammals identified in the Postroman sample.

Postroman assemblage indicates that the butchering took place in or near the settlement, and the studied remains have a domestic origine (Fig. 6).

In the Post Roman period, cattle were primarily exploited for meat, the identified individuals being butchered at immature ages. Regarding the sheep/goat group, it seems that a mixed exploitation was preferred, targeting both secondary and primary products. Pig was raised for meat and fat, juvenile individuals being predominant. Only one immature individual was estimated for dog, two immatures and one mature for red deer, and one mature individual each for wild boar and hare (Table 13).

Table 13. Estimation of ages at death in the Post Roman sample (MNI=minimum number of individuals).

Species	Immature (MNI)	Mature (MNI)
<i>Bos taurus</i>	2	0
<i>Ovis aries/Capra hircus</i>	1	1
<i>Sus domesticus</i>	2	1
<i>Canis familiaris</i>	1	0
<i>Cervus elaphus</i>	2	1
<i>Sus scrofa</i>	0	1
<i>Lepus europaeus</i>	0	1

Based on tooth wear analysis, one individual of cattle was estimated to have been sacrificed under one year old, while another was butchered at 2–3 years old. For sheep/goat, one individual was estimated to have been sacrificed under 1 year of age, and another between 2–3 years old. Additionally, only one individual of pig was estimated to have been butchered at 1–2 years old (Table 14).

Table 14. MNI repartition on age classes, in the Post Roman sample.

Taxon	<1 year	1–2 years	2–3 years	Total individuals
<i>Bos taurus</i>	1	0	1	2
<i>Ovis aries/Capra hircus</i>	1	0	1	2
<i>Sus domesticus</i>	0	1	0	1

Based on the presence of canine tooth in swines, there were estimated a male individual for pig and a male one for wild boar.

The environment in the Post Roman period was predominated by forests with a rich aquatic network, but also with open spaces near the settlement for graze (Fig. 7).

**Samples as an all**

After the separate archaeozoological presentation of the five cultural levels, a study of the entire faunal material was carried out using statistical analyses.

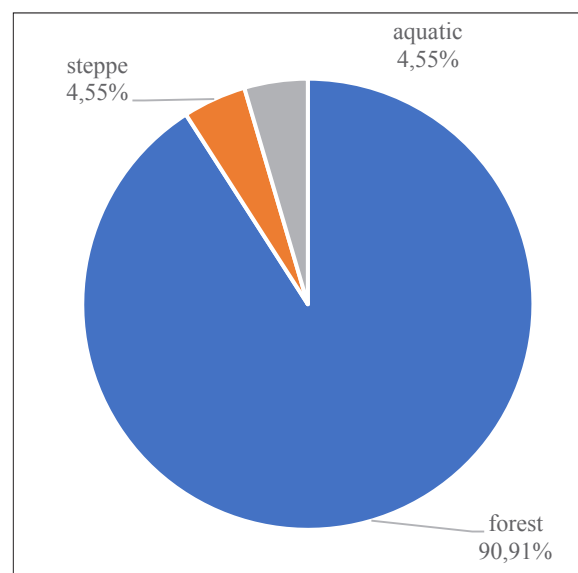


Fig. 7. Taxa grouping (NISP%) from ecological point of view, in the Post Roman sample.

Based on taxa frequency the correspondence analysis (CA) was performed using XLSTAT Version 2021.1 software. This method of statistical analysis was used to determine the associations of taxa within the studied periods. There are 14 taxa considered as variables. The CA results are projected on the first two principal axes which accounted for 97.05% of the overall variance (the first axis 84.05% and the second axis 13%). Eigenvalues, inertia of the principal axes, and the contribution of taxa and periods are presented in Table 15.

Table 15. Eigenvalues and scores for the principal axes.

	F1	F2	F3
Eigenvalue	0.135	0.021	0.005
Inertia (%)	84.049	13.003	2.948
Cumulative %	84.049	97.052	100.000
<b>Contribution of taxa</b>			
	F1	F2	F3
<i>Unio sp.</i>	0.438	0.000	0.047

	F1	F2	F3
Birds	0.003	0.000	0.000
Fish	0.001	0.000	0.000
Cattle	0.100	0.014	0.316
Sheep/Goat	0.010	0.051	0.208
Pig	0.208	0.010	0.191
Horse	0.007	0.205	0.112
Donkey	0.001	0.000	0.000
Dog	0.000	0.002	0.025
Red deer	0.091	0.428	0.066
Wild boar	0.132	0.181	0.019
Roe deer	0.001	0.000	0.000
Hare	0.006	0.109	0.016
Wolf	0.001	0.000	0.000
<b>Contribution of periods</b>			
	F1	F2	F3
LBA I	0.126	0.000	0.000
LBA II	0.443	0.445	0.047
Iron Age	0.051	0.002	0.936
Postroman	0.381	0.553	0.017

Considering the first axis (horizontal), LBA I, roe deer, fish, *Unio* sp., birds, donkey and wolf variables are situated on the axis, while LBA II, Iron Age, wild boar, horse, sheep/goat, pig variables are situated at the top, and Post Roman, dog, cattle, red deer, hare are situated at the bottom of the axis. The second axis focus LBA I, roe deer, fish, *Unio* sp., birds, donkey and wolf in the left side of the chart, and LBA II, Iron

Age, Post Roman, horse, wild boar, sheep/goat, pig, cattle, dog, red deer and hare in the right side of the chart (Fig. 8).

Cattle, sheep/goat and pig played significant roles in the subsistence economy across all studied samples. Dog and donkey are associated with LBA I, while horse had a more significant role in the LBA I and LBA II samples. Regarding game activities, red deer was more intense hunted in LBA I and Post Roman times, while in LBA II the wild boar presented a more important role. Hare appear only in LBA I and Post Roman assemblages, but without having an important role in the food economy. Roe deer and wolve are situated in the quadrant close to the LBA I variable, being hunted probably mosly in this period. Birds are also more associated to this time, and aquatic resources seem to have been intensely exploited (fish and mollusks are situated in the same quadrant with LBA I) (Fig. 8).

The faunal richness of the studied archaeozoological samples shows a gradual decrease from the LBA I to the Iron Age, followed by an increase in the Post Roman period. The Shannon-Weaver is increasing from LBA I to LBA II, followed by a decrease to Iron Age, and then another increase in the Post Roman period. Equitability shows a similar pattern, increasing from LBA I to LBA II and maintaining relative stable values until the Post Roman (Fig. 9).

With a diversity index ( $H'$ ) value of 1.26, the Iron Age assemblage exhibits the lowest species diversity among all samples, followed by LBA I assemblage with a value of 1.43. The highest species diversity is observed in the LBA II assemblage, with an  $H'$  index value of 1.73. The lower equitability

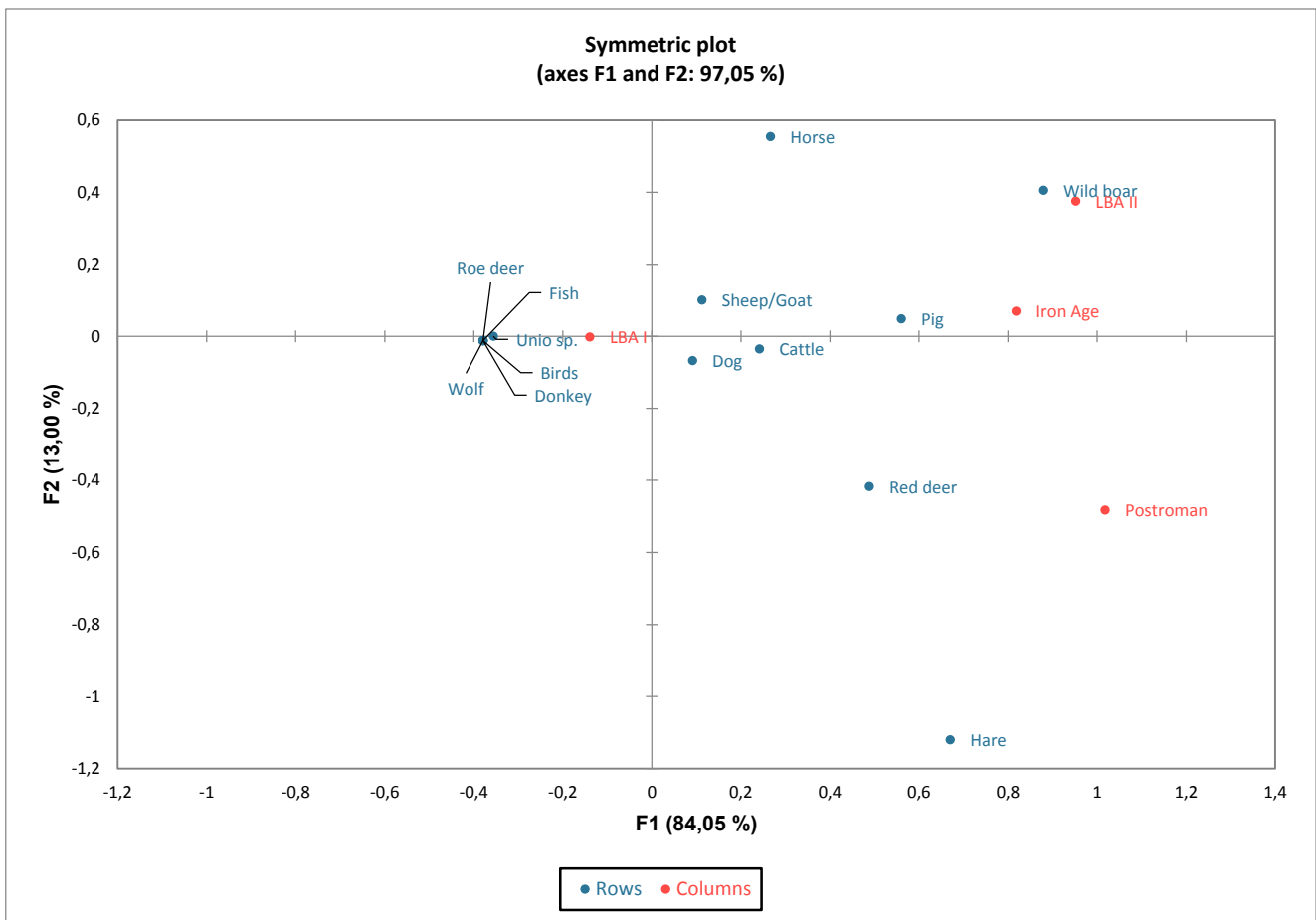


Fig. 8. Plot of the correspondence analysis (bi-dimensional representation).



value in the LBA I sample indicates a less even distribution of the taxa compared to LBA II, where the  $V'$  value is the highest (0.79), and both the Iron Age and Post Roman exhibit similar values. This uneven distribution could be attributed to the high number of the mollusks (767 fragments) in the LBA I assemblage (Table 16).

**Table 16.** Diversity measures of archaeozoological assemblages.

	Richness (S)	Shannon-Weaver index ( $H'$ )	Equitability ( $V'$ )
LBA I	15	1.43	0.53
LBA II	9	1.73	0.79
Iron Age	6	1.26	0.7
Postroman	9	1.55	0.71



**Fig. 9.** Diversity measures of faunal samples, on logarithmic scale.

## CONCLUSIONS

The material analysed in this work is represented by faunal remains recovered from archaeological multicultural site of Vețel-Luncă (Hunedoara County, Tomania), from levels of Chalcolithic (Tiszapolgár culture – 4 skeletal remains), Late Bronze Age (phase I – 1671 faunal remains, and phase II – 143 faunal remains), Iron Age (19 skeletal fragments), and Post Roman (113 faunal remains).

Archaeozoological results indicate that animal husbandry played the most significant role in the economy during all periods, with domestic mammal frequencies ranging from 74% in Post Roman to 88% in Iron Age. Hunting was also an important activity, mainly in LBA II and Post Roman periods.

According to the study of skeletal frequencies indicating all body regions, it seems that both domestic and wild animals were butchered and consumed within the settlement.

In the LBA I and LBA II samples, cattle and sheep/goat were primarily exploited for their secondary products, but during Iron Age these species were bred for both primary and secondary ones. However, in the Post Roman period, the economy shifted towards meat production, when cattle were sacrificed at immature ages; only sheep/goat were used for both secondary and primary products during this period.

The environment was predominated by a vast and dense

forest with a rich aquatic resource (Mureș River) and with open spaces around the settlement, especially during LBA I and Post Roman.

The correspondence analysis (CA) was conducted to evaluate subsistence patterns in the settlement across the time, from prehistory to Post Roman period. Cattle, sheep/goat and pig have the most important role in the subsistence economy of all periods. Dog and donkey are associated with LBA I, whereas horse held greater significance in LBA I and LBA II. Regarding the wild mammals, red deer was more hunted during LBA I and Post Roman, while wild boar had greater importance during LBA II.

The richness of the studied archaeozoological samples exhibits a gradual decrease from LBA I to Iron Age, and then it increases in Post Roman. The Iron Age assemblage shows the minimum species diversity among all samples, while the LBA II displays the highest value of diversity.

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