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FOSSIL *OVIBOS MOSCHATUS* (ARTIODACTYLA, BOVIDAE) FROM BURYN, WITH REFERENCE TO MUSKOX DISPERSAL IN THE LATE PLEISTOCENE OF UKRAINE

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Fossil *Ovibos moschatus* (Artiodactyla, Bovidae) from Buryn, with Reference to Muskox Dispersal in the Late Pleistocene of Ukraine. Krakhmalnaya, T. V., Kovalchuk, O. M. — The skull fragment of muskox *Ovibos moschatus* (Artiodactyla, Bovidae) obtained from Chasha River bed alluvium near the Buryn (Sumy Region, North-Eastern Ukraine) is described here in detail. It belongs to a young male, and presumably dates back to Late Pleistocene. This new find slightly extends the known Ukrainian range of the species to the east. Taxonomic attribution of extinct muskox and dispersal of *Ovibos moschatus* within the territory of Ukraine during the Late Pleistocene are also discussed in the paper.
Key words: muskox, skull, morphology, species range, periglacial zone, Eastern Europe.

Introduction

The muskox, *Ovibos moschatus* (Zimmermann, 1780), is a characteristic component of subarctic fauna being well adapted to cold climatic conditions with low snow cover (Lent, 1988). The natural range of this species is currently restricted to areas of open tundra with permafrost in Greenland, northern Canada, Alaska, and some isles of the American archipelago, while muskoxen were widely distributed throughout the Holarctic during cold phases of the Pleistocene (Raufuss & Koenigswald, 1999; Markova et al., 2015). Fossil muskox remains are rather scarce compared to those of other herbivores of the "mammoth steppe" mammalian assemblage. This may be due to relatively smaller populations of this species (fig. 1) which seems to be ecologically intolerant and was not able to adapt to increasing humidity and average annual temperatures during the Holocene (Lent, 1988; Markova et al., 1995, 2015).

Fig. 1. Localities with fossil muskox remains on the territory of Ukraine.

To date, more than 200 localities with fossil remains of *O. moschatus* in Europe and Siberia are known and mapped (Raufuss & Koenigswald, 1999; Markova et al., 2015; Marciszak et al., 2018); however only two of them from the territory of Ukraine (Dobranychivka and Mezyn) were included to the list. The aim of the present study is to describe in detail a new find of muskox remains of the Late Pleistocene age from the Buryn (Ukraine), compare it with relevant fossils from other localities, and to find out how it fits into the known past range of the species. Such data are necessary for precise reconstruction of muskox dispersal within the territory of Eastern Europe during the last cooling stage at the end of Pleistocene.

History of the study of muskox in Ukraine

Fossil muskox remains of Pleistocene age were found for the first time near the Zbranky village (51°17′ N, 28°39′ E) in the Zhytomyr Region, Ukraine (fig. 1). Pidoplichko (1933) noted five skulls belonging to *Ovibos moschatus* from this locality within the specimens representing at the exhibition "Quaternary period in Ukraine". Gromova (1935) also mentioned the complete skull and a series of muskox bones from Zbranky, pointing Kyiv and Leningrad as depositaries of these specimens. Later these remains were disappeared, apparently during the World War II (Krakhmalnaya, 2007 a). Muskox skull from Zbranky discovered in Pleistocene clay deposits in 1897 was described by Ryziewicz (1955). Somewhat later, Khan (1966) also mentioned it in his publication with measurements.

Frontal-occipital part of the skull of *Ovibos moschatus* was found on July 1951 in Kyiv (50°29′ N, 30°32′ E) during the operation of a hydraulic monitor (Pidoplichko, 1952). Further fate of this find is obscure — the specimen is recently absent in the collection of National Museum of Natural History, National Academy of Sciences of Ukraine (NMNHU-P). Only photos and a brief description of the skull without measurements were presented in the original publication.

Three bones belonging to *O. moschatus* were identified in materials of the Late Paleolithic site Dobranychivka (50°10′ N, 31°48′ E) in the Kyiv Region (Pidoplichko, 1969; Shovkoplyas et al., 1981), however only one heel bone (calcaneus) was described in detail (Belan, 1985). A single muskox skull comes from the Bugorok camp (52°13′ N, 33°18′ E) near the Pushkari village in the Chernihiv Region (Velichko, 1961). Another skull was found in 2006 near the Khodoriv village, 49°55′ N, 31°14′ E (Krakhmalnaya, 2007 b). To date, this is the southernmost find of this species. There is also some information about the finds of muskox remains at the Paleolithic sites of Korman IV and Molodovo I (Chernivtsi Region). However, this material was not noted in rich museum collections from the Dniester region after the World War II (Belan, 1985). The most numerous muskox remains at the territory of Ukraine were obtained during excavations of the Late Paleolithic site Mezyn, 51°50′ N, 33°05′ E (fig. 1). In total, 188 bones including 14 skulls were collected (Pidoplichko, 1969), while only a fragment of the neurocranium, lower jaw and several postcranial bones are represented in the NMNHU-P.

Absolute dates of the osteological material accompanying the fossil remains of muskoxen are known only for two aforementioned localities: Mezyn — 27 500 ± 800, 21 600 ± 2200, 15 100 ± 200 years, and Dobranychivka — 12 700 ± 200 years (Sinitsyn et al., 1997).

Systematic paleontology
Family BOVIDAE Gray, 1821
Subfamily Caprinae Gray, 1821
Tribe Ovibovini Simpson, 1945
Genus *Ovibos* Blainville, 1816

***Ovibos moschatus* (Zimmermann, 1780)**

Material. Skull fragment, Buryn district local history museum.

Locality and geological age. Chasha River bed alluvium (51°10′ N, 33°52′ E), near Buryn, Sumy Region, Ukraine; Late Pleistocene.

Description. The skull (fig. 2) belongs to a young, probably 4-year-old individual, which is evidenced by the presence of thickened horncores whose bases not yet fused together (according to the scheme in Henrichsen & Grue, 1980). Only cranium cerebrale with unequally preserved horncores is available for the study. Basis cranii as well as occipital part of the skull are completely destroyed; however jugular processes are preserved. Imprint of the brain is well pronounced on the inner surface of calvaria. The skull is dark brown in colour, which is usual for the fossil material that has been in water for a long time. The horncores are wide, compressed dorso-ventrally; they come down almost vertically, slightly deviating laterally in lower part. Their surface is rather loose and bears the traces of exostoses.

Measurements (according to Walker, 1982). See table 1.

Comparison. The muskox skull from Buryn as compared to those of adult individuals of *O. moschatus* from the Pleistocene (Vangengeim, 1961; Sher, 1971; Krakhmalnaya, 2007 b) is characterized by well-developed cerebral part, high occiput and large foramen

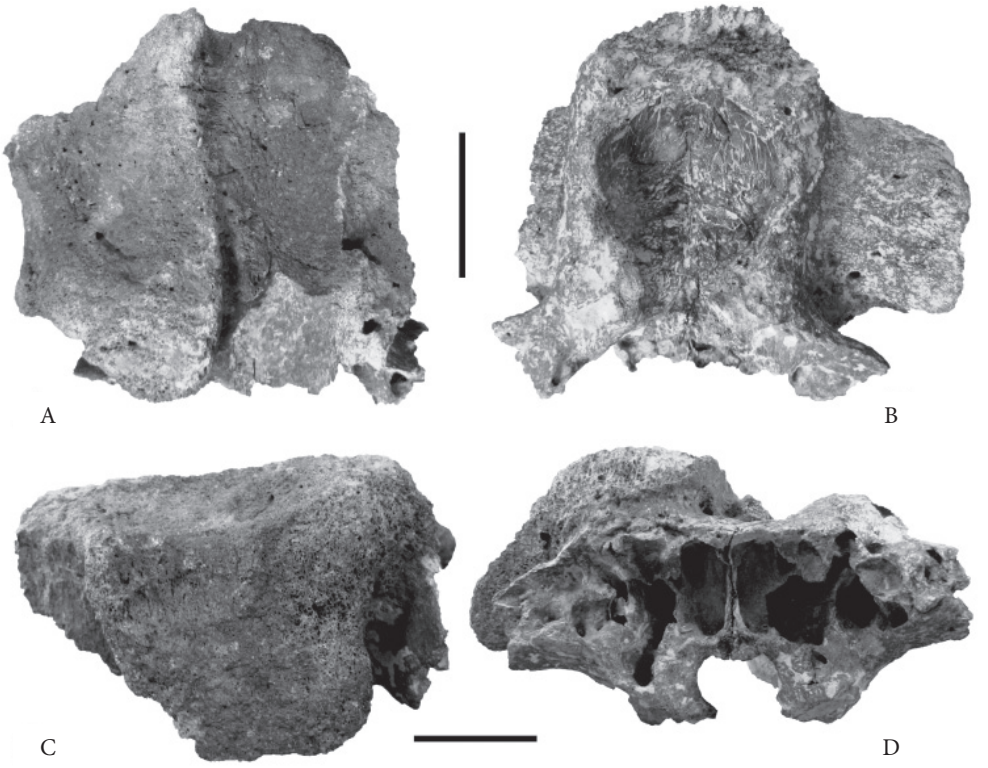

Fig. 2. Skull fragment of muskox from the Buryn district local history museum in dorsal (A), ventra (B), lateral (C), and posterior view (D). Scale bar equals 10 cm in A and B, 5 cm in C and D.

Table 1. Skull measurements of Pleistocene *Ovibos moschatus* from Europe and Siberia

Locality	Measurements[1], in mm								Reference
	1	2	3	4	5	6	7	8	
Europe (Ukraine*, Germany**, Poland***)									
Buryn*	~150.0	>200.0	165.0	113.0	102.0	133.0	7.2	~40.1	Our data
Zbranky*	–	195.0	–	–	–	100.0	8.5	–	Ryziewicz, 1955
Mezyn*	–	145.0	–	101.5	80.5	72.5	–	–	Belan, 1985
Khodoriv*	168.2	168.0	133.2	126.0	113.0	186.4	7.2	35.2	Krakhmalnaya, 2007
Rhine**	–	174.0	–	–	–	106.0	16.0	–	Khan, 1966
Splawie***	–	–	–	–	–	142.0	14.0	–	Chubur, 2015
Siberia (Russian Federation)									
Yenisei River	–	188.0	–	–	–	173.0	–	–	Tchersky, 1891
Yana River	–	205.0	–	–	–	206.0	–	–	Tchersky, 1891
Bolshoy Lyakhovsky Island	–	–	–	–	–	168.0	–	–	Tchersky, 1891
Lena River	–	192.0	–	–	–	226.0	–	–	Tchersky, 1891
Bolshoy Lyakhovsky Island	–	175.0	–	–	–	187.0	–	–	Vangengeim, 1961
Mamontova Gora	–	175.0	–	–	–	137.0	–	–	Rusanov, 1968
Far North-East of the USSR[2]	–	177.0	–	–	–	188.5	–	30.6	Sher, 1971
Far North-East of the USSR[3]	–	151.0	–	–	–	83.6	–	32.3	Sher, 1971
Khaptashynsky Yar	–	–	–	–	–	78.0	–	–	Lazarev & Tomskaya, 1987
Alazeia	–	–	–	–	–	144.0	–	–	Lazarev & Tomskaya, 1987
Tomsk Region	–	203.0	164.0	–	–	–	–	–	Shpansky, 2000
Minusinsk	–	174.0	105.0	–	–	–	–	–	Malikov, 2015

[1]Measurements: 1 — skull breadth at the anterior margin level of orbits; 2 — maximum occipital breadth; 3 — minimum occipital breadth; 4 — akrocranium-basion height; 5 — height of akrocranium-upper margin of foramen magnum; 6 — diameter of horncore base; 7 — distance between inner margins of horncore processes; 8 — breadth of foramen magnum. [2]Skulls of males, mean values. [3]Skulls of females, mean values.

magnum. Maximum occipital breadth of the studied specimen is comparable to those in skulls obtained from the Yana River (Tchersky, 1891), Tomsk Region (Shpansky, 2000), and to a lesser extent — to those from Zbranky (Ryziewicz, 1995). These four skulls have the widest occipital region in comparison with others, whose measurements are presented in table 1. According to the minimum occipital breadth, the specimen from Buryn is also similar to those from the Tomsk.

The height of the occipital region can only be compared with material from Ukraine. It is smaller than those in the specimen from Khodoriv. The breadth of foramen magnum in the studied specimen slightly exceeds those few measurements, which are indicated in table 1.

Diameter of horncore base is greater than those in an adult female from Mezyn (Belan, 1985) and male from Zbranky, but considerably smaller than in the skull from Khodoriv (Krakhmalnaya & Kovalchuk, 2017). Minimum distance between inner margins of horn processes does not exceed 10 mm which is typical for muskox males (Tchersky, 1891; Sher, 1971). Muskoxen from Siberia have more powerful horns, especially males from the Yana and Lena Rivers (Tchersky, 1891), as well as from other localities of this region, except of the skull from the Mamontova Gora (Rusanov, 1968) and some female skulls (Sher, 1971; Lazarev & Tomskaya, 1987).

Remarks. Late Pleistocene muskox of Eurasia has uncertain taxonomic status in the scientific literature. Recently, this species is increasingly referred to *O. moschatus* (Zimmer-

mann, 1780), emphasizing its relatedness with the extant American muskox. However, not all the researchers agreed with the unification of the extinct representative of the genus with the living one. There is no doubt that they differ significantly in a number of morphological characters noted in the comparative analysis of their skulls (Ryziewicz, 1955; Sher, 1971; Tikhonov, 1994; Chubur, 2015). These differences allowed C. H. Smith to describe the extinct muskox as *O. pallantis* in 1827. However, "the Fossil Musk Ox, *O. pallantis*, with the horns pressed against the temples behind the orbits, found on the coasts of Siberia, is not definitively ascertained to be a separate species" (Smith, 1827, p. 370).

Recognizing the close proximity of the two species, but wanting to confirm the significance of the morphological differences between them, a number of researchers considered the extinct Late Pleistocene muskox as a sub-species of the extant *O. moschatus* and identified it as *O. moschatus pallantis* (Lydekker, 1900; Andrée, 1933; Gromova, 1935; Baryshnikov, 1981; Belan, 1985; Krakhmalnaya, 2007 a; Krakhmalnaya & Kovalchuk, 2017). Khant (1996) described a new subspecies *Ovibus pallantis rhenanus* from the Rhine Valley, Germany. Using modern research methods, e. g. ancient DNA analysis supports the attribution of the Late Pleistocene and extant muskoxen to the same species (MacPhee et al., 2005; Campos et al., 2010). Taking these data into account, researchers began to recognize the species name *O. moschatus* for the Pleistocene muskox instead of *O. pallantis* or *O. moschatus pallantis*.

Discussion

The skull of a young muskox male from Buryn is quite comparable in size (e. g. in maximum occipital breadth) with the skulls of adult individuals from Siberia and exceeds by this value all known specimens from the territory of Ukraine. However, according to maximum diameter of horncore base, the skull described herein is smaller than those from other localities.

Muskox was a typical component of the periglacial fauna. This species, along with other large mammals of the "mammoth" fauna, was an object of hunting for an ancient man. The Late Pleistocene muskox is represented on the territory of Ukraine in materials from seven localities, four of which are archaeological sites. It allows us to assume that these animals

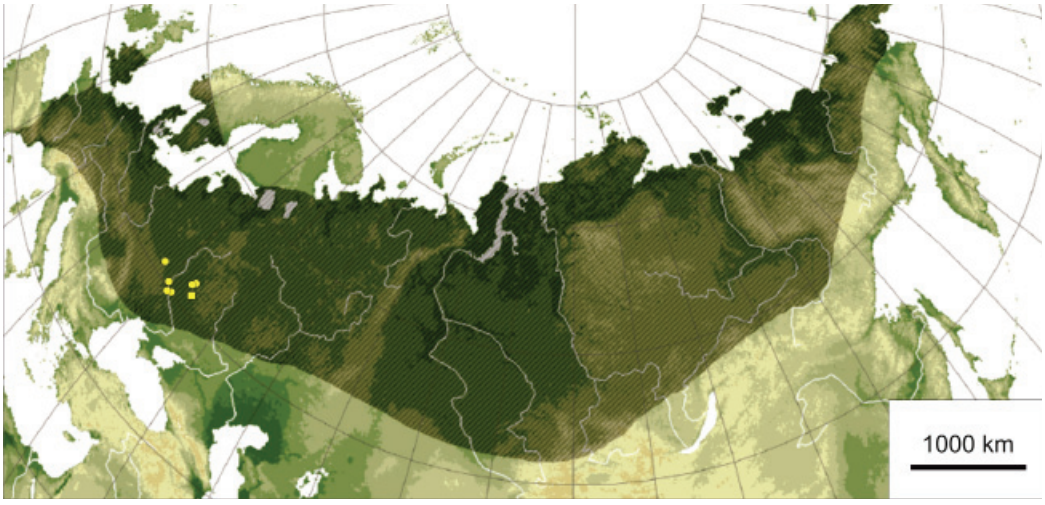

Fig. 3. Last Glacial maximum distribution of *Ovibos moschatus* (after Kahlke, 2014, with modifications). Previously known localities with fossil muskox remains within the territory of Ukraine are indicated by circles. The find described herein is indicated by square.

in the Dnipro region were extracted by Late Paleolithic hunters. Most likely, during Late Pleistocene muskoxen appeared there sporadically in winter time. The new find of the fossil remains belonging to this species from river alluvium near Buryn allows us to extend the known range of *O. moschatus* in Ukraine to the east (fig. 3) thereby clarifying the data on its former distribution (Kahlke, 2014).

Although territories occupied by man and muskox during the Late Pleistocene were partially overlaid in many regions, people probably did not cause the significant decrease of the former range of this species. In some areas, the number of people and muskoxen grew almost simultaneously (Lent, 1999). According to the latest data aiming to check the human impact on species dynamics based on the study of the DNA of *Ovibos moschatus* from all parts of its previous range (Campos et al., 2010), muskoxen survived several periods when the flowering of populations of these animals was alternated with a decrease in their number. We assume that the decline in population numbers of this species was due to unfavorable climate changes, primarily the significant increasing humidity and progressive warming during the Holocene.

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