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Remains of large mammals from the Epigravettian site of Yudinovo

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ABSTRACT

The Epigravettian site of Yudinovo (Bryansk oblast, Russia) was discovered in 1930 by K.M. Polikarpovich. It is located in the Sudost' river valley and has a unique stratigraphy. This article presents the results of the study of the remains of large mammals from Yudinovo and also discusses their significance in revising the former interpretation of the existence of the site during the very end of the final part of the Late Pleistocene. In total, 38 268 mammalian bones were identified from cultural layers excavated between 1947–2019. The faunal assemblage is relatively small with a dominance of woolly mammoth and arctic fox, typical of a cold and dry tundra-steppe environment. We undertook stable isotopic tracking from samples of bones. Our analyses confirm the hunting of both adult and juvenile larger mammals by ancient humans. Based on the eruption sequence and wear of the milk teeth from young animals, we were able to clarify the season of their death. It seems that these individuals were hunted during the late spring or early autumn. Traces of gnawing by dogs were recorded on a few bones. We also present in this article the results of the study of so-called "dwellings", constructed by stacking up body parts and bones that were extracted from carcasses of freshly killed mammoths. We interpret these structures as middens representing the remains of ritually deposited hunted game. It can be assumed that these "dwellings" were probably an important part of the socio-symbolic system of the peoples, who created them.

Keywords: faunal assemblage, large mammals, Late Pleistocene, mammoth hunting, Sudost' river valley, Yudinovo

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Остатки крупных млекопитающих с эпиграветтийской стоянки Юдиново

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РЕЗЮМЕ

Стоянка эпохи эпиграветта Юдиново (Брянская область, Россия) была открыта в 1930 году К.М. Поликарповичем. Она расположена в долине реки Судость и имеет уникальную стратиграфию. В статье представлены результаты изучения остатков крупных млекопитающих, а также обсуждается их значение для пересмотра прежней интерпретации существования этой стоянки в самом конце финальной стадии позднего плейстоцена. В общей сложности 38 268 костей млекопитающих было обнаружены в культурных слоях в результате раскопок 1947–2019 гг. Состав фауны относительно скуден, с доминированием шерстистого мамонта и песца, что типично для холодной и сухой тундростепи. Нами также был задействовано отслеживание стабильных изотопов в костях. В результате анализа показано, что древние люди охотились как на взрослых, так и на молодых крупных млекопитающих.

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Основываясь на последовательности прорезания и степени изношенности коронки молочных зубов молодых животных, мы смогли уточнить сезон их смерти. Вероятнее всего они были добыты в конце весны или в начале осени. Здесь обнаружены следы от зубов собак (погрызы) на отдельных костях. Мы представляем в этой статье также результаты исследования так называемых “жилищ”, которые были сложены из частей тела и костей, которые были извлечены из туш недавно убитых мамонтов. Мы интерпретируем эти структуры как ритуальное погребение остатков добытых на охоте животных. Можно предположить, что эти “жилища”, вероятно, были важной частью социально-символической системы людей, которые их создали.

Ключевые слова: долина реки Судость, крупные млекопитающие, охота на мамонта, поздний плейстоцен; фаунистический комплекс, Юдиново

INTRODUCTION

In the summer of 1934, the first Yudinovo site excavation followed the fortuitous finding of woolly mammoth bones by the archaeologist K.M. Polikarpovich in loess sediments at the site in 1930. He carried out excavations in 1947 and 1961, which were continued by the archaeologist V.D. Bud’ko in 1962, 1964, 1966 and 1967. The campaign was led by Z.A. Abramova in 1980 and G.V. Grigor’eva in 1990. G.A. Khlopachev carried out excavations from 2004 until the present day (Khlopachev 2019). The Epigravettian sites Kostënki 11/Ia, Eliseevichi 1, Mezin, Mezhirich, Dobranichevka and Gontsy on the Russian Plain are known for large accumulations of large mammals bones (Fig. 1). The results of dating and stone tool analyses show a strong similarity between Yudinovo and these sites, and an affiliation to the “Anosovka-Mezin” cultural entity (Rogachëv 1962; Khlopachev and Gavrilov 2019). The unusual circular structures made of large bones have traditionally been interpreted as the ruins of winter dwellings (Bud’ko 1966; Polikarpovich 1968; Pidoplichko1969; Klein 1973; Gladkih et al. 1984; Soffer 1985; Abramova et al. 1997; Soffer et al. 1997; Pidoplichko and Allsworth-Jones 1998; Sergin 2008; Iakovleva 2015). Some scientists argue that the bone structures at the Yudinovo site are derived from a ritualized deposition and middening of hunted animal remains (Sablin 2019; Khlopachev and Gavrilov 2019).

MATERIAL AND METHODS

The Epigravettian site of Yudinovo is located in the Sudost’ river valley, on the south-western edge of Yudinovo village (Bryansk oblast, Russia) (Fig. 1).

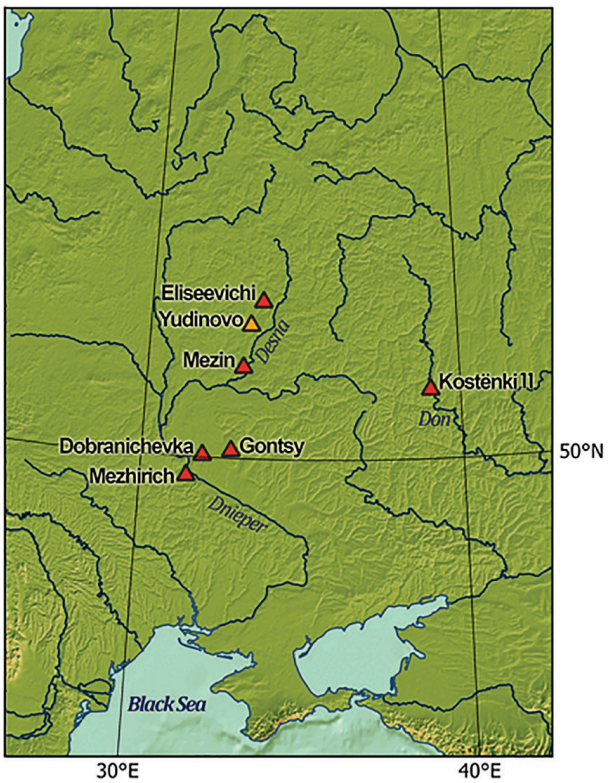

Fig. 1. Map of Upper Paleolithic sites mentioned in the text.

To date, an area of more than 1000 m2 has been excavated here (Khlopachev 2018). Yudinovo has a unique stratigraphy and radiocarbon dates for two cultural layers fall in the interval 14.9–12.0 kya 14C BP (Abramova et al. 2001; Khlopachev and Gribchenko 2012; Khlopachev 2010, 2015). The stratigraphic data also suggests that the main cultural layer was formed over the course of several seasons, and that the earliest features here were the hearths: the accumulations of large mammal bones appeared

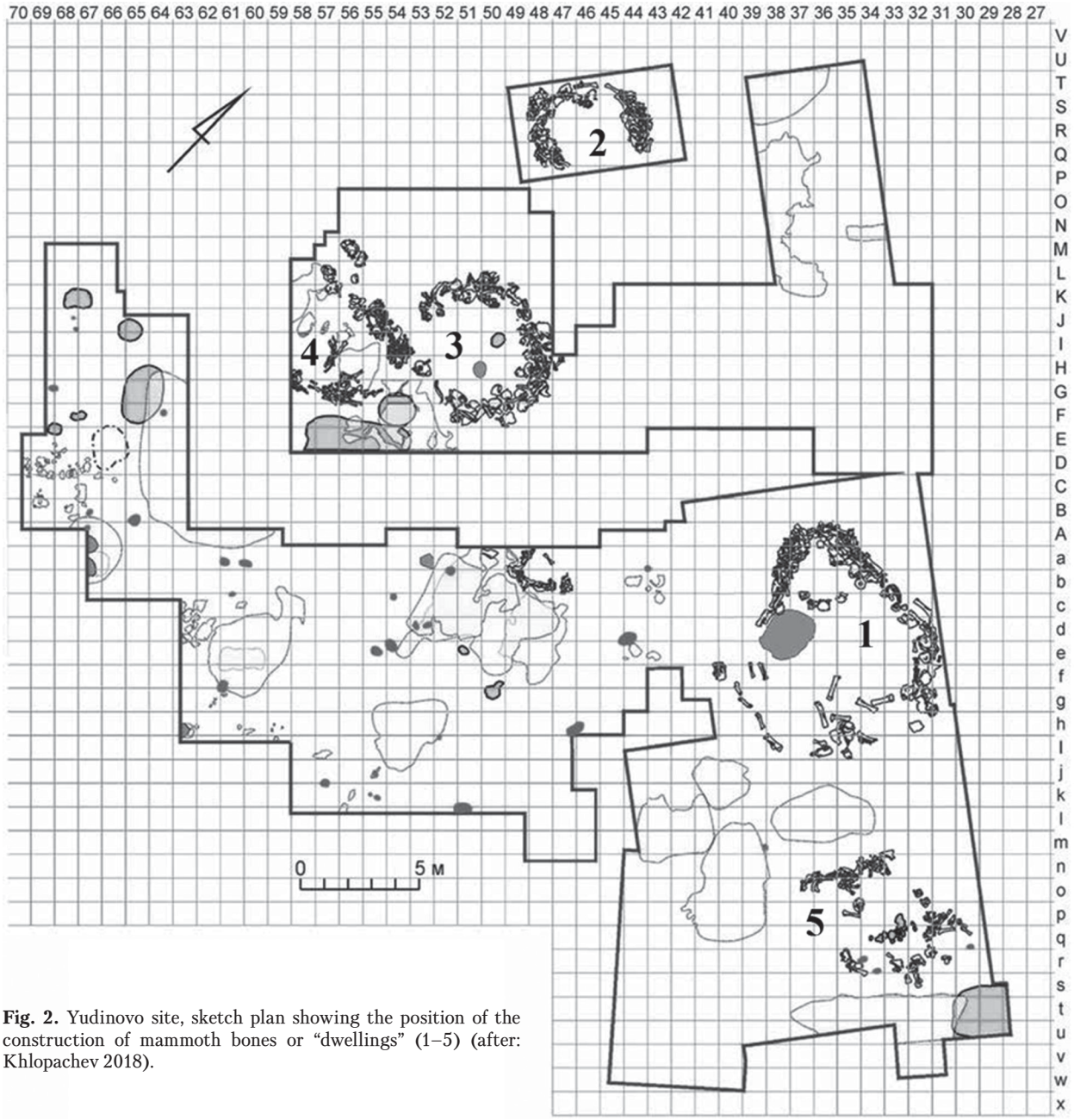

Fig. 2. Yudinovo site, sketch plan showing the position of the construction of mammoth bones or "dwellings" (1–5) (after: Khlopachev 2018).

later (Khlopachev 2018). The osteological material derives from the five "dwellings", as well as from the pits (Fig. 2).

The mammal remains from Yudinovo have been investigated by Vereshchagin and Kuzmina (1977), Kuzmina and Sablin (1993), Burova (2002), Sablin (2002, 2014, 2019), Khlopachev et al. (2006), Germonpré et al. (2008a, 2008b), Khlopachev and Sablin (2009, 2015). In total, we identified 38268 mammalian bones from the cultural layers excavated between 1947–2019. The analysis is based on collections held in the Zoological Institute RAS and the Museums of the Republic of Belarus. The earlier paleontological studies allowed scientists to recognize the dominance of woolly mammoth and arctic fox in the Yudinovo faunal assemblage (Polikarpovich

Table 1. Remains of large mammals from the Epigravettian site of Yudinovo (1947 to 2019 excavations).

Species	NISP	MNI
Lepus timidus tanaiticus Gureev, 1964	5	1
Marmota bobak Muller, 1776	121	6
Canis lupus L., 1758	193	4
Vulpes lagopus rossicus Kuzmina et Sablin, 1993	26764	193
Vulpes vulpes L., 1758	2	1
Ursus arctos L., 1758	25	3
Panthera leo spelaea (Goldfuss, 1810)	3	1
Mammuthus primigenius (Blumenbach, 1799)	10907	130
Equus ferus Boddaert, 1785	19	2
Rangifer tarandus L., 1758	87	4
Saiga tatarica L., 1766	2	1
Ovibos moschatus Zimmermann, 1780	140	7

1968; Vereshchagin and Kuzmina 1977; Soffer 1985; Kuzmina and Sablin 1993; Burova 2002; Sablin 2002, 2014). In our analyses, we applied quantitative units widely used in paleontological and zooarchaeological studies (Shipman 1981; Klein and Cruz-Uribe 1984; Van Wijngaarden-Bakker 2001). The number of identifiable bones (NISP) should exceed 200–300 finds in order to provide a representative sample for an adequate characterization of the osteological material (Kosintsev et al. 1989). The calculation of the minimum number of individuals (MNI) was carried out using a combination of parameters such as re-fittings, pairings, age and sex. Stable isotopic tracking was applied to the large mammal remains collected by the Epigravettians, in order to detect potential signals of ecological stress.

RESULTS

According to the results of our taphonomical analyses, the osteological material from the "dwellings" and pits is, on the whole, well preserved (stage 1 according to A. Behrensmeyer (1978)). The large mammals' remains found directly in the cultural layer in the adjacent area are more strongly weathered (stages 2–4). Here, the bones display a different stage of preservation with much deterioration caused by trampling and water runoff. For the most part these are fragments of animal ribs and vertebrae. None of the fossil bones from the Yudinovo accumulations show signs of abrasion or evidence of root etching by plants. Tooth marks produced when dogs gnawed on the bones were found on 18 specimens (Fig. 3A–C).

We determined 12 species of mammals among the osteological material from Yudinovo (Table 1). As a result of our analysis, beaver, bison, and corsac fox were removed from the former species list, and three new species were added – Don hare, red fox, and saiga antelope (Sablin 2014).

A small fox was identified as a subspecies of arctic fox, *Vulpes lagopus rossicus* Kuzmina et Sablin, 1993 (Kuzmina and Sablin 1993; Sablin 1994), which became extinct at the end of the Pleistocene (Dalen et al. 2007). 193 individuals of this animal were preserved in the sample and with over 54% of the total MNI, indicate a very high representation. All body parts are represented (Table 2). In terms of skeletal preservation by anatomical parts, elements of the cranial and postcranial skeleton exhibit a similar representation. It appears the complete carcasses of arctic fox were brought to the site by the Epigravettian hunters. The bones of the animals present butchering marks (cutmarks) related to skinning, disarticulation and defleshing. Subsequently, some of the long bones were broken, or grooved and sawn. So on the one hand, these carcasses were exploited for fur and meat, and on the other the bones were exploited as a source of bone marrow and industrial supports. However, the quantities of organic matter from the mammoth carcasses are not compatible with the use of arctic foxes as a main food resource. Anatomical associations, at least of vertebras and autopodial units, such as many

Table 2. Skeletal elements of carnivores from the Epigravettian site of Yudinovo.

Bones	*Canis lupus*	*Vulpes vulpes*	*Vulpes lagopus rossicus*	*Ursus arctos*	*Panthera leo spelaea*
Cranium	6		158		
Maxilla	1		110		
Mandibula			378	2	
Tooth	9		1997	2	3
Sternum	2		557		
Vertebrae	29		5018		
Os costa	27		897		
Sacrum	1		136		
Scapula	3		320		
Humerus	3	1	600		
Ulna	1		426	1	
Radius	1	1	644		
Pelvis	4		419		
Femur	5		547	3	
Patella			133		
Tibia	2		324		
Metacarpal/ metatarsal	45		2185		
Astragalus	1		361		
Calcaneus	1		385		
Carpal/ tarsal	10		3666		
Phalanx	42		7503		

almost completely articulated bones of the paws, are evidence of the burial of carcass parts still covered in soft tissues and a rapid preservation during embedding. Our analysis of the arctic fox remains from the Yudinovo site show characters similar to the arctic fox from the nearby contemporaneous Epigravettian site of Eliseevichi 1 site (Sablin 2017). Other fur animals, such as marmot, wolf, red fox, brown bear and cave lion are represented by relatively low counts of remains (Table 1, 2). Marmots could have been hunted for their rich fat.

Wooly mammoth dominate the spectrum of herbivores at Yudinovo. 36.8% of the total MNI could be attributed to *Mammuthus primigenius* (Blumenbach, 1799) (Table 1). The total number of animals represented here may be up to 130 individuals. This includes 115 adults/sub-adults and 15 juveniles younger than 2 years. Most of the complete or partly preserved mammoth skulls were found in the central areas of the five "dwellings", with the frontal bones facing the inner side of these circular constructions and the alveoli placed downwards. Scapulae, pelvises, long limb bones, sometimes large complete ribs and sections of vertebral column in anatomical order were also included in these unusual structures. The most likely explanation of the form of the five "dwellings" and the human involvement with them is that the bones derived from freshly killed mammoths. One may expect that in very large carcasses dismemberment was carried out at or near the death-site. Many carpals, tarsals and phalanges within the cultural layers (Table 3) are evidence of transporting the complete feet to the camp by the hunters. In contrast, reindeer and muskox, which were not the most important prey species for the Yudinovo hunters, are represented in the main by limb fragments and pieces of antler (Fig. 3D) (Table 3).

We interpret the "dwellings" as middens representing the remains of ritually deposited hunted game (Sablin 2019). It can be assumed that these structures were probably an important part of the socio-symbolic system of the people, who created them.

Our results confirm that at least the Sudost' river valley region was close to the southern limit of the permafrost – the presence of muskox underlines the dry-cold climatic conditions. A periglacial tundra-steppe is an open landscape with scant woodlands of birch and pine in the river valleys (Velichko and Zelikson 2005). The floodplains were easily accessible to the herbivores during winter. It has been estimated that the numbers of large herbivores in the Late Pleistocene tundra-steppe were comparable to those in reserves in the African savannah today (Vereshchagin and Gromov 1977; Nogues-Bravo et al. 2008). The average density of *Loxodonta africana* Blumenbach, 1797 in Chobe National Park in Botswana is 5 individuals per square kilometer (Älvgren 2009). Nogues-Bravo et al. (2008) estimate the analogous index for *M. primigenius* in the Pleistocene at between 0.1 and 4 individuals per square km. Stable isotopic tracking and morphometry may be a way to test if late mammoth populations still had an optimal ecology, or survived in sub-optimal conditions, were metastable and, therefore, vulnerable to extinction.

Table 3. Skeletal elements of herbivores from the Epigravettian site of Yudinovo.

Bones	*Lepus timidus tanaiticus*	*Marmota bobak*	*Mammuthus primigenius*	*Equus ferus*	*Rangifer tarandus*	*Saiga tatarica*	*Ovibos moschatus*
Cranium		5	568	1			
Maxilla		3	13				
Mandibula	1	4	90				7
Tooth		12	1160	1		1	4
Tusk			1168				
Antler					9		3
Hyoid			36				
Sternum			11				
Vertebrae		15	1321	1	2		2
Os costa		1	4296				1
Sacrum		1	11		1		2
Scapula		6	235		1		6
Humerus		5	78				1
Ulna	1	8	58				4
Radius		2	84				
Pelvis		5	135				1
Femur	2	9	99	2			18
Patella			26				2
Tibia		9	148		1		11
Fibula		2	46				
Metacarpal/metatarsal		7	496	5	44		34
Astragalus		2	37		1		2
Calcaneus		6	24		2		4
Carpal/tarsal	1	13	368	3	16	1	13
Phalanx		6	399	6	10		25

The δ13C and δ15N values of the Yudinovo mammoths varied from −20.8 to −19.5‰ and from +5.0 to +8.9‰, respectively (Drucker et al. 2018). In comparison, δ13C and δ15N values of the reindeer obtained from the same site were −19.0‰ and +3.3‰, respectively and those of the muskox −18.9‰ and +2.9‰, respectively. These results were attributed to a high consumption of lichen, as still observed nowadays for reindeer (Drucker et al. 2018). Higher δ15N values in bone collagen of mammoth compared with coeval large herbivores is a classic trait of the tundra-steppe. The Yudinovo canids had higher δ13C values (wolf, −19.2‰; arctic fox, −19.9‰; brown bear, −19.1‰) but equivalent δ15N values (wolf, +8.12‰; arctic fox, +4.9‰; brown bear, +6.6‰), consistent with a meat-dominated diet. Stable isotopic tracking showed that the animal population here had an optimal ecology (Drucker et al. 2018).

The tibia of the Yudinovo mammoths is the only long bone for which measurements could be taken on a relatively large number of specimens (n=16). Therefore, the tibia is used here as a reference bone. The average height at the withers of the animals is 226 cm (comparable to the adult female size) (Sablin 2014, 2019; Khlopachev and Sablin 2014). The average live weight of the animals is also relatively low and is estimated as 1820 kg, calculated using the formulae of P. Christiansen (2004). Rare instances

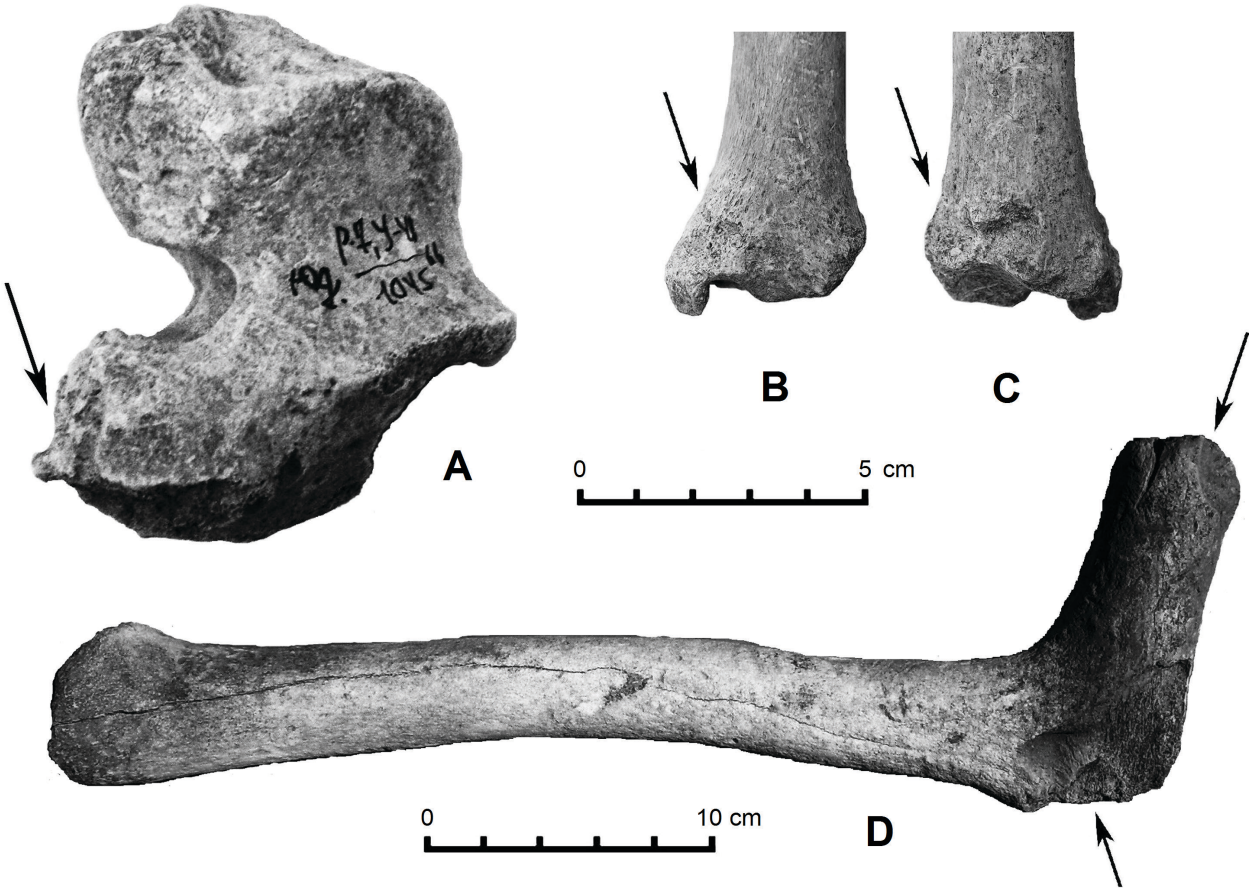

Fig. 3. Modified large mammal bones from the site of Yudinovo. The arrows indicate gnawing and cut marks. A – traces of tooth marks of dog on the distal epiphysis of femur of brown bear; B – traces of tooth marks of dog on the distal epiphysis of tibia of wolf (front view); C – traces of tooth marks of dog on the distal epiphysis of tibia of wolf (back view); D – cut marks on the antler of reindeer.

of a fragment of a tool embedded in a bone provide direct archaeological evidence of human hunting (Nuzhnyi et al. 2014; Sinitsyn et al. 2019). Indirect evidence, such as the accumulation of remains from several individuals with specific ages and sex, occurs more frequently. Thus, the predominance of bones of adult females and juvenile individuals at Yudinovo indicates that relatively small animals (from mother-calf units) were preferentially hunted, and that large males tended to be avoided (Germonpré et al. 2008a, 2008b). If we assume that family groups of mammoths on the Russian Plain were comparable in size to family groups of African elephants and consisted of 5 to 10 individuals, then at the Yudinovo site the remains of 13 to 26 family groups are represented (Sablin 2014, 2019).

The Yudinovo mammoths were hunted to obtain large quantities of meat, fat, organs, and brains (Germonpré et al., 2008). Interest in adult animals may be related to the need for bones for fuel and also to obtain tusks (ivory) as a main raw material resource for tools, art and ornaments. The dogs would have been very helpful in tracking, hunting and transporting mammoth carcass parts (Germonpré et al. 2008a; Sablin 2017). It can be assumed that dogs were present at Yudinovo, although no remains of this animal have been found so far. But a number of indirect signs, such as specific gnawing marks on some bones, suggest the occurrence of dogs here (Fig. 3A–C). At the nearby contemporaneous site of Eliseevichi 1, two dog skulls have been recognized (Sablin and Khlopachev 2002, 2003; Sablin 2017).

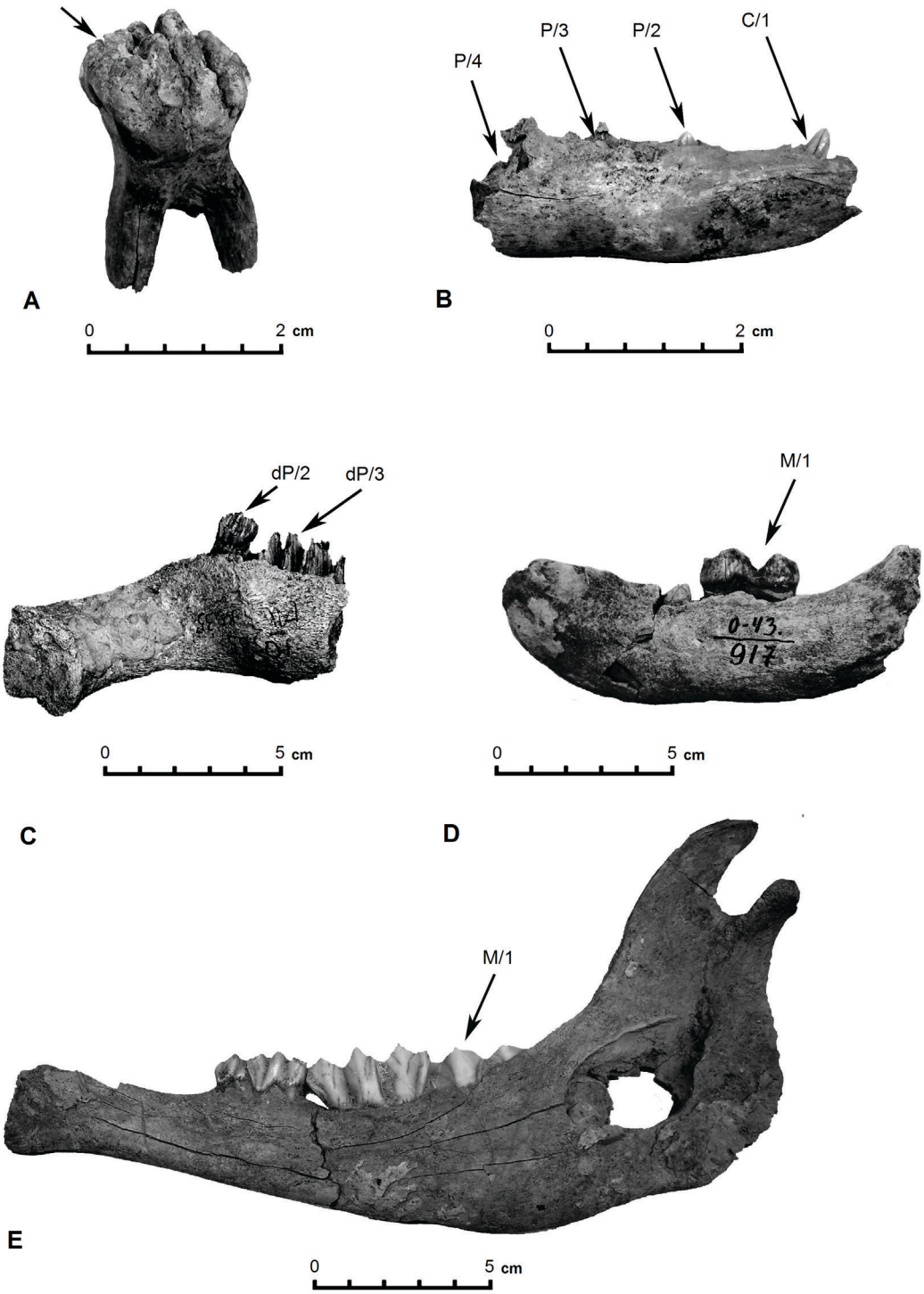

Fig. 4. Remains of juvenile mammals from the site of Yudinovo. A – dP2 of 1 month old mammoth calf. The arrow indicates the wear of the first plate (initial stage); B – left branch of the mandibula of a 4 month old cub of polar fox with the erupting C_1, P_2, P_3 and P_4 teeth; the deciduous teeth are not preserved; C – right branch of the mandibula of an up to 1 week old mammoth calf with dP_2 and dP_3 teeth (the plates on the teeth show no signs of abrasion); D – left branch of the mandibula of a 7–9 month old cub of brown bear with M_1 tooth; E – left branch of the mandibula of a 5 month old calf of muskox with dP_2, dP_3, dP_4 and M_1 emerging.

The Yudinovo large mammal sample contains at least 1 juvenile marmot, 15 mammoth calves, 7 polar fox cubs, 1 brown bear cub and 1 muskox calf (Fig. 4A–E). On the basis that animals are born at the beginning of spring and the eruption sequence and wear of their milk teeth, it seems that prehistoric people hunted these individuals during the late spring or early autumn. Analysis of the remaining osteological material indicates that the site was seasonally occupied, from September to May exclusively, or ca. 270 days per year (Khlopachev et al. 2012; Sablin 2014, 2019). The people who occupied the site probably moved away from the floodplain during the summer.

CONCLUSIONS

In order to have a better understanding of the activities of prehistoric people at the Yudinovo site, particularly the role of large mammals in these activities, it was necessary to undertake this complex study. The thorough analysis of the existing osteological material permitted us to answer some questions.

The faunal spectrum is not diverse and is typical of a cold and dry periglacial tundra-steppe environment. However, stable isotopic tracking showed that the animal population lived here under optimal ecological conditions. The hunting of mammoths was possible thanks to a combination of the small body size of the animals themselves and the presumed presence of dogs. Yudinovo was probably occupied several times from September to May exclusively, over a long period of time.

The site may have had two main functions, as a settlement, but not exclusively for habitat, and also as a special ritualized place. In common with Gavrilov (2015) Khlopachëv & Gavrilov (2019) and Sablin (2019), we argue that the Anosovka-Mezin type mammoth bone structures are not the remains of dwellings, despite their traditional interpretation as such (Bud'ko 1966; Polikarpovich 1968; Klein 1973; Soffer 1985; Abramova et al. 1997). It seems that the remains of mammoths were carefully preserved by prehistoric people in mounds, which may have had a largely ritual significance.

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