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Roman Croitor, Vitalie Burlacu

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Categoria A

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CERCETĂRI INTERDISCIPLINARE – МЕЖДИСЦИПЛИНАРНЫЕ ИССЛЕДОВАНИЯ – INTERDISCIPLINARY SURVEYS

Roman Croitor, Vitalie Burlacu

The Middle Paleolithic site of Buzdujeni 1 (Northern Moldova): evidence on periodic occupation by cave hyena

Keywords: *Crocutea crocuta spelaea*, Late Pleistocene, Eastern Europe, Micoquien, taphonomy.

Cuvinte cheie: *Crocutea crocuta spelaea*, Pleistocenul târziu, Europa de Est, cultura Micoquie, tafonomie.

Ключевые слова: *Crocutea crocuta spelaea*, поздний плейстоцен, восточная Европа, Микокская культура, тафономия.

Roman Croitor, Vitalie Burlacu

The Middle Paleolithic site of Buzdujeni 1 (Northern Moldova): evidence on periodic occupation by cave hyena

The new archaeozoological and taphonomical data identify the Middle Paleolithic site of Buzdujeni 1 as a periodic cave hyena (*Crocutea crocuta spelaea*) den. The most complete taphonomic evidence on hyena den come from the recently excavated squares K-5 and L-5 of layer 3, but the presence of hyena at Buzdujeni 1 site is also recorded in layers 4, 5, and 6. The evidence of cave hyena presence at Buzdujeni 1 include steak-like bone fragments, nibbled and chewed stick-like bone fragments, gnawed bones of large prey species (*Bison priscus*, *Coelodonta antiquitatis*), and skeletal remains of juvenile individuals. The composition of fauna from Buzdujeni 1 indicates generally open landscape in the environments of the site when Paleolithic layers were accumulated.

Roman Croitor, Vitalie Burlacu

Situl din Paleoliticul mijlociu Buzdujeni 1 (regiunea de nord a Moldovei): dovezi ale prezenței hienei de peșteră

Noile date arheologice și tafonomice din grota atribuită paleoliticului mijlociu Buzdujeni 1 indică prezența hienei de peșteră (*Crocutea crocuta spelaea*), care a folosit periodic acest loc ca vizuină, după ce stațiunea a fost părăsită de omul preistoric. Cea mai completă dovadă tafonomică a acestei specii de animale se găsește în cel de al treilea strat, în carourile K-5 și L-5. De asemenea, dovezi ale prezenței hienei de peșteră, sunt remarcate și în straturile 4, 5 și 6, prin prezența unor fragmente de oase mici sub formă de „așchii”, „așchii” specifice cu urme de la dinții unor animale de pradă, oase cu urme de roadere de la animale de talie mare (*Bison priscus*, *Coelodonta antiquitatis*), precum și resturile scheletice ale unor specii juvenile. Compoziția generală a faunei din grota Buzdujeni 1 indică un peisaj deschis în vecinătatea grotei în timpul formării straturilor paleolitice ale stațiunii.

Роман Кроитор, Виталий Бурлаку

Среднепалеолитическая стоянка Буздужаны 1 (Северная Молдова): свидетельства о периодическом присутствии пещерной гиены

Новые археозоологические и тафономические данные из среднепалеолитической стоянки в гроте Буздужаны 1 указывают на периодическое существование в данном палеолитическом памятнике логова пещерной гиены (*Crocutea crocuta spelaea*), которая поселялась в гроте когда его покидали люди. Наиболее полные тафономические свидетельства логова пещерной гиены выявлены в недавно раскопанных квадратах K-5 и L-5 третьего слоя памятника. Присутствие и деятельность пещерной гиены также отмечены в слоях 4, 5 и 6. Следы деятельности пещерной гиены включают мелкие фрагменты костей в виде «шепок», специфические «щепки» со следами зубов хищника, обглоданные кости крупных животных (*Bison priscus*, *Coelodonta antiquitatis*), а также скелетные остатки ювенильных особей. Общий состав фауны из грота Буздужаны 1 указывают на открытый ландшафт в окрестностях грота во время формирования палеолитических слоёв памятника.

Introduction

The Middle Paleolithic site of Buzdujeni 1 (situated above the Recoveț River valley, Edineț District, Moldova: see fig. 1) was discovered by I. Borziac [1973] and its main part was excavated during

the 70-s [Vishniatskiy et al. 2020]. The Paleolithic site is situated in a grotto with a 60 m² surface and includes nine layers, including the youngest Holocene one. The archaeological findings come from all Paleolithic layers, however, their distribution does

not permit to regard the identified layers as cultural strata. Recently, the reevaluation of stone artefacts permitted to refer Buzdujeni 1 to the Micoquien group of monuments [Vishniatskiy et al. 2020]. According to Vishniatskiy et al. [2020], the accumulation of Buzdujeni 1 layers took place most probably during MIS 3 that corresponds to the obtained earlier dating reported by Hedges et al. [1996: cal. 41-35 Ky BP for layers 6 and 8] and the dates recently obtained by Vishniatskiy et al. [2020: cal. 46-47 Ky BP for layers 6 and 2].

The deposits of grotto Buzdujeni 1 have yielded the abundant osteological material of large mammals dominated by cave bear that, according to Vishniatskiy et al. [2020], inhabited the grotto of Burdujeni when it was abandoned by humans. The faunal list and some general taphonomic features of the mammal assemblage from Buzdujeni 1 were reported by David [1980]. Besides cave bear *Ursus spelaeus*, the fauna from Buzdujeni contains an important amount of remains of cave hyaena

Crocota crocota spelaea, horse *Equus ferus ssp.*, and steppe bison *Bison priscus*. Other large mammals, such as *Saiga tatarica*, *Equus hemionus hydruntinus*, *Cervus elaphus*, *Megaloceros giganteus*, are represented by very few remains [David 1980]. David's [1980] brief report on Buzdujeni fauna does not provide data on stratigraphic position of mammal remains and only briefly mentions some bone modifications, such as tool marks, and the presence of burnt bones. A detailed taphonomic study of this interesting site was never carried out.

In 2017, new osteological material was discovered during the renewed archaeological excavations at Buzdujeni 1 [Vishniatski et al. 2020]. The unearthed mammal remains bring interesting taphonomical details that permit a better understanding of the character and history of bone accumulation at the Buzdujeni 1 site.

Material and Research Method

The studied new archeozoological material includes 310 bone fragments and isolated teeth. Most of the bone fragments are poor and species identification is not possible. Only 60 bone fragments and isolated teeth provided diagnostic characters that permitted taxonomic determination. The systematic composition and stratigraphic distribution of the studied material are presented in Table 1. All bone remains were screened for the presence of post-mortem surface modification marks (tooth marks and tool marks). The adapted in the present study terminology for bone fragmentation type is broadly used in the archeozoological literature [Villa, Bartram 1996; Diedrich 2011]. Our archeozoological results slightly differ from the data published by Vishniatski et al. [2020] since we take in consideration also the fragments of postcranial bones that we ascribed with a certain confidence to *Bison priscus* (layer 3) and *Mammuthus primigenius* (layer 4), and a bone fragment of *Coelodonta antiquitatis* that was omitted in the previous report. The comparative material involved in the present study is stored in the Institute of Zoology, Ministry of Education, Culture, and Research (Chisinau, Republic of Moldova).

We applied the multivariate cluster analysis of the main typical taphonomical features characteristic of human Paleolithic dwelling and hyena den according to the bibliographic data

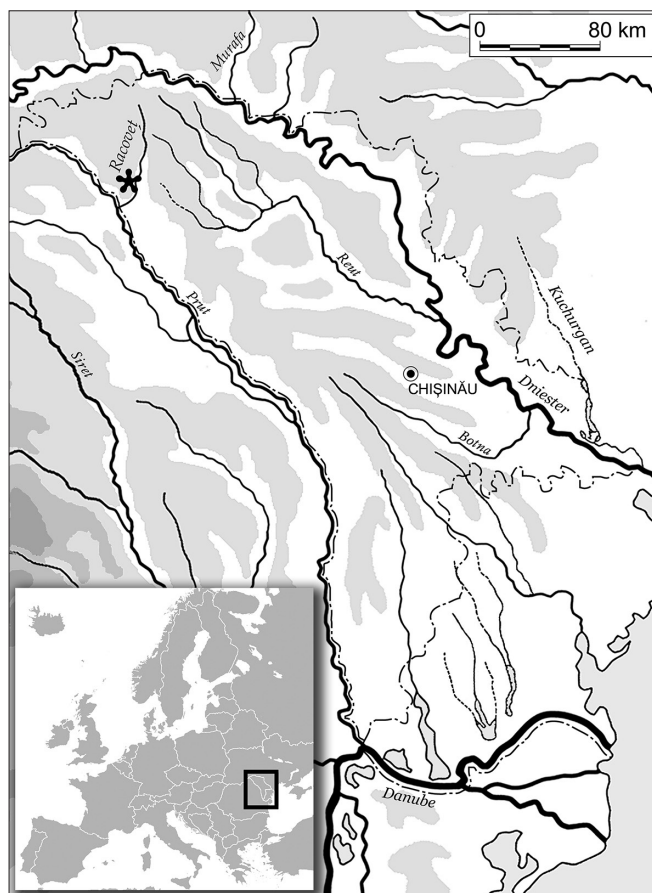


Fig. 1. The geographical location of the Middle Paleolithic site of Buzdujeni 1 (indicated by the asterisk).

Species	Layer 3	Layer 4	Layer 5	Layer 6	Layer 8
<i>Crocota crocuta spelaea</i>	4	1	10		
<i>Ursus spelaeus</i>	6		2		1
<i>Bison priscus</i>	2	5	5		
<i>Equus ferus ssp.</i>			6		
<i>Coelodonta antiquitatis</i>				1	
<i>Mammuthus primigenius</i>		13		2	
<i>Marmota bobac</i>			2		
Not determinable	119	33	89	10	
Total sample amount	131	52	126	13	1

Table 1. Faunal remains from the Middle Paleolithic site of Buzdujeni 1 discovered during the 2017 archaeological campaign (squares K-5 and L-5).

[Brugal et al. 1997; Pokines, Peterhans 2007; Villa et al. 2010; Diedrich 2011; 2013; Dusseldorp 2011; 2013] compared to the taphonomic characteristics of the archaeozoological sample and the archaeological context [Vishniatski et al. 2020] from each included in the study layer of the Middle Paleolithic site of Buzdujeni 1 (Table 2). The hierarchical clustering paired group algorithm UPGMA was computed using the Jaccard Similarity Index for presence-absence data [PAST-3 application: Hammer et al. 2001]. The cophenetic correlation coefficient is computed in order to estimate how faithfully a dendrogram preserves the pairwise distances among the original unmodeled data points [Farris 1969].

Abbreviations used in the article: P, premolar; M, molar; C, canine; I, incise; L, length; D, breadth; H, height; DLM, lateromedial measure-

ment; DAP, anteroposterior measurement. All measurements are indicated in millimetres.

Description

Layer 3. The third layer has yielded a large number (114 pieces) of small stick-like bone fragments. At least two of stick-like fragments bear clear carnivore tooth marks. Larger bone fragments and isolated teeth are represented by 17 specimens, one of which (a fragment of the long bone diaphysis of bison) also shows well-expressed tooth marks. The diagnostic bone remains indicate the presence

of cave hyena (*Crocota crocuta spelaea*), cave bear (*Ursus spelaeus*), and bison (*Bison priscus*). *Crocota crocuta spelaea* is represented by several postcranial bones (the distal fragment of ulna – probably a juvenile individual – with destroyed articulation part; the distal part of the radius with destroyed epiphysis; the metapodial diaphysis; and the third upper incise I3). *Ursus spelaeus* is the most common species of the sample, but all remains are isolated teeth: the upper canine, the upper fourth premolar P4, the lower third molar M3 (Table 3), the incisor, the fragment of a molar, and the upper deciduous tooth DP2. *Bison priscus* is represented only by two fragments of limb bones: the poorly diagnostic limb bone fragment with tooth marks and the proximal fragment of the metacarpal bone. The measurements of proximal metacarpal epiphysis (DLM = 82.7 mm; DAP = 43.4 mm) suggest that this skeletal fragment belongs to a female.

Layer 4. The character of bone fragmentation from this layer is different. Bone fragments are larg-

Layers	tool marks	tools	burnt bones	tooth marks	bone stiks	bone flakes	juvenile hyenas	cave bear
Layer 3	0	1	0	1	1	0	1	1
Layer 4	0	1	1	0	0	1	1	0
Layer 5	1	1	0	0	1	1	1	1
Layer 6	0	1	0	1	0	1	0	0
Layer 8	0	1	0	0	0	0	0	1
Hyena den	0	0	0	1	1	0	1	0
Human dwelling	1	1	1	0	0	1	0	0

Table 2. Taphonomical features of archaeozoological samples unearthed from the squares K-5 and L-5 of the Middle Paleolithic site of Buzdujeni 1 compared to the typical taphonomic features of a hyena den and Paleolithic human dwelling.

Tooth	Measurement	Layer 3	Layer 5
P ⁴	L	20.0	21.7
	D	16.6	15.9
M ³	L	29.5	
	D	20.1	

Table 3. Measurements (millimeters) of isolated teeth of cave bear (*Ursus spelaeus*) from Buzdujeni 1.

er and may be described as “bone flakes”. One of the bone fragments is burned. The whole sample from this layer includes 52 bone fragments. The cave hyena (*Crocota crocota spelaea*) is represented by a single distal fragment of the juvenile radius with shed distal epiphysis. *Bison priscus* remains include four fragments of the mandible with alveoli for molar roots and a small fragment of the metacarpal bone. The presence of *Mammuthus primigenius* is confirmed by the fragment of enamel plate. Large fragments of thick postcranial bones (12 pieces) from this layer also should be ascribed to this species.

Layer 5. The deposits of this stratum yielded the richest and most diversified faunal remains. Unlike the above-mentioned layers, the bone fragments do not show a specific type of fragmentation and represent a mixture of large fragments of bones, “bone flakes”, and “bone sticks”. The bone remains from this layer do not show doubtless presence of tooth marks.

Horse remains (we prefer to designate the horse findings as *Equus ferus ssp.* since the taxonomy of Late Pleistocene horses still requires a revision) include an incisor and four fragmented cheek teeth. The better preserved upper cheek tooth provided the following measurements: the crown height is 75.2 mm, the crown length is 29.4 mm, the crown breadth is 31.0 mm, the protocone length is 15.0 mm. The relative length of its protocone (51.0 %) and tooth crown measurements allow defining this specimen as M1-2. Nonetheless, the protocone of this tooth is still very short if compared to the geologically younger horse from Duruitoarea Veche: the relative length of protocone in M1 and M2 of the horse from Duruitoarea Veche is 57.1% and 56.0% respectively.

Bison is represented by three skeletal fragments: a portion of the metacarpal, a part of molar and an incisor. The fragment of the metacarpal bone is the most interesting specimen since it is artificially polished from both sides.

As in previous cases, cave bear (*Ursus spelaeus*) is represented by isolated teeth: the upper fourth premolar P4 (Table 2) and the poor fragment of lower first molar (M1?) or deciduous tooth. The second carnivore species, *Crocota crocota spelaea*, is also represented only by isolated teeth: a lower first molar M1 (LxD = 31.3x14.2 mm), a fragment of canine, and a first lower incisor (I1). Two skeletal elements (a maxilla and a fragment of incisor) belong to *Marmota bobak* (= *Marmota bobac*).

The bone assemblage from Square L-4 of Layer 5 (not indicated in figure 3 in Vishniatskiy et al. 2020). This bone assemblage comes from the partially excavated Square L-4. It is interesting by the presence of upper and lower teeth that belong to the same individual of *Crocota crocota spelaea* (Table 4). Large herbivores also are represented by isolated teeth: *Bison priscus* (upper M2, M3) and *Equus ferus ssp.* (a poorly preserved incisor). This bone assemblage is included in the Layer 5 column of Table 1.

Layer 6. The sample contains a proximal part of the third metatarsal of *Coelodonta antiq-uitatis* bears the tooth marks in its lower part (fig. 2; 3). This specimen is used for Carbon-14 dating and was not available for direct study, therefore we cannot provide its exact measurements. Two molars of *Mammuthus primigenius* that also come from this layer are currently studied by E. Maschenko [Vishniatski et al. 2020]. According to E. Maschenko [Vishniatski et al. 2020], the mammoth teeth belong to two different individuals. Stick-like bone fragments are not present in this sample. The mammal remains from this level include also poorly diagnostic fragments of limb bones and ribs. It is difficult to have a clear idea about the bone fragmentation type in this case, but apparently, this fragmentation resulted from

Tooth	L	D	H
P ²	16.8	11.4	
P ³	24.4	18.5	
P ₃	22.0	15.6	
P ₄	22.7	14.3	
M ₁	29.8	12.9	
C ₁	18.6	13.5	40.5

Table 4. Measurements of teeth of cave hyena individual (*Crocota crocota spelaea*) from the bone assemblage of the Square L-4 of layer 5. The height of canine (H) is indicated with tooth's root.

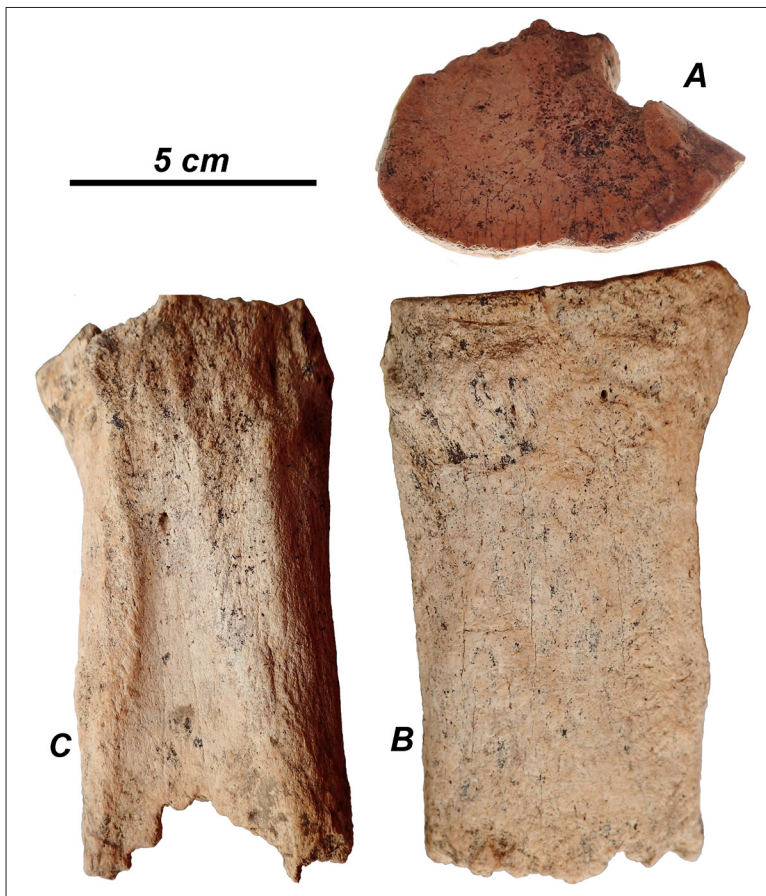


Fig. 2. The proximal fragment of the left third metatarsus of *Coelodonta antiquitatis* from layer 6 with hyena tooth marks: A, proximal articulation view; B, dorsal view; C, posteromedian view.



Fig. 3. The chewed by hyena distal part of the third metatarsus of *Coelodonta antiquitatum* from Buzdujeni 1.

trampling, so we arbitrarily classify the bone fragments as “flakes”.

Layer 8. We have at our disposal a single animal skeletal fragment, the part of upper canine of cave bear *Ursus spelaeus* (fig. 4).

Cluster analysis. The cluster analysis shows that the bone assemblage from layer 3 is closely associated with “typical” hyena den (fig. 5). Layer 4 is most similar with “typical” human settlement due to the predominating taphonomical features characteristic of human activity. Layers 5 and 6 are associated with the human settlement taphonomical type to a lesser degree, apparently, because of containing traces of hyena presence and activity recorded in those layers. Finally, the poor faunal remains from layer 8 do not permit to give adequate results. The cophnetic correlation index is 0.6894. A larger archaeozoological material with more detailed taphonomical analysis potentially will give more accurate results. It is necessary to

stress that the revealed taphonomic similarities are restricted only to the squares K-5 and L-5 where the archaeozoological material comes from.

Discussion

The archaeozoological material that we have at our disposal suggests that the taphonomic history of the site of Buzdujeni 1 is rather complex and was influenced by several factors, some of which will be discussed here. The complicated history of layers accumulation is supported by the microlayer structure observed in layers 3, 4, 5, and 7 [Vishniatski et al. 2020]. Vishniatski et al. [2020] indicate that all layers of the site contain stone and bone artefacts that indicate the Paleolithic human presence in the Buzdujeni grotto during all period of Pleistocene sediments accumulation in this site. Nonetheless, the presence of ancient humans in the grotto was not permanent. Cave hyena is also responsible for bone accumulation in the grotto when it was abandoned by humans. The osteological material from layers 3, 5, and 6 show that the Buzdujeni Grotto was repeatedly occupied by *Crocota crocota spelaea*.

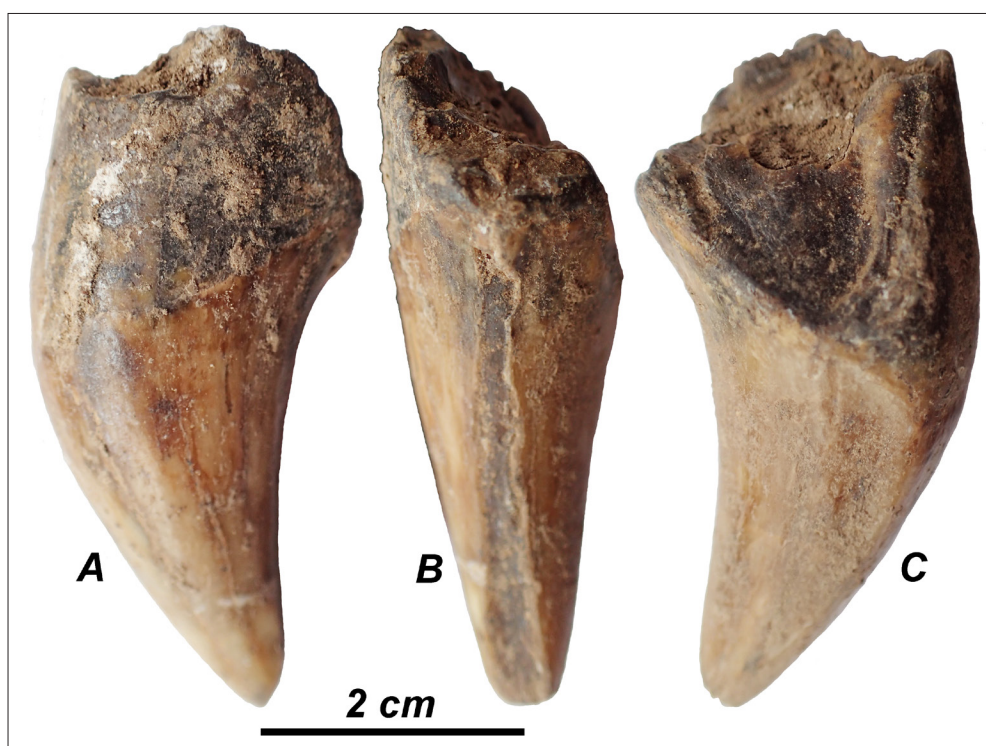


Fig. 4. The left upper canine of *Ursus spelaeus* from layer 8 of Buzdujeni 1: A, lateral view; B, posterior view; D, mesial view.

The most complete traces of cave hyena activity come from the squares K-5 and L-5 of layer 3 where the hyena den was situated. This conclusion is confirmed by the cluster analysis (fig. 5) of the main taphonomic features presented in Table 2. The almost entire bone accumulation from this layer (possibly with exception of cave bear remains) is hyena related: bison remains belong to a female that was the easier prey for a hyena individual or a pack of hyenas and one of the limb bones shows clear tooth marks. Steppe bison *Bison priscus* was a common prey for cave hyena and also served as prey for hyena in the Bohemian karst [Diedrich, Zák 2006] and other European Late Pleistocene sites [Villa, Bartram 1996; Diedrich 2011; Dusseldorp 2011]. All small bone fragments from this bone accumulation represent stick-like fragments resulted from bone cracking. At least two specimens represent peculiar for hyenas “nibbling sticks”, i.e. uni- or bipolar nibbled and chewed stick-like bone fragments [Diedrich, Zák 2006]. According to Diedrich and Zák [2006], the hyena cubs were the main producers of such characteristic bone fragments.

Another bone fragment with well-expressed tooth marks comes from layer 6. This is a proximal fragment of metatarsal of woolly rhinoceros *Co-*

lodonta antiquitatis (fig. 2; 3). The woolly rhinoceros is another common for cave hyena prey species [Diedrich 2011; 2013; Dusseldorp 2011; 2013].

The partially destroyed distal parts of limbs of large herbivores from layers 3 and 6 (*Bison priscus* and *Coelodonta antiquitatis* correspondingly) with tooth marks represent a specific consumption habit of cave hyena to bring distal parts of prey legs to their den [Brugal et al. 1997; Diedrich 2011; Diedrich, Zák 2006].

The fragment of a juvenile radius of cave hyena from layer 4 may indicate the presence of a cub-raising cave den of *Crocota crocota spelaeae*. Juvenile hyena remains are considered as typically indicative of hyena bone accumulations since juvenile hyenas stay in the den for the first 15 months of their life and experience high infant mortality [Dusseldorp 2011 and references therein]. The reported cases of alternate cave occupations by hyenas and humans are quite common, especially during Early and Middle Paleolithic of Europe [Brugal et al. 1997; Diedrich 2011; Dusseldorp 2013].

The large number of cave bear individuals represented by the correspondingly large amount of skeletal elements unlike the rest of species recorded at Buzdujeni (fig. 5). The richness and full-

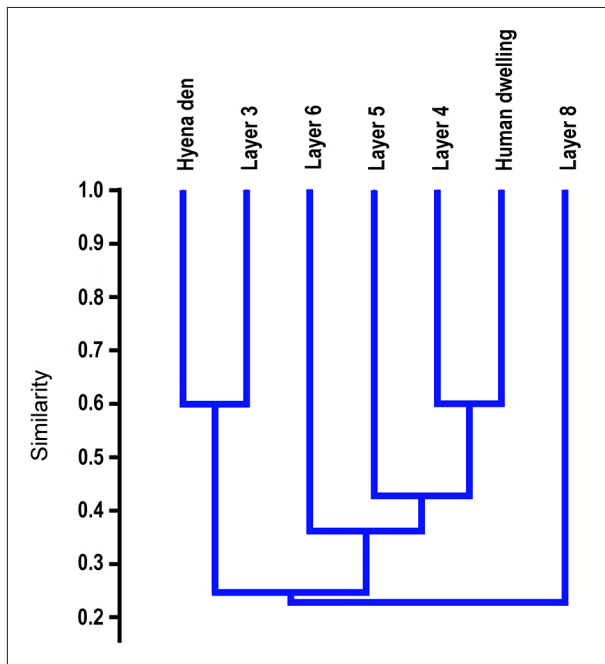


Fig. 5. The dendrogram based on taphonomic characteristics and archaeological context of layers from the Middle Paleolithic site of Buzdujeni 1 compared to the “typical” hyena den and Paleolithic human settlement.

ness of cave bear remains suggest that the Buzdujeni Grotto was periodically used by *Ursus spelaeus* for hibernation. A high number of cave bear remains from Buzdujeni 1 resulted from the attritional mortality during hibernation that is common in the similar sites with cave bear remains [Argenti, Mazza 2006; Dusseldorp 2013]. Hibernation-related death could be caused by such natural causes as starvation or disease. However, the hibernating cave bears were also quite often attacked by predators, such as hyenas and wolves [Argenti, Mazza 2006]. The taphonomic data demonstrate that cave bears were quite often scavenged by cave hyena [Diedrich 2011; 2013]. Unfortunately, we do not have at our disposal sufficient data that could reveal the mortality cases of cave bear from Buzdujeni 1 and shed light on the possible character of the relationship between cave bear and cave hyena at this site.

According to Vishniatski et al. [2020], cave bears are responsible for bone fragmentation at

Buzdujeni 1 through trampling that apparently resulted in most of the large bone fragments from layer 4. Therefore, the “bone flakes” from Buzdujeni 1 are not analogous to the bone flaking described by Villa and Bartram [1996], although the participation of hyenas in production of large bone fragments, for instance in the layer 6, cannot be excluded.

It is difficult to say which animal remains from Buzdujeni 1 were accumulated by humans only. As Dusseldorp [2013] demonstrated, Neanderthals appear to be preferentially associated with cervids, while hyena deposits contain more bovids, equids and megafauna. The data from Buzdujeni 1 are in accordance with the conclusions of Dusseldorp [2013] on cave hyena prey preference. The prey fauna from Buzdujeni 1 is dominated by steppe bison and horse (fig. 6), but remains of mammoths and rhinoceroses also are present [David 1980]. The predominance of *Bison priscus* and *Equus ferus ssp.* in the fauna from Buzdujeni 1 indicates rather open steppe-like landscapes, a biome

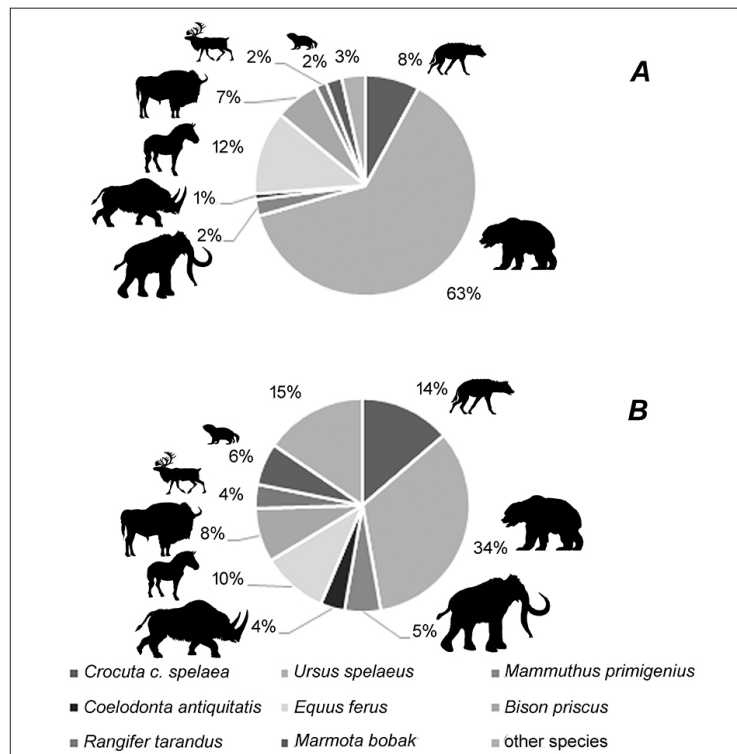


Fig. 6. Species composition of mammal assemblage from Buzdujeni 1: A, mammal remains composition according to bone number; B, mammal remains composition according to the minimum number of individuals. The diagrams include the data from David [1980] and the data obtained from this research.

that is well-suited to such cursorial pack hunter and scavenger as *Crocuta crocuta spelaea* [Croitor, Brugal 2010; Villa et al. 2010]. Cervid species (*Cervus elaphus*, *Megaloceros giganteus*, *Rangifer tarandus*), although present at Buzdujeni 1, are very low in number [David 1980].

Conclusions

The new archaeozoological and taphonomical data identify the Buzdujeni Grotto as a periodic hyena den. The most complete taphonomical evidence on hyena den come from squares K-5 and L-5 of layer 3, but the presence of hyena at Buzdujeni 1 site is also recorded in layers 4, 5, and 6. The evidence of cave hyena presence at Buzdujeni 1 includes steak-like bone fragments, “nibbling sticks” (nibbled and chewed stick-like bone fragments), gnawed bones of large prey species (*Bison priscus*, *Coelodonta antiquitatis*), and skel-

etal remains of juvenile individuals. The composition of fauna from Buzdujeni 1 (*Equus ferus ssp.*, *Equus hemionus hydruntinus*, *Bison priscus*, *Saiga tatarica*) indicates generally open landscape in the environments of the site when Paleolithic layers were accumulated. Remains of typically forest species are scarce at Buzdujeni 1 site. The results of this study reveal a complicate story of Late Pleistocene bone accumulation in the Middle Paleolithic site of Buzdujeni 1 that resulted from ancient human presence and activity, but also from the presence and bone accumulation of cave hyena (*Crocuta crocuta spelaea*), and from the presence of cave bear (*Ursus spelaeus*) that used the grotto for hibernation. The main conclusion is that we need more fossil remains from this interesting site in order to reveal the stratigraphic distribution of species and to understand better the history of the animal bone accumulation from Buzdujeni 1.

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