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Zooarchaeological study of an Upper Palaeolithic site with mammoth remains, Pushkari I–excavation VII (Chernigov oblast, Ukraine)

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ABSTRACT

The Pushkari archaeological complex is one of the few sites which shows human occupations related to the first part of the Upper Pleniglacial. Pushkari I furnished rich archaeological material. Study of the lithic industry identified a facies of Gravettian with epigravettian features, called Pushkarian.

In order to figure out acquisition and treatment modalities of large mammals, and to test the hypothesis of the use of woolly mammoth as a source of food and building material, we conducted a zooarchaeological study of the faunal remains from excavation VII of Pushkari I.

The faunal spectrum is made of *Mammuthus primigenius*, the predominant species, *Equus* sp., *R. tarandus*, *Canis lupus* and *Vulpes vulpes/Alopex lagopus*. Taphonomic study suggests that some bone remains of mammoth lay in open-air for a long time before they were buried while bones of carnivores and other bones of mammoth were quickly buried. All the assemblage was affected by acid sandy deposits. Phenomena of freeze-thaw action were observed, but the archaeological layer was little disturbed.

Mammoths came regularly on the promontory. The skeletal preservation shows that they died there. The mortality profile with a majority of adults combined with a palethnographic interpretation suggests that they were slaughtered and butchered by human groups. Tusks were stored.

The spatial distribution indicates a campsite, which corresponds to recurrent short-termed occupations on the promontory by human groups. This site is a strategic place to collect flint to make weapons, to find dry mammoth bones, and to hunt and butcher mammoths. This study provides new data to understand the particular status of the woolly mammoth for the Upper Pleniglacial human groups in the Russo-Ukrainian plain.

1. Introduction

The Pushkari archaeological complex was discovered in the 1930s by Rudinsky (1947), Our work focuses on Pushkari I, which furnished a unique cultural layer. Stratigraphic and geographic studies showed that the archaeological layer is located at a depth of 0.70 m under the modern surface. As it is located just above the Briansk soil (Pidoplichko, 1947; Boriskovsky, 1953; Velichko, 1973; Velichko et al., 1997) it can be correlated to the beginning of the Upper Pleniglacial. During the maximum of Upper Pleniglacial, between 23 000–20 000 BP, the climate in the area became colder and more arid (Ivanova and Tzeitlin, 1987; Damblon and Haesaerts, 1997; Haesaerts et al., 1998, 2003, 2007). In the region, recovered remains of human occupations during this period are scarce, with less dense concentrations than during the previous Interpleniglacial and later Pleniglacial (Djindjian et al., 1999; Noiret, 2009). Pushkari is one of the few archaeological complexes giving information about this time. In order to understand procurement and processing of large mammals, and to test the hypothesis of the use of woolly mammoth as a source of food and building material,

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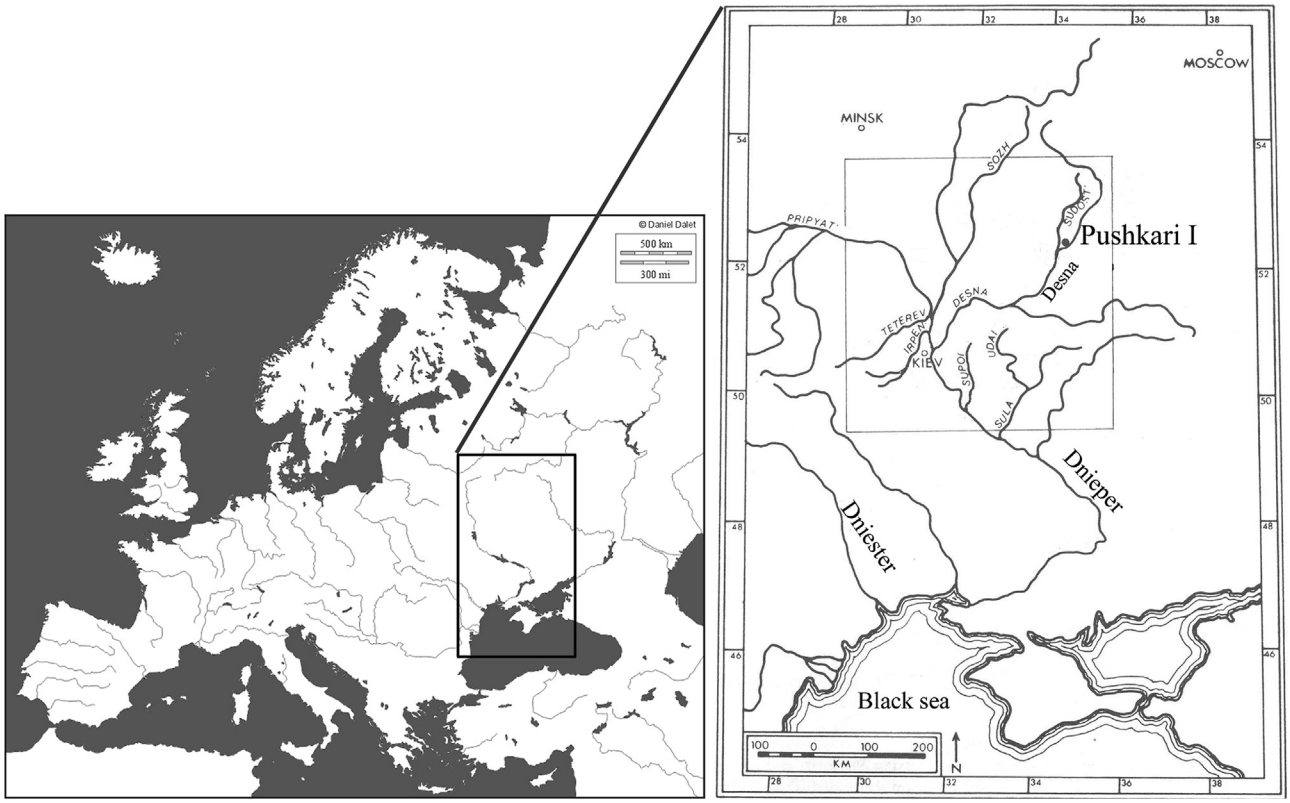

Fig. 1. Location of Pushkari I.

we zooarchaeologically studied the faunal remains from excavation VII from Pushkari I.

2. Palaeological and archaeological context

The archaeological complex of Pushkari is situated in Northeastern Ukraine near the village of Pushkari, on the promontory of Pogon in the district of Novgorod-Severski in Chernigov oblast (Fig. 1).

During the 1930s, the Academy of Sciences of USSR set up expeditions in order to find Palaeolithic open-air sites. During the expedition from Chernigov, A.J. Rudinski discovered in 1932 the first locus of the archaeological complex of Pushkari, called Pushkari I (1947). Several campaigns of excavation were led, divided in seven sectors.

A.J. Rudinski excavated the site in 1932 and 1933 (excavation I) (Rudinsky, 1947). R.I. Boriskovski directed excavations from 1937 to 1939 (excavations II, III, IV) (Boriskovski, 1949). V.I. Belyaeva has conducted field work since 1981 (excavations V, VI, VII). We focus here on excavation VII (42 excavation m^2), which was identified by archaeological surveys made by Gribchenko in 1996, 1997 and 1998 and has been excavated by V.I. Belyaeva since 1998 with P. Vasil'ev (Fig. 2).

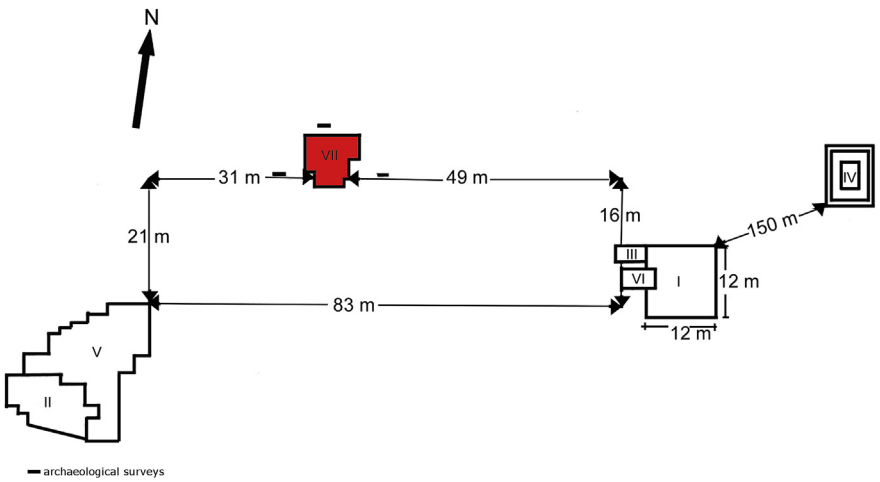

Fig. 2. Schema of the location of archaeological excavations of Pushkari 1. I–VII: loci of excavations (after Belyaeva, 2002, 2009).

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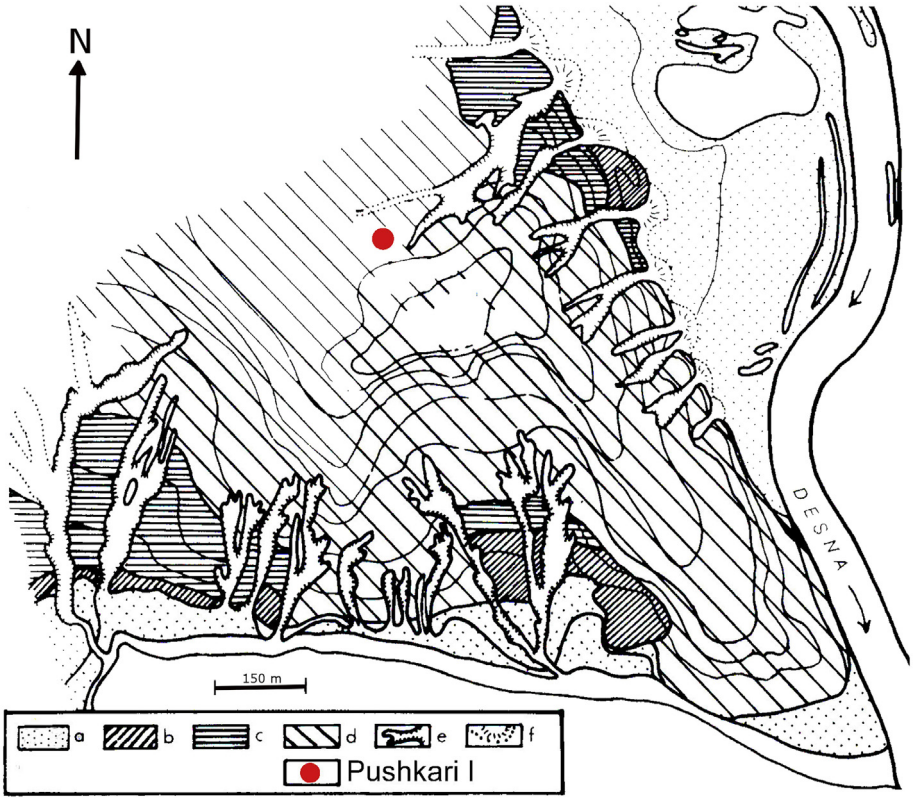

Fig. 3. Geomorphology of the promontory. a: floodplain; b: first terrace; c: second terrace; d: plateau; e: recent ravines; f: ancient ravines (after Soffer, 1985 and Velichko, 1961).

2.1. Geomorphological and geological context

The site of Pushkari I is located on the right (west) bank of the Desna river on a promontory situated at 35–40 m above the thalweg (Fig. 3). The plateau is located above the river on a promontory at an angle of 40–50°. The interfluvial plateau is adjacent to the river.

The geological study was made by Velichko et al. (1997, 1999) and Gribchenko (2006). The Pushkari site complex is located in quite thick loess deposits (Velichko et al., 1997, 2002). The particle size and the chemical and mineralogical components reflect the alternation of loess and paleosols. The cultural layer lies 0.70–0.90 m below the modern surface, above yellowish-brown loess silts, and is covered by loess silty sands. At around 1.50 m below the modern surface, the Bryansk soil was identified (Fig. 4; Table 1).

Table 1
Description of the stratigraphy of Pushkari I (from Velichko et al., 1997; Velichko et al., 1999).

Number of the sedimentary layer	Description of the geological environment	Thickness of the layer (m)	Depth of the layer (m)
1	Humus-bearing. Dark grey sandy clay.	0.11	0.11
2	Horizon A2/B. Sandy clay. Lenses of heterogeneous sands. Lenses of grey and dark brown sediments. Gradual transition to the lower layer.	0.11	0.22
3	Horizon B. Average particle sands with calcareous sands and lithic artefacts in the lower part.	0.11	0.33
4	The B2 horizon is composed of sand, light brown fine grain and deep brown clays. In the upper part of the layer was composed of calcareous sands. Below there are ferruginous concretions/ochreous, with some terriers. Finally there are coarser sands.	0.18	0.51
5	Silty sediment light brown, with thin incursions of dark brown carbonate sands.	0.30	0.80
6	Sediment light brown, slightly oxidized (iron), covering the cultural layer. They are composed of fine-grained and coarse sand lenses more.	0.10	0.90
7	Yellow-brown sandy loess. The transition to the lower layer is unclear.	0.07	0.97
8	Sandy loams. The upper part is slightly gleyed, having a bluish tint.	0.09	1.06
9	Sandy loams, porous. There are some gleyed sediments. In the upper part (to a depth of 1.15 m) sediments have a brownish coloration.	0.05	1.11
10	Greyish-brown clay. The limit with the lower layer is clear.	0.03	1.14
11	Yellow-brown clays, clear, dense, slightly gleying with small concretions of carbonate.	0.10	1.24
12	Reddish-brown clay, with light density. This layer is quite irregular with numerous varied oriented veins of sedimentary.	0.08	1.32
13	Light brown clay, very dense, slightly clay with lenses of greenish sediments. The sediment is not homogeneous.	0.10	1.42
14	Dense silt with varied colorations. The top of the layer is disturbed by solifluction which develop up to 60–70 cm.	0.40–0.86	1.99–2.28

(*continued on next page*)

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Table 1 (*continued*)

Number of the sedimentary layer	Description of the geological environment	Thickness of the layer (m)	Depth of the layer (m)
15	Light gray silt, sediment lenses gleyed bluish and silty carbonates. The upper part of the layer is characterized by darker veins of fine sediment. Presence of carbonate concretions.	0.50	2.78
16	The upper part of the humus layer corresponds to the horizon of the deposit Mezin. Silts slightly gray-brown and darker black. The layer has varied with the intrusion of numerous veins sediment colorations.	0.10	2.88
17	Dark gray silt, sand and a little sparse. The upper part of the layer is blue-gray with gleying lenses. There concretions and many brands oxidation to iron and manganese. In the lower part of the layer, there many terriers.	0.19	3.07
18	Dark brown silt, sand of various colors.	0.26	3.33
19	Fine-grained sand, silt, yellow-brown, dense and slightly chalky. There is ortsand* and traces of oxidation (iron).	0.22	3.55
20	A mix of pale to darker, dense gray silty sands, which contains brown lenses, dense sand with ferruginous concretions in a thickness of 5–7 cm.	0.56	4.11
21	Light gray sand with a brownish hue and traces of oxidation, with greenish sandy loams.	0.10	4.21

*Ortsand : kind of hardpan (sandstone) which is formed in the basement of sandy land accretion of sand and gravel by hydroxides of iron, aluminum and manganese, as well as organic matter. Percolation of rainwater and seasonal upwelling of water table are the necessary conditions for the descent of organic compounds and iron intake.

The Bryansk soil is characterized by carbonated soil which is rich in humus. It was formed in glacial loams during the Dunaevo Interstadial of the upper Pleistocene, corresponding to MIS 3 and covered by till of the Late Glacial Maximum of the Valdai (*Upper Würmian*) glaciation. It is dated between 27 000–23 000 BP (Velichko, 1961b; Velichko and Morozova, 1972; Markov, 1977; Velichko, 1982; Rusakov and Korkka, 2004).

The cultural layer formed just after the Bryansk episode during MIS 2 corresponding to the Maximum of the Upper Pleniglacial. During the Upper Pleniglacial, between 23 000–20,000 BP, the climate of the area became colder and more arid (Ivanova and Tzeitlin, 1987; Damblon and Haesaerts, 1997; Haesaerts and *al*., 1998, 2003; 2007).

The entire deposit is highly altered. There is also a high concentration of clay aggregates. Some sediments came from slope failure deposits.

According to the micromorphology of the cultural layer, the sediments sampled in the cultural layer contain lightly colored and tapered edge amphibole grains. There are also patinated mudrocks. The same phenomenon was observed in the mica grains. However, the low proportion of clay aggregates and mica and light colors indicate that the geological layer was relatively little disturbed by pedogenesis.

2.2. Dating

The first radiocarbon dating carried out on a bone from the archaeological layer of Pushkari I was 16 775 ± 605 (OC 899) BP. However, Velichko (1961a), Velichko et al. (1997) and Velichko and Zelikson (2005) think that this date is too recent considering the stratigraphical context. The latest results have yielded older dates, between 22 500 and 19 000 BP (Table 2).

2.3. Vegetation

A palynological study was conducted by Velichko et al. (1999) in the cultural layer. It revealed the predominance of herbaceous taxa. They noticed the presence of *Plantago* sp. (plantain) and *Anthoceros* sp. (hornwort) which are relied to wetlands. The area was an open landscape of steppe-tundra type, with the proximity of forest cover and a relatively wet climate.

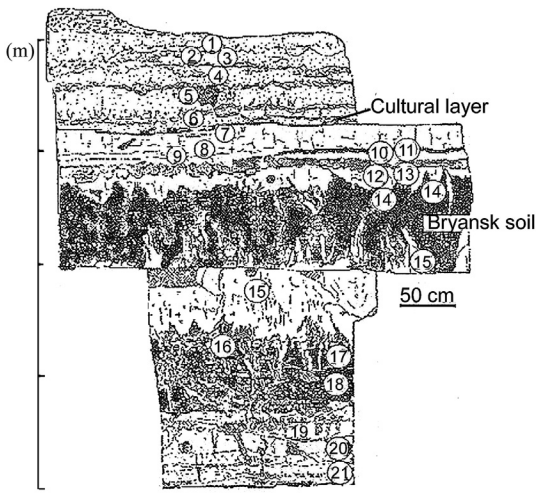

Fig. 4. Stratigraphy of Pushkari I (see table 1) (after Velichko et al., 1997, 1999).

Table 2
Radiocarbon and calibrated dates of the cultural layer of Pushkari I, using the IntCal13 calibration (Reimer et al., 2013), by OxCal 4.2 © Christopher Bronk Ramsey 2014.

Excavation	Datings ^{14}C BP (Belyaeva, 2002; Gribchenko et al., 2011)	Lab code	Material	Calibrated range (68.2%)	Calibrated range (95.4%)
II	16 775 ± 605	QC899	Burned bone	21 033–19 521	21 861–18 911
V	19 010 ± 220	AA1389	Burned bone	23 142–22 587	23 463–22 446
	20 500 ± 500	GIN11311b	Bone	25 295–24 117	25 825–23 604
	20 900 ± 900	GIN11311a	Bone	26 060–24 088	27 260–23 275
	20 600 ± 1200	GIN8529	Mammoth tooth	26 115–23 453	27 613–22 410
	20 700 ± 500	GIN8529a	Mammoth tooth	25 511–24 367	25 978–23 820
	21 000 ± 400	GIN3382	Bone	25 765–24 834	26 041–24 315
	21 100 ± 400	GIN3381	Burned bone	25 855–24 970	26 135–24 388
	22 350 ± 150	GIN11307	Burned bone	26 892–26 391	27 092–26 199
VII	19 500 ± 240	Ki11901	Horse bone	23 785–23 165	24 068–22 906
	20 160 ± 180	GIN11310	Burned bone	24 449–24 015	24 808–23 791
	20 350 ± 180	GIN10195	Burned bone	24 749–24 193	25 065–24 023
	20 500 ± 500	GIN11311	Mammoth tooth	25 295–24 117	25 825–23 604
	20 840 ± 190	GIN11309	Burned bone	25 449–24 873	25 592–24 538
	20 900 ± 600	GIN11311a	Mammoth tooth	25 781–24 467	26 470–23 788

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2.4. Faunal associations

Boriskovski (1949, 1953) and Sablin (1997) highlighted the presence of the following mammals: *Mammuthus primigenius*, *Equus* sp., *Rangifer tarandus*, *Cervus elaphus*, *Ursus arctos*, *Canis lupus*, *Alopex lagopus*, and *Dicrostonyx torquatus*. We can interpret the palaeoenvironment as an open landscape, steppe-tundra type, with a wooded area with the presence of *Cervus elaphus*. The microfauna is represented by *Discrotonyx torquatus* (arctic lemming) and *Microtus gregalis* (narrow-headed vole) which are typical species of cold steppe, and *Arvicola terrestris* (water vole) which lives near rivers.

2.5. Lithic remains

Excavation VII of Pushkari I furnished around 20 000 artefacts (Belyaeva, 2004). The majority of the tools are represented by long points with regular shape and retouching. These points are symmetrical with oblique truncation and backed edges. Some points showbilateral distal retouches and some points are asymmetric. Some points have lateral retouches and proximal truncation, called Pushkarian points. There also scrapers and endscrapers, microliths and combined tools in low proportions. There are many flakes.

This is a complete lithic assemblage containing the products of debitage. Classical tools include points and scrapers on large blades, points, retouched blades, and scrapers on small blades. An archaic group of tools includes Mousterian types, including scrapers, wedge-shaped tools, becs, and massive points. There are made on cores and technical flakes, with well defined retouch. Nodule forms have only elements of secondary treatment. Flakes produced from nodules were selected to make tools. Among them are endscrapers and scraper forms (Fig. 5). The tools are oriented to hunting activities. The lithic assemblage of Pushkari I is particular, presenting some "archaic" pieces and some Epigravettian features. It is classified as a particular facies of recent Gravettian with Epigravettian features, called Pushkarian (Rudinsky, 1947; Boriskovsky, 1953; Otte et al., 1996; Belyaeva, 1997, 2000, 2002; Nuzhnyi, 2009). The flint is black, from Cretaceous deposits accessible at the base of the promontory.

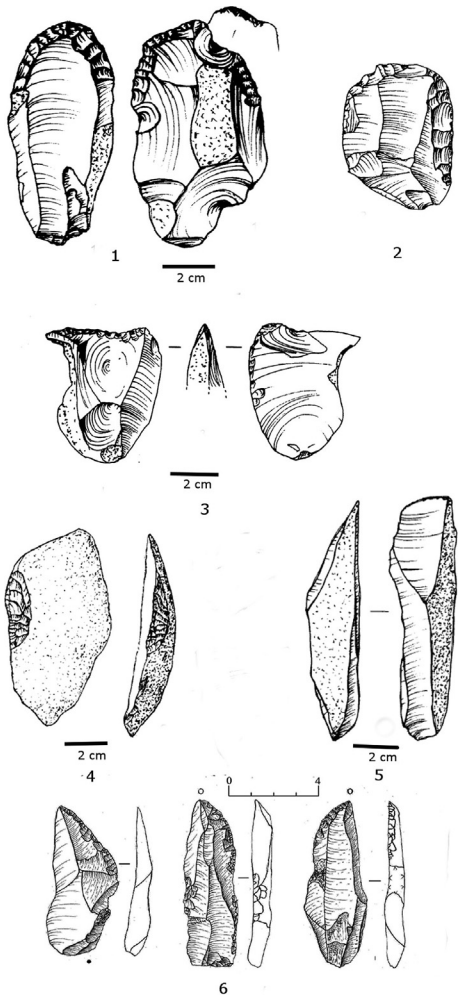

Fig. 5. Lithic tools of Pushkari I–excl. VII. 1: endscrapers; 2: "archaic" form tool; 3: bec shape form; 4: cortical forms; 5: blade forms; 6: Pushkarian points with lateral retouches and proximal truncature (Belyaeva, 2004).

2.6. Human remains

A tooth (P^2) of *Homo sapiens* was discovered in 19-Ж (Belyaeva et al., 2011; Khaldeyeva et al. 2012).

3. Zooarchaeology

3.1. Material and methods

We studied the faunal remains curated in the site of Pushkari of excavation VII of Pushkari I, excavated from 2003 to 2013. The study was undertaken following zooarchaeological methods including paleontology, taphonomy and palethnography (Poplin, 1976; Von den Driesch, 1976; Binford, 1979; Barone, 1986; Patou-Mathis, 1994; Lyman, 1994, 2008; O'Connor, 2000; Péan and Patou-Mathis, 2003; Reitz and Wing, 2008). Taxonomic references and systematic were used in agreement with the code of zoological nomenclature (2000).

To determine the faunal remains including the individual ages and sex, we used comparative anatomy references (Bouchud, 1953; Coppens, 1965; Lavocat, 1966; Laws, 1966; Lessertisseur and Saban, 1967a,b; Pales and Lambert, 1971; Schmid, 1972; Olsen, 1979; Pales and Garcia, 1981; Roth, 1984; Barone, 1986; Hillson, 1986; Eisenmann, 1991; Haynes, 1991; Hufthammer, 1995; Averianov, 1996; Lister, 1996; Shoshani and Tassy, 1996; Beauval et al., 1998; Lister, 1999; Altuna, 2004), and osteological collections of references (Collections de l'Institut de Paléontologie Humaine – Muséum National d'Histoire Naturelle de Paris). Measurements were taken following von den Driesch (1976), Agenbroad (1994), and Lister (1996).

We used quantitative units from Poplin (1976) and Lyman (2008). Abbreviations correspond to:

NR: Number of remains.

NRt: total Number of Remains.

MNE: Minimum Number of element. It defines the representation of skeletal elements preserved for a taxon, taking into account the reassemblies, pairings, age and sex.

cMNI: Minimum Number of Individuals by combination, taking into account the reassemblies, pairings, age and sex.

Ind: Indetermined.

Qsp: specific coefficient. It is obtained from the frequency of occurrence of an element in the anatomy of a species.

MAU: Minimum Animal Unit. It allows you to specify the degree of preservation of different anatomical elements of a species.

$$\mathrm{MAU} = \mathrm{MNE}/\mathrm{Qsp}$$

$$\text{MAU frequency } (\%) = \mathrm{MAU} \times 100/\mathrm{MAUmax}$$

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Ps: percent survivorship, establishes an observation on three levels: for each element; for each anatomical region; for the overall deficit (total) of the species It is calculated by element. It takes into account the MAU which is based on the minimum number of individuals evaluated by the cMNI.

$$Ps = MNE \times 100/Qsp \times MNImax = MAU \times 100/MNImax$$

3.2. Results

3.2.1. Taxonomic composition

The faunal spectrum is composed of *Mammuthus primigenius* (woolly mammoth), *Alopex lagopus* (polar fox), *Vulpes vulpes* (red fox), *Canis lupus* (wolf), *Equus* sp. (horse), and *Rangifer tarandus* (reindeer) (Table 3). Mammoth is predominant in terms of number of remains, minimum number of elements and in minimum number of individuals. Small canids are well represented. The remains of mammoth are the most fragmented bones.

Table 3
Counting of the faunal remains, Pushkari I–excavation VII.

Species	NRt	MNE	cMNI
Small canids (*Alopex lagopus/Vulpes vulpes*)	115	84	3
Canis lupus	22	22	1
Equus sp.	12	8	1
Rangifer tarandus	6	4	1
Mammuthus primigenius	419	168	11
NISP	**574**	**286**	
Large-sized mammal	169	12	
Large/medium-sized mammal	14	1	
Medium-sized mammal	41	12	
Small-sized mammal	25	9	
Unidentified splinters	50		
Total	**873**	**320**	**17**

3.2.2. Paleontological characteristics of fox remains

Foxes are represented by 115 bone remains belong to at least three individuals. We took measurements on six hemi-mandibles, long bones, and innominate to determine the species.

According to the dimensions and specific determination from Altuna (2004) (Table 4) at least two hemi-mandibles (mandible 1) and a radius belong to an *Alopex lagopus*. At least two hemi-mandibles (mandible 2) and a tibia belong to a *Vulpes vulpes*. Other remains cannot be taxonomically determined (mandible 3) but the small dimensions suggest that they could belong to *A. lagopus*.

Table 4
Osteometry of fox bones, Pushkari I- excavation VII. a) mandibles and teeth; b) long bones; c) pelvic girdle.

Elements	Criteria (measurements in mm)			
a) Mandibles and teeth				
	Height of the branch	Width × length M_2	Length M_1 × Length M_1–M_2–M_3	Articular condyl of the mandible
Mandible 1	31	4 × 6	/	/
Mandible 2	/	6,5 × 7,9	13 × 20	/
Mandible 3	/	/	/	7
b) Long bones				
	Width of the proximal extremity	Maximal length	Width of the distal extremity	
Humerus	20	/	/	
Radius	/		14	
Radius	/		14	
Radius	/		13	
Tibia	24		/	
c) Pelvic girdle				
	Acetabulum width			
Innominate	15			

3.2.3. Skeletal preservation

3.2.3.1. Small canids. Foxes are represented by 115 bone remains corresponding to at least 84 elements. Comparing the number of remains and the minimum number of elements, bones are not very fragmented. According to the anatomical preservation in minimum number of elements comparing to the modified Minimum Animal Unit (Fig. 6), mandible is the most represented element. Cranial elements, anterior and posterior limbs and metacarpals are relatively well preserved. The axial skeleton is poorly represented.

Considering the skeletal preservation in terms of percentage of Minimum Animal Unit and percentage of survivorship by anatomical parts, we noticed a low representation of all parts. Anterior basipods and metapodials are the most represented. The cranial skeleton and anterior and posterior limbs are relatively well represented. The axial skeleton, posterior basipods and metapodials and acropods and sesamoids are poorly represented (Fig. 7).

Twenty-five bone remains of small-sized mammals, were found which correspond to at least eight elements: two vertebrae, a rib, a scapula, four long bones. These bones probably belonged to foxes. From these results, three complete foxes were brought to the site.

3.2.3.2. Wolf. Wolf is represented by twenty-two remains corresponding to at least twenty-two elements, mainly metapodials and phalanges. We have also a right mandible with three teeth (P_3, P_4, M_1), a left mandibula with a tooth (M_2), a lumbar vertebra, a humerus, an ulna (Fig. 8) and a radius belonging to at least one individual.

3.2.3.3. Horse. Horse is represented by twelve remains corresponding to at least eight elements, mainly tooth: Left P_3, M_1, M_2; Right P_3, I_1; Left P^4; also a left rib and a right pelvis. These bones belonged to at least one individual.

3.2.3.4. Reindeer. Reindeer is represented by six remains corresponding to at least four elements: a left humerus, a cervical vertebra, a rib and a large sesamoid belonging to at least one individual.

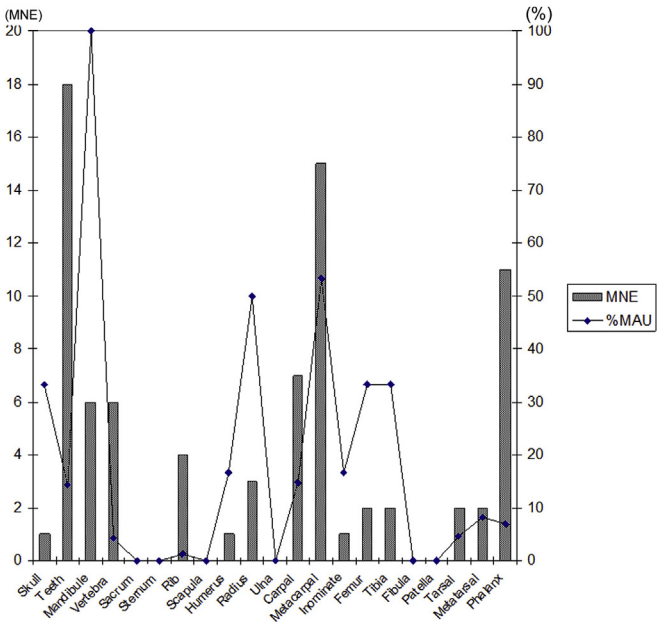

Fig. 6. Anatomical representation in Minimal Number of Elements and in percentage of Minimum Animal Unit of small canids (A. lagopus/V. vulpes), Pushkari I–VII.

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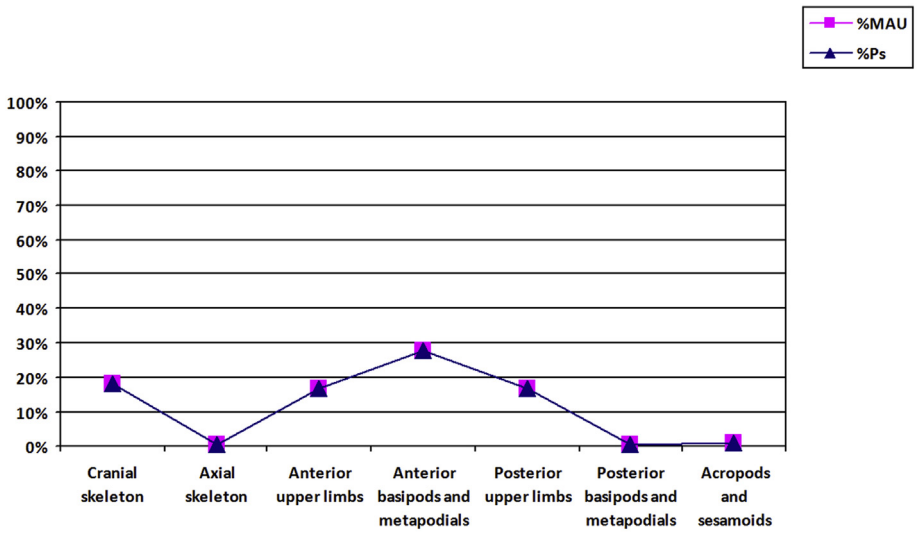

Fig. 7. Skeletal preservation by anatomical part in survivorship percentage and Minimum Animal Unit of A. lagopus/V. vulpes, Pushkari I-exc. VII.

Fig. 8. Right mandible, in lateral view (a) and right ulna, in anterior view (b) of Canis lupus, Pushkari I–exc. VII. (ph: L. Demay).

3.2.3.5. Mammoth. Mammoth is represented by 419 remains, corresponding to at least 168 elements (Table 5. Skeletal preservation of *Mammuthus primigenius*, Pushkari I–exc. VII.) belonging to at least eleven individuals. To these data are added at least two other bones, a long bone, and a flat bone (pelvis or scapula). Remains of *Mammuthus primigenius* are mainly teeth and tusks then ribs and vertebrae, then cranial elements, limbs, shoulder girdle pelvis, and short bones. Comparing the Number of Remain and the Minimum Number of Elements by anatomical parts, cranial and axial skeletons are the most fragmented, due to the natural anatomical preservation (Table 5; Fig. 9).

Comparing the %MAU and %Ps which have similar trends, this is a low representation of all elements (Fig. 10). The cranial skeleton is the most represented, then the upper limbs. The axial skeleton and short bones are rarely represented.

The skeletal preservation by elements in percentage survivorship highlights the presence of all bones except axis and caudal

Table 5
Skeletal preservation of *Mammuthus primigenius*, Pushkari I–exc. VII.

Elements	Qsp	NR	MNE				MNIf	cMNI				MAU	%MAU	Ps%
			L	R	Unid.	Tot.		Juv.	Subad.	Ad. *s.l.*	Tot.			
Skulls	1	18			1	1		1			1	1	12.5	9.1
Maxillar	2	1		1		1			1		1	0.5	6.25	4.5
Mandibles	1	8	2	3		3		1	1	1	3	3	37.5	27.3
Undefined teeth	12	30			18	18		1		7	8	1.5	18.75	13.7
Upper cheek	6	20	8	3	2	13		1	2	5	8	2.16	27	19.6
Lower cheek	6	24	8	2	11	21		1	2	6	9	3.5	43.75	31.8
Tusks	2	37	4	4	8	16				1	9	8	100	72.7
Cranial skeleton	20	**138**				**73**		1	5	5	**11**	**3.65**	**45.6**	**33.2**
Atlas	1	3			2	2					2	2	25	18.2
Cerv. vert.	5	2			1	1					1	0.2	2.5	1.8
Thor. vert.	19	25			16	16			1	1	2	0.84	10.5	7.63
Lumb. vert.	5	1			1	1					1	0.2	2.5	1.8
Unidentified vert.		1			1	1					1	1	12.5	9.1
Ribs	38	68	5	1	22	28					1	0.74	9.25	6.7
Axial skeleton	91	**100**				**49**			1	1	**2**	**0.54**	**6.75**	**4.9**
Scapula	2	3	1	2		3		1		1	2	1.5	18.75	13.7
Humerus	2	2		1	1	2		1	1		2	1	12.5	9
Radius	2	9	1	2	1	4			1	2	3	2	25	18.2
Ulna	2	3	1	1	1	3				1	2	1.5	18.75	13.7
Anterior upper part	8	**17**				**12**		1	1	2	4	**1.5**	**18.75**	**13.63**
Hamatum	2	5	2	3		5		1		1	2	2.5	31.25	22.7
Capitatum	2	1	1			1					1	0.5	6.25	4.5

(*continued on next page*)

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Table 5 (*continued*)

Elements	Qsp	NR	MNE				MNIf	cMNI				MAU	%MAU	Ps%
			L	R	Unid.	Tot.		Juv.	Subad.	Ad. *s.l.*	Tot.			
Pisiforme	2	5	2	2		4					2	2	25	18.8
Carpals	16	11	5	5		10					2	0.62	7.75	5.6
Metacarpals	10	3	1		2	3					1	0.3	3.75	2.7
Mc I	2	2			2	2					1	1	12.5	9.1
Mc II	2	1	1			1					1	0.5	6.25	4.5
Basipod-metapod	26	**14**				**13**					**2**	**0.5**	**6.25**	**4.9**
Pelvis	2	5	1	1		2		1			1	1	12.5	9.1
Femur	2	10	3	2		5			2	2	4	2.5	31.25	22.7
Tibia	2	7	1	2		3			1		1	1.5	18.75	13.7
Fibula	2	2	1			1					1	0.5	6.25	4.5
Posterior upper part	10	**24**				**11**		1	2	2	**5**	**1.1**	**13.75**	**10**
Talus	2	2	1	1		1					1	0.5	6.25	4.5
Calcaneus	2	3	1	2		3					2	1.5	18.75	13.7
Basipod-metapod	22	**5**				**4**					**2**	0.18	**2.25**	**1.6**
Unid. metapodial	20	1			1	1					1	0.05	0.625	0.45
Unid. phalanges	56	3	1		2	3					1	0.05	0.625	0.45
Proximal phalange	20	1	1			1					1	0.05	0.625	0.45
Acropod-sesamoid	96	**4**				**4**					**1**	0.04	**0.5**	**0.36**
								cMNI total = 11				**MAU max 8**		

vertebrae. Cheek teeth, mandibles and femurs are relatively well represented. Tusks are the most represented (Fig. 11).

3.2.4. Population structures

The age of the individuals was determined from the stages of eruption and dental wear and epiphysation stages of the long bones. Horse is represented by a single individual. According to the stages of eruption and tooth wear, it is aged about 4–5 years. Reindeer is represented by a single individual. From a proximal end of humerus not totally epiphysed, this individual was less than 42 months old.

Woolly mammoth age was derived from the cheek teeth. The cheek teeth are represented by 74 remains corresponding to at least 52 elements. The lower cheek teeth are represented by 24 remains corresponding to at least 21 elements belonging to at least 9 individuals with a juvenile (Table 6; Fig. 12). The lower cheek teeth are represented by 21 remains corresponding to at least 14 elements belonging to at least 7 individuals (Table 7).

The unidentified cheek teeth are represented by 30 remains corresponding to at least 17 elements, 10 unidentified molars, a M3, three M2/M3, a M2, A M1/M2 which could be paired with other upper and lower cheek teeth. At least one other individual has been identified by a Dp3 corresponding to the III-V Laws stages and juvenile class.

By combining all the data, the minimum number of individuals is estimated at 11 mammoths, with two juveniles, two young adults and seven adults *s.l.*. Stages and age groups are specified for each individual identified (Table 8).

Table 6
Lower cheek teeth, eruption and wear stages related to age classes of *M. primigenius* of Pushkari I- exc. VII.

Element	Lateralization	Laws stages	Classes
Isolated cheek teeth: NR = 18; MNE = 15			
Molar	ind	XVI–XXVIII	YA-IA-MA-OA
Molar	ind	XVI–XXVIII	YA-IA-MA-OA
Molar	ind	XVI–XXVIII	YA-IA-MA-OA
Molar	ind	XVI–XXVIII	YA-IA-MA-OA
M_1	L	IX–XIV	J-YA
M_1/M_2	L	IX–XIX	J-YA-IA
M_1	ind	IX–XIV	J-YA
M_1/M_2	ind	IX–XIX	J-YA-IA
M_2	ind	XIV–XIX	YA-IA
M_2	L	XVI	YA
M_2	L	XVI–XVIII	YA-IA
M_2	ind	XIV–XVIII	YA-IA
M_2/M_3	L	XIV–XXVIII	YA-IA-MA-OA
M_2/M_3	L	XIV–XXVI	YA-IA-MA-OA
M_3	ind	XXI–XXVII	IA-MA-OA
Cheek teeth on mandible: NR = 6; MNE = 6			
Dp_4	L	VIII	J
Dp_4	R	VIII	J
M_1	L	VIII	J
M_1	R	VIII	J
Molar	L	XVI–XXVIII	YA-IA-MA-OA
M_2/M_3		XIV–XXI	YA-IA

Table 7
Upper cheek teeth, eruption and wear stages related to age classes of *M. primigenius* of Pushkari I–exc. VII.

Element	Lateralization	Laws stages	Classes
Isolated cheek teeth: NR = 20; NME = 13			
Dp^4	L	VIII	J
Dp^4	R	VIII	J
M^1	L	IX–XIV	J-YA
M^1	R	XII–XIV	YA
M^1/M^2	L	XI–XVI	YA
M^1/M^2	L	IX–XIV	J-YA
M^2	R	XVI–XVII	YA-IA
M^2/M^3		XVI–XXV	YA-IA-MA
M^2/M^3	L	XVI–XXV	YA-IA-MA
M^2/M^3	L	XVI–XXV	YA-IA-MA
M^3	L	XXI–XXIV	IA-MA
M^3	R	XXII–XXV	MA
Molar	L	IX–XXVII	J-YA-IA-MA-OA
Cheek teeth on maxillary: NR = 1; NME = 1			
M^1		IX–XIV	J-YA

Table 8
Combination of data about eruption and wear stages related to age classes of *M. primigenius* of Pushkari I–exc. VII.

Laws stages	Classes	MNIc
		Total: 11
III–V	Juvenile	2
VIII		
XII–XIV	Young adult	2
IX–XIV		
XVI	Intermediate adult	2
XVI–XVIII		
XIV–XXI	Intermediate adult or mature adult	3
XVI–XXV		
XVI–XXV		
XXI–XXIV	Mature adult	2
XXII–XXV		

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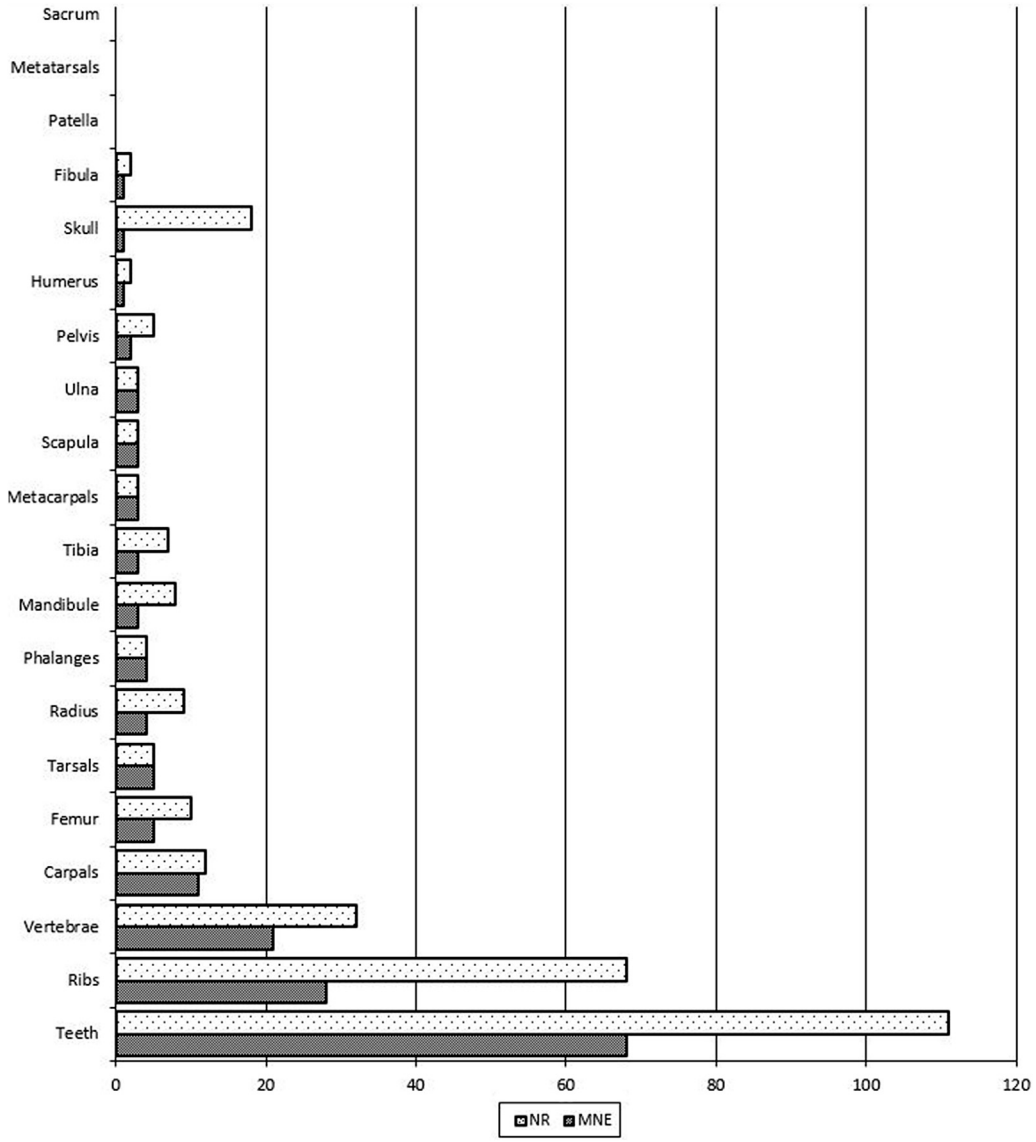

Fig. 9. Distribution of skeletal elements in Minimum Number of Elements in Number of remains of M. primigenius, Pushkari I, exc. VII.

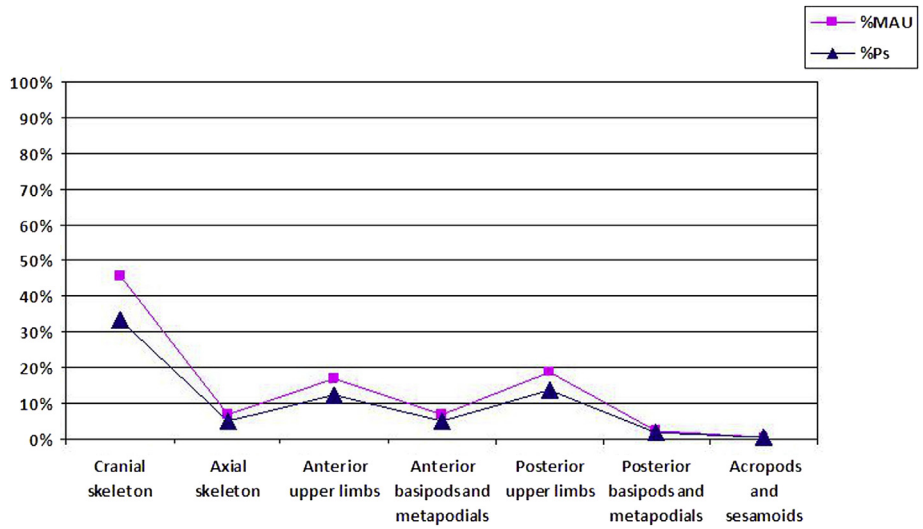

Fig. 10. Skeletal preservation by anatomical part in %MAU and %Ps of Mammuthus primigenius, Pushkari I–exc. VII.

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Age determination from the post-cranial elements used 13 elements from long bones 13 elements (Table 9). By combining all the data on the long bones, the minimum number of individuals is estimated at four mammoths, a young adult, a young or intermediate adult, an intermediate or mature adult, and a mature adult.

Table 9
Long bones, epiphysation stages related to age classes of *M. primigenius*, Pushkari I–exc. VII.

Elements	Lateralization	Stages	Classes	Possible pairings
Humerus	R	<XVIa	YA	x
Ulna	R	>XVIIIa–XX	AI-AM	▲
Ulna	L	>XVIIIa–XX	AI-AM	▲
Radius	R	>XVIIIa–XX	AI-AM	▲
Radius	L	<XVIa if female; <XVIIIa–XX if male	YA-AI	x
Radius	R	>XVIIIa–XX	AI-AM	◊
Femur	L	<XVIIIa–XX	YA-AI	○
Femur	L	<XVIIIa–XX	YA-AI	x
Femur	R	>XVIIIa–XX	AI-AM	▲
Femur	R	>XVIIIa–XX	AI-AM	◊
Femur	L	>XVIIIa–XX	AM	◊
Tibia	L	<XVIa–XVII if female; <XVIIIa–XX if male	YA-IA	x
Tibia	R	<XVIa–XVII if female; <XVIIIa–XX if male	YA-IA	x

There are two hipbones belonging to the same individual. According to the small size and the fact that they are not fused, it is a juvenile.

The maximum diameter of the glenoidal cavity was measured on two: the scapulae measuring, for one 120 mm, for the other 180 mm. They belong to two different individuals. The first individual is a juvenile. The second individual is an adult. Adult scapulae are generally between 150 and 200 mm (Beauval et al., 1998), greater diameter being attributed to males. Here, we cannot determine the sex of the individual.

For sex determination, we used the circumference of the base of the 16 tusks from at least eight individuals (Fig. 13). Based on the work of Haynes (1991), juveniles are below 200 mm. Young males and adult females are between 200 and 350 mm. Tusks of mature males can exceed these dimensions. The different measures in Pushkari I–exc. VII indicate the presence of seven young males/females/adult females and one adult male.

A femur of a mature adult is 92 cm long. According to the dimensions, at this stage, the length of the femurs of males does not fall below 96 cm (Haynes, 1991). It is therefore a female.

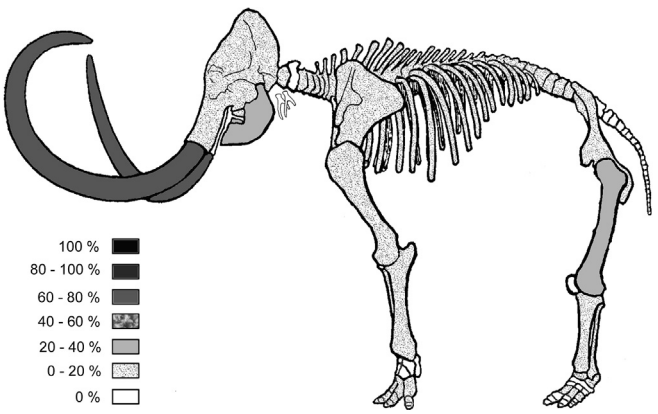

Fig. 11. Frequency of anatomical elements in %Ps of Mammuthus primigenius, Pushkari I–exc. VII. (skeleton of Borna modified from Abel 1925 in Osborn, 1942).

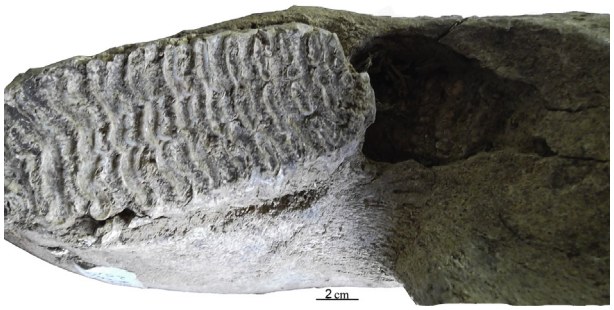

Fig. 12. Mandible and cheek teeth of juvenile M. primigenius of Pushkari I–exc. VII, in occlusal view. (ph: L. Demay).

The minimum number of individuals is 11 mammoths. We note the presence of two juveniles, two young adults, two intermediate adults, three middle-aged adults and two mature adults, with at least one female and one male.

3.2.5. Taphonomical study

3.2.5.1. Climato edaphic agents. The climatic and soil agents indicate the conditions of burial (Fig. 14). The surface of the bone is affected, which affects the visibility. Half of the remains, especially large mammals, show rough surfaces and large detachments of splinters due to weathering. These bones were relatively long in the open air, especially the bones of mammoths (Table 10), probably because of their large size.

Table 10
Alterations due to climato-edaphic factors in NR by species.

Species	Weathering	Percolation water	Run-off water	Charriage-à-sec
Mammuthus primigenius	280	183	38	119
Rangifer tarandus	3	5	0	0
Equus sp.	6	9	0	0
Canis lupus	1	17	0	6
A. Lagopus/V. Vulpes	2	112	3	34
Large mammal	123	102	8	45
Large/Medium-sized mammal	9	7	0	1
Medium-sized mammal	12	30	5	15
small-sized mammal	0	20	0	4
Unidentified splinters	9	7	0	7
Total NR (%NRT)	445 (51%)	492 (56.4%)	54 (6.2%)	231 (26.5%)

The bones were covered by loess sediments, whose acidity is probably the origin of the intense alteration of the bones. There are few marks of dissolution due to runoff of water and acidic solutions generated by the installation of a vegetative cover. Oxide deposits (manganese and iron) due to water percolation are visible on many bones of large, medium and small mammals.

The geological study indicates that the layer that covered the cultural layer has oxidized sediments (Velichko et al., 1997, 1999). This feature helps to explain the oxidation of bone remains by percolating water. There are around 25% of traces of *charriage-à-sec*, reflecting some soil movements and actions of trampling, but not intense.

3.2.5.2. Fractures. The fractures observed on the bones of large mammals and medium-sized mammals are longitudinal, spiral and stepped types. Several bones have both fractures in non-human spiral (Fig. 15) and stepped type (Karr and Outram, 2012). These phenomena are due to ice crystallization, drying, and wetting. These observations are characteristic of freeze/thaw alternation.

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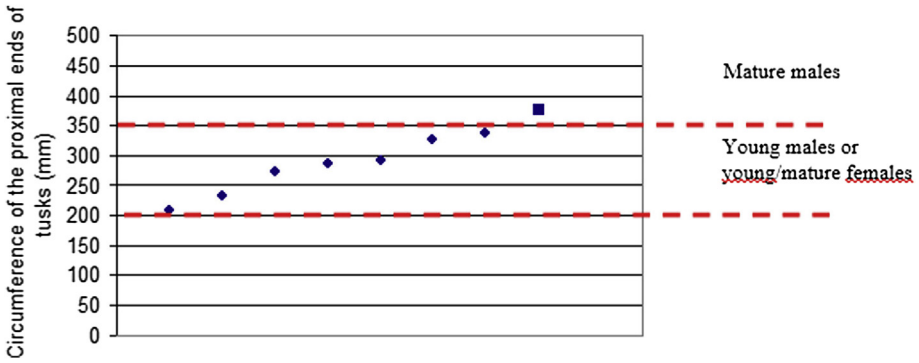

Fig. 13. Circumference of the base of the tusks of M. primigenius of Pushkari I–exc. VII.

3.2.5.3. Non-human biological factors. There are relatively few marks due to non-human biological factors (Fig. 16). Vermiculations due to the roots of the plants are concentrated in small areas of the bones. All species are affected (Table 11). These observations reflect a relatively poor vegetation cover on the promontory. There are no marks related to carnivores and rodents.

Table 11
Alterations due to non-anthropogenic biologicals factors in NR.

Species	Plants	Carnivores	Rodents
Mammuthus primigenius	132		
Rangifer tarandus	1		
Equus sp.	3		
Canis lupus	5		
A. Lagopus/V. Vulpes	38		
Large mammal	53		
Large/Medium-sized mammal	4		
Medium-sized mammal	14		
Small-sized mammal	3		
Unidentified splinters	8		
Total NR (%NRT)	261 (29.9%)	0	0

3.2.6. Palethnography

3.2.6.1. Exploitation of animals. There are thousands of burnt bone fragments. Some remains belong to large-sized mammals, including mammoth ribs and vertebrae. Bone surfaces are damaged, and it was difficult to characterize the anthropogenic activities. Anthropogenic cutmarks observed, seven on a reindeer rib (Fig. 17) and four on a large-sized mammal rib (Fig. 18), result from defleshing.

3.2.6.2. Seasonal slaughter. We have few elements to determine precisely the seasonal settlements by human groups. The high number of mammoths on the promontory could be explained by the fact that at the end of the winter season, mammoths, stressed from lack of food, come to find the necessary nutrients. It is then possible that the herds of mammoths may go north to the end of the winter season-beginning of the summer season, and that human groups have exploited this opportunity to hunt.

3.2.6.3. Spatial distribution and areas of activities. A crack relaed to cryoturbation phenomenon was observed in the cultural layer in the west, but did not seem to have disturbed the layer significantly (Fig. 19).

Two hearths have been excavated, one at the edge of the limit of excavations in the northern part of the excavation and the other in the center (No. 2). Around the hearths and in the east part of the site there are many flakes and flint tools which could correspond to a flint workshop. A small lens of ash with charcoal and burned bones is associated with the unburned remains of carnivores. A small pit, with charcoal, lithic artifacts and unburned bones of carnivores and herbivores, was also found. It is probably a dumping zone (Fig. 20). Several vertebrae are articulated in the square Ж-3 20–21 (Fig. 21). They could correspond to an area of butchering.

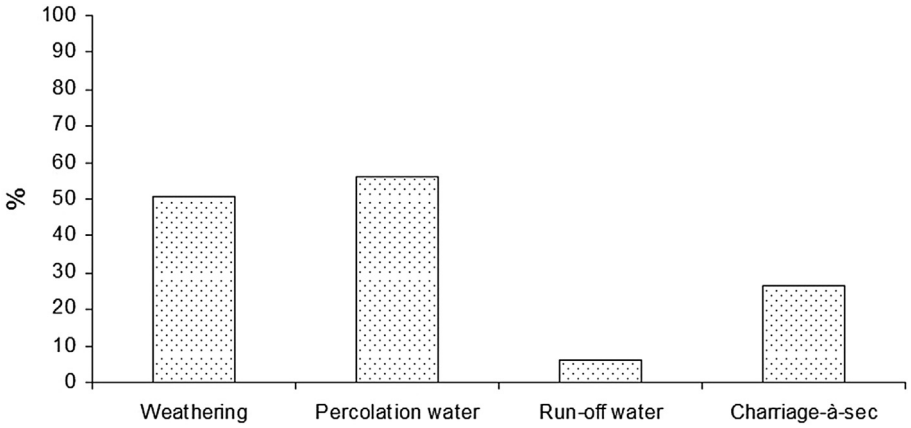

Fig. 14. Alterations due to climato-edaphic factors in %NRt.

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Fig. 15. Radius of C. lupus with fracture due to freezing, in anterior view. (ph: L. Demay).

4. Discussion

4.1. Climate

Based on the taphonomical results, it is certain that the bones were affected by phenomena of cryoturbation and alternating freeze/thaw. However, the climate was relatively wet during the formation of the overlying layer to the cultural layer and drier during the latter, but with the presence of the conditions a little wetter than expected for this period.

Combining these data with those of the pollen study by Yu. N. Gribchenko (Velichko et al. (1999) highlights the dominance of herbaceous and taxa typical of steppe environment, but also the presence of taxa indicating the presence of forest and wetland taxa such as *Plantago* sp. and *Anthoceros* sp. The proximity of the Desna River explains the presence of riparian forests. However, although the occupation took place in a relatively arid climate, the presence of forests and river created milder weather. Subsequent environmental characteristics indicate a wetter climate than initially expected during the Late Glacial Maximum.

4.2. A place for mammoth herds

The skeletal representation of *Mammuthus primigenius* indicates that all bones including autopodial are represented. Based on these results, we can say that the mammoths died on the promontory. Compared with other excavations of Pushkari I, the promontory contains all types of mammoth bones. The promontory of Pogon where the Pushkari sites lie was probably a favoured place for mammoth herds for the diversification of food consumption (plants, minerals) related to the nutrient needs (Olivier, 1982). Vegetation and mineral composition on the promontories are different that in the lowlands. We can compare this case with the data observed at Kraków Spadzista Street (B) (Wojtal and Sobczyk, 2003) and at Yudinovo (Germonpré et al. 2008).

4.3. Acquisition of mammoth

Comparing models of mortality patterns made on populations of proboscideans (Haynes, 1985, 1987b), the profile of the population represented in Pushkari I–exc. VII does not match with the profile of catastrophic mortality (A) or to a profile of attritional mortality (B) but with a profile type C (adult dominant) (Fig. 22). The latter is characteristic of human slaughtering. The low number of individuals may distort this interpretation. However, compared with previous excavations and studies of high representation of adults it is possible to check the validity of age mammoth classes for excavation VII. Excavations conducted by Rudinski in 1933 furnished at least one mammoth (Rudinsky, 1947). Excavation III in 1938 furnished at least 40 mammoths (Boriskovski, 1949, 1953). The excavation conducted by R. I. Boriskovskii and then V. I. Belyaeva yielded 65 mammoths studied by Sablin (1997), almost exclusively mature individuals.

The presence of adult mammoths dead on a promontory could not be related with natural mortality. No marks of carnivores were observed on bones, so they are not implicated.

4.4. Exploitation of fauna

4.4.1. Food

Although we did not observe any cutmarks of butchering on the mammoth bones, the mortality profile, the low representation of other game, the taphonomic data and analysis of lithic material, suggest that this animal was consumed. Reindeer was consumed and probably also horse.

4.4.2. Use of bones

The site of Pushkari I is known to have furnished a dwelling structure with mammoth tusks associated with small pits and hearths in excavations II and V (Fig. 23). In excavation VII, bones, including mammoth bones, were used as combustibles. We noticed a significant representation of tusks, as in the other loci from Pushkari I.

According to the General Index of Skeletal Conservation, cranial remains are more represented than post-cranial skeleton (theoretical index is 0.08):

$$IGCS_{NR} = 138/164 = 0.84$$

$$IGCS_{MNE} = 73/93 = 0.78$$

The Index of Dental Conservation shows that teeth are strongly represented (theoretical index is 0.05):

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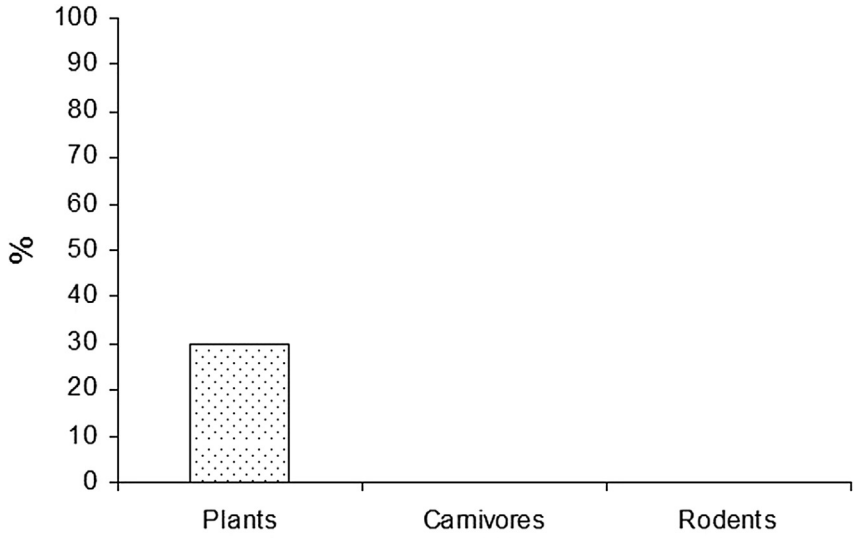

Fig. 16. Alterations due to non-anthropogenic biological factors in %NRt. Bones of the upper and lower extremities of canids are well preserved more or less in their anatomical position, indicating that bones deposits were little disturbed. Taphonomic study suggests that some bones of mammoths lay in open-air for a long time before they were buried and affected by acid sandy deposits. Alteration on bone surfaces implies humid climate.

$ICD_{NR} = 111/164 = 0.67$

$ICD_{MNE} = 68/93 = 0.73$

This is not a differential conservation, indicating a voluntary conservation of dental elements, particularly tusks, by human groups. It is possible that the humans have stored them (Fig. 24). We are currently unable to define the possible secondary use.

Moreover a complete femur of a female woolly mammoth is in oblique position (Fig. 25). This is the only one in this case. The interpretation could be that this bone was placed vertically by the occupants of the site and then collapsed before or during burial.

In Pushkari I–exc. VII, we observed the storage of cranial elements, in particular tusks. The presence of small pits could be related with the manufacture of lightweight structures, but we cannot say if the bones were used to build.

4.4.3. Activities and functions

The excavations of Pushkari I furnished few industrial or artistic artefacts: three worked bones, two spindles and an ivory pendeloque (Boriskovski, 1953; Abramova, 1962). No artefact of this type was discovered in excavation VII. Pushkari I is not a site oriented to bone processing activities. According to the skeletal preservation and the spatial distribution, carnivores were probably used for their fur.

Fig. 17. Rib of R. tarandus with defleshing cutmarks, Pushkari I–exc. VII. (ph: L. Demay).

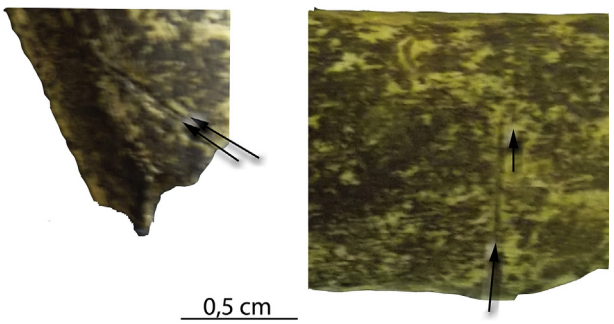

Fig. 18. Rib of large-sized mammal with defleshing cutmarks, Pushkari I–exc. VII. (ph: L. Demay).

Tools were made and the site with local flint, in particular hunting artefacts. The spatial distribution, with flint workshop, area of butchering and hearts is relatively similar to Kraków Spadzista, which is oriented to butchering activities (Wilczyński et al., 2012). In Pushkari I, there is little other game than mammoth. Combining all these data with the mortality profile, we

Fig. 19. Crack due to cryoturbation phenomenon in the cultural layer, Pushkari I–exc. VII. (ph: V. I. Belyaeva).

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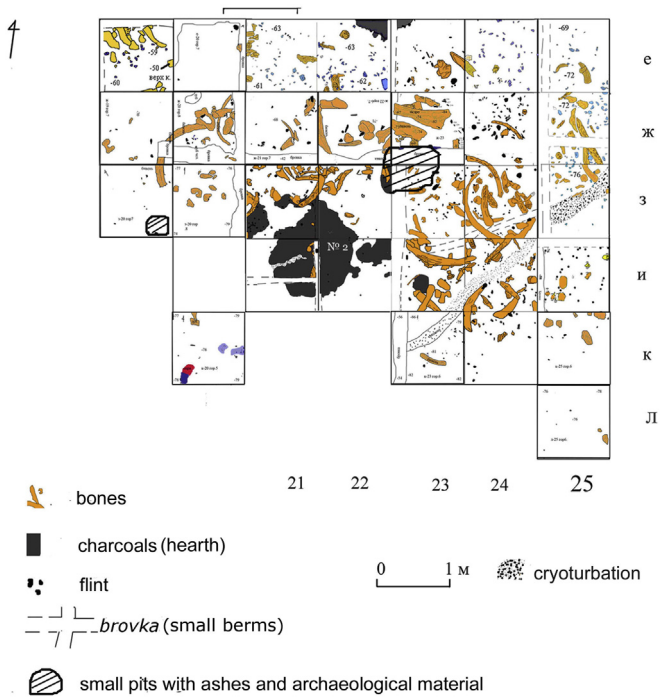

Fig. 20. Plan of excavation VII, Pushkari I (after Belyaeva et al., 2011).

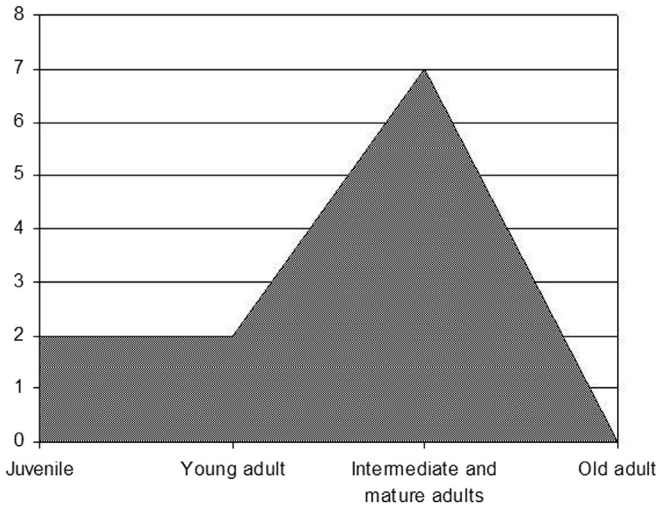

Fig. 22. Profile of population of M. primigenius, Pushkari I–exc. VII.

can propose that Pushkari I could be a mammoth kill and butchering site.

Comparing the profile of mortality of Pushkari I–exc. VII with those of other Upper Palaeolithic sites with activities of mammoth hunt (Yudinovo, Mezhirich, Milovice) (Fig. 26), Pushkari I has a lower representation of young mammoths than in other fields. The selection is oriented toward adult individuals.

Excavations and spatial distribution define the site of Pushkari I–exc. VII as a campsite with a spatial organization more developed than those known during this period, probably of recurrent short-termed occupations. The promontory is characterized by a local flint of good quality which was used by human groups. So on the one hand the exploitation of flint is a main criterion. On the other hand, we argue that the recurrent presence of mammoth is an opportunity to hunt.

4.4.4. Culture

In the Desna valley the site of Klussy presents a stratigraphic situation similar to that of Pushkari I. From the excavations lead by Shovkoplias (1967) and new excavations led by Stupak in 2002 and 2005, and lithic study made by Nuzhnyi (2009), the lithic industry is similar at Pushkari I and Klussy. There are many remains of mammoth and burned bones. Unfortunately, the site has few damaged splinters to inform us about the exploitation of fauna.

From comparison with other cultural complexes – the Kostenki-Borshevo group, the Kostenki-Alexandrovka group, the Gagarinovo-Khotylevo group and the Kostenki-Avdeevo group (Amirkhanov, 1998) – Pushkari I industry is distinctive (Rudinski, 1947; Boriskovski, 1953; Nuzhnyi, 1992; Belyaeva, 1997, 2000, 2002, 2004, 2009; Sinitsyn, 2007). Klussy is the only site which could be relatd to Pushkari I, forming a particular Pushkarian culture.

In the Desna valley, the recent excavations at the site of Obollonia dated to 20 730 ± 120 BP showed exploitation of mammoth as food, and ivory used for bone industry. The lithic industry studies revealed a specific assemblage with Aurignacian features (Stupak, 2011; Stupak and Klopachev, 2014). So, in the same area during a

Fig. 21. Vertebrae of M. primigenius, Pushkari I–exc. VII. (ph: L. Demay).

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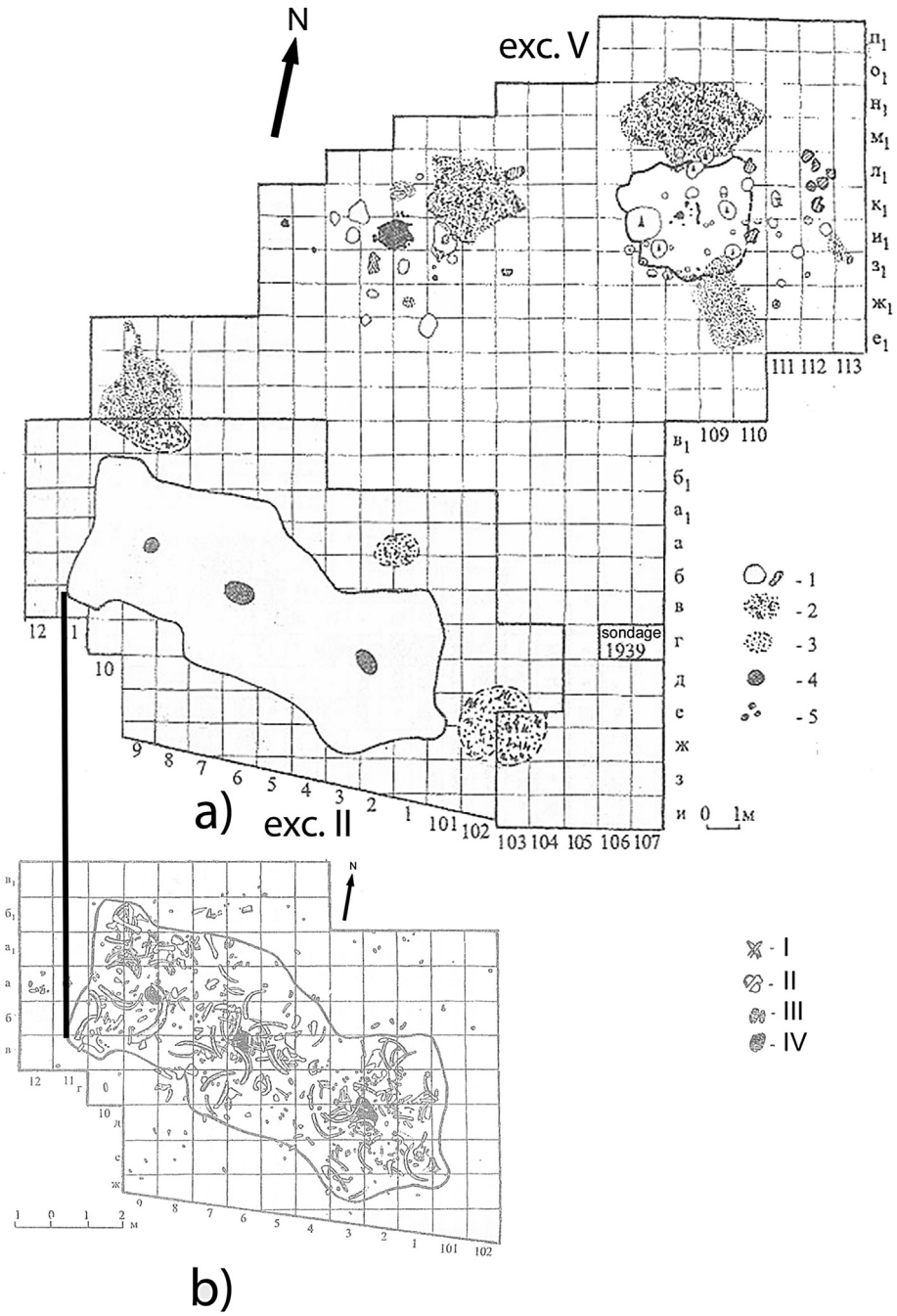

Fig. 23. Plan of excavations II and V with the dwelling structure of Pushkari I. a) Plan of excavations II and V. 1: hollow area; 2: concentration of charcoals and flint; 3: concentration of flint; 4: hearth; 5: small pit. b) Detail of exc. II. I: tusk of mammoth II: bone of mammoth; III: molar of mammoth; IV: hearth (after Boriskovski, 1949; Belyaeva, 2002).

relatively contemporaneous period, we have different cultures oriented on mammoth.

The mammoth exploitation in Pushkari I was oriented to hunting, as during the Gravettian, with the Pavlovian, Kostienki-Avdeevo culture (Soffer, 1993; Svoboda, 1994, 2005; Péan, 2001; Péan and Wojtal, 2003; Oliva, 2013). The Late Gravettian is characterized by circulation in the territory from central Europe to the Don Valley (Kostienki) (Grigor'ev, 1970; Otte, 1981; Kozlowski, 1986; Djindjian et al., 1999; Haesaerts et al., 2004). Several sites of the Kostienki complex present some similar features to Pushkari I. For instance, the storage of tusks is known in Kostienki 1. They were used to establish dwelling structures. In Kostienki 4 elongated structures (without mammoth bone) with alignment of hearths are known, as in the Pushkari I excavations II and V (Boriskovski, 1949; Belyaeva, 2002; Sinitsyn, 2007) (Fig. 27). However, the cultural features of these sites from Kostienki (lithic industry, boneous industry, artistic pieces) related to the recent Gravettian are different. It is possible that during the Last Glacial Maximum, territories were more restricted, which produced smaller, regional cultures (Djindjian, 2002, Fig. 28).

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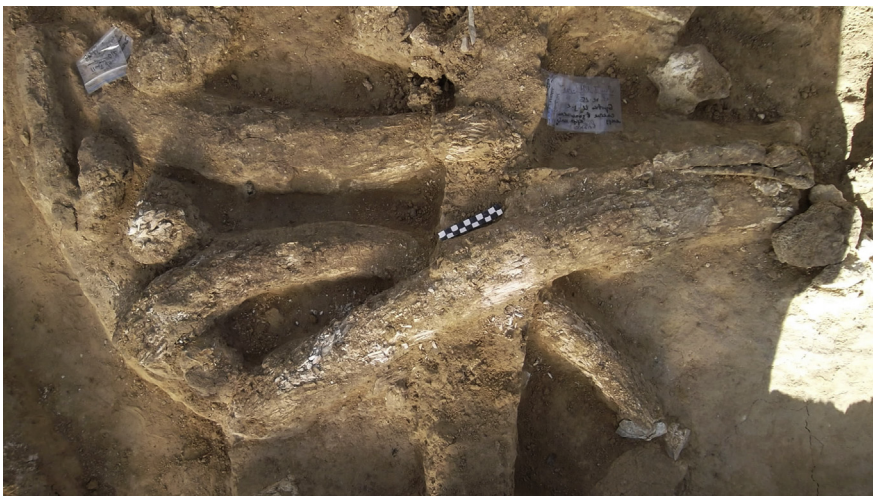

Fig. 24. Entanglement of tusks of M. primigenius, Pushkari I–exc. VII. (ph: L. Demay).

Fig. 25. Femur of M. primigenius in oblique position, Pushkari I–exc. VII. (ph: V. I. Belyaeva).

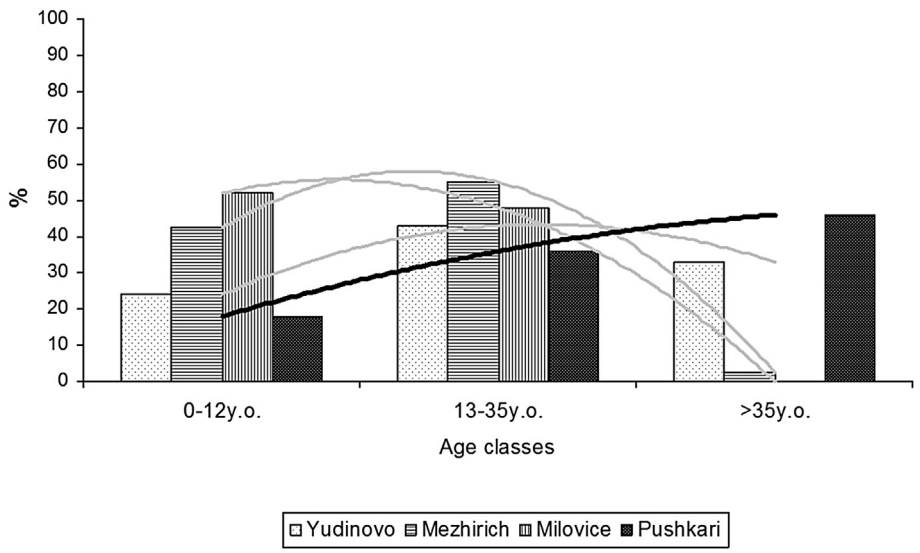

Fig. 26. Profile of population by age classes of M. primigenius of Yudinovo (Germonpré et al., 2008), Mezhirich (Pidoplichko, 1998), Milovice (Péan, 2001; Svoboda and al., 2005; Brugère, 2009) and Pushkari I–exc. VII.

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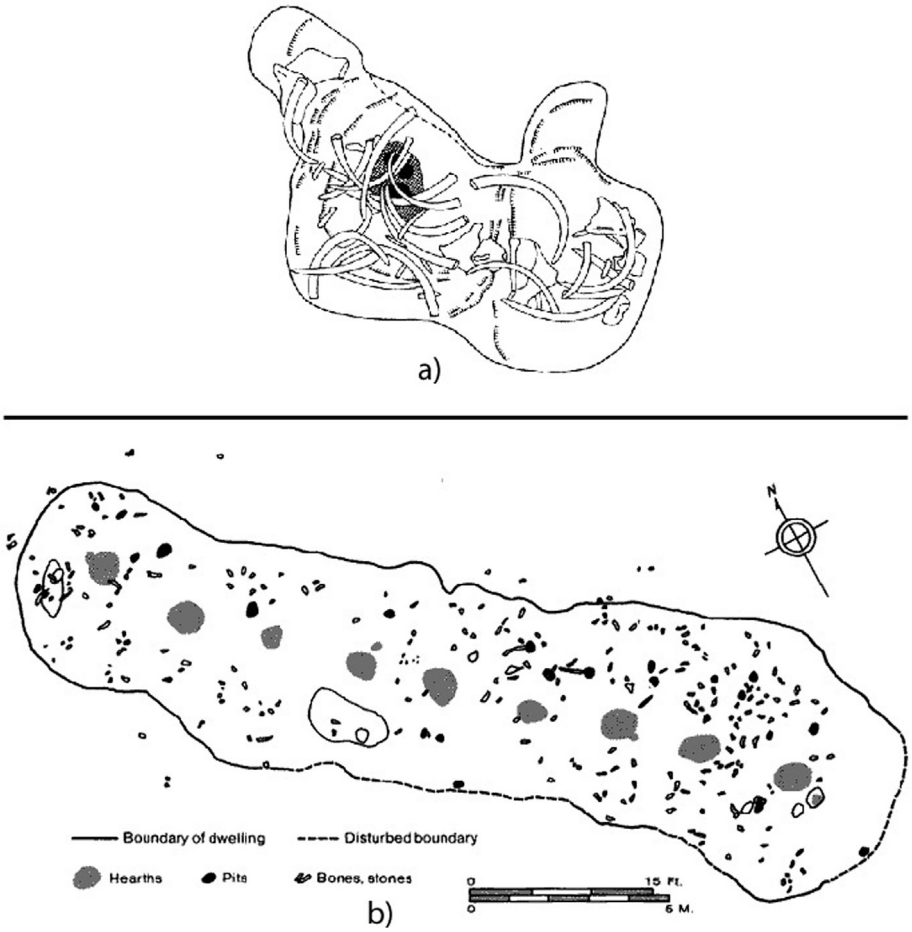

Fig. 27. a) Hearth covered by storage mammoth tusk, probably to support roof, Kostienki I/1 (K. Sklenar). b) Elongated dwelling structure, Kostienki IV/1and 2 (B. Fagan).

5. Conclusion

Pushkari I–excavation VII, located on a promontory, is one of few sites related to the Last Glacial Maximum. The previous studies showed particular cultural features. This site, Gravettian with Epigravettian features, does not show shoulder blade or bone industry, however particular points with lateral retouches and proximal truncation are present. This culture is called Pushkarian. This industry is oriented towards hunting activities.

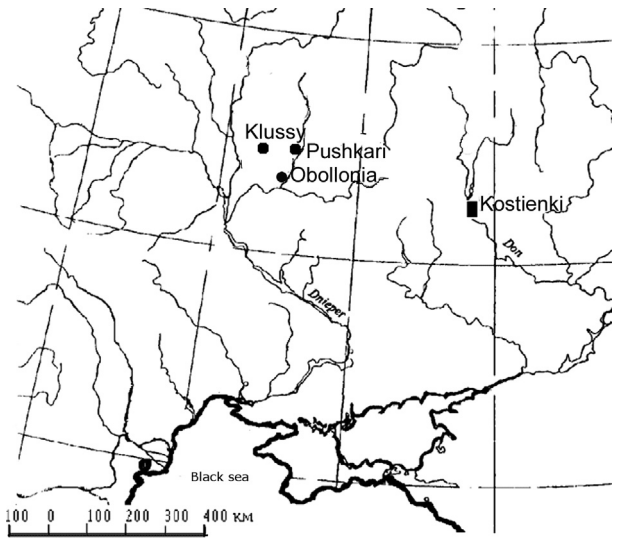

Fig. 28. Mentioned sites (map after Sinitsyn, 2007).

Based on our zooarchaeological study of faunal remains, the faunal spectrum is made of *Mammuthus primigenius* (woolly mammoth), the predominant species, *Equus* sp. (horse), *Rangifer tarandus* (reindeer), *Canis lupus* (wolf) and *Vulpes vulpes*/*Alopex lagopus* (fox). Anatomical representation and location suggest that wolf and fox were exploited for their fur. Some of the bones of large mammals, especially of mammoth, were used as fuel. Anatomical representation of the mammoth and some articulated vertebrae show that they died near the site. Mortality profile is characterized by predominance of adults *s.l.* with an adult female and at least one male, typical of a predator influence. We observed human cutmarks on bones of large-sized mammals. Human groups probably hunted and consumed reindeer, horse and mainly mammoths. Moreover, tusks are heavily represented, sometimes entangled, and indices allow conservation to highlight anthropogenic influence of storage. The use of ivory as a raw material for making artefacts has not been demonstrated and it is currently very difficult to deny or confirm whether it was used as building material. The presence of hearths, areas of activities (butchery, flint workshop) suggest a relative organization of the space compared to the few sites known during this period.

Bones of the upper and lower extremities of canids are well preserved more or less in their anatomical position, indicating that bone deposits were little disturbed. The taphonomic study

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suggest that some bones of mammoths lay in open-air for a long time before they were buried and affected by acid sandy deposits.

Pushkari I–excavation VII is a camp site, with recurrent occupations. The promontory appears as a strategic place for recurrent occupations. On the one hand they exploited local flint of good quality. On the other this place seems to be favoured regularly by mammoth herds which provided food and bone. So they had an important influence on the exploitation of the territory by human groups generating adaptive strategies. This study provides new data to understand the particular status of the woolly mammoth for the Upper Pleniglacial human groups in the Russo-Ukrainian plain.

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