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Quaternary mammal remains from the Krasniy Yar locality (Tomsk region, Russia)

A.V. Shpansky*

Tomsk State University, Lenin ave. 36, Tomsk, Russia, 634050

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Abstract

The geological structure and faunal content of one of the principal localities for Quaternary mammal remains in Western Siberia, Krasniy Yar (Tomsk region, Russia) are considered. This locality contains 3 layers of bone remains: lower (Middle Neopleistocene), middle (the end of Late Neopleistocene) and upper (end of Neopleistocene—beginning of Holocene). The richest horizon in number of species and the quantity of remains is the middle horizon, which contains the mammoth fauna.

1. Introduction

One of the richest localities for Quaternary mammalian remains on the Ob River is situated in the vicinity of the village Krasniy Yar, Krivosheinskiy District, Tomsk region (Fig. 1). The occurrence of ancient bones on the sand bank has been known since the last century. Alekseeva (1980) was the first to collect bones in the 1960s and1970s. In ten years she collected about 5500 bones. During the last 13 years more than 3300 bones of large mammals have been collected. Until the present time the fauna from this location has not been dated, and has been considered "mixed".

2. Geological position of the locality

Recently, the author has been able to determine the complex geological structure of the section near Krasniy Yar. This research has revealed that the Ob River erodes sediments of the Middle-Upper Neopleistocene (Shpansky, 2000, 2003). The complete structure could be seen on the terrace 2 (7–10 m high) above the flood plain, of alluvial origins. Table 1 describes the section of the Quaternary sediments of the Krasniy Yar locality from top to bottom.

The youngest site is in the upper part of the alluvial sediments of terrace 2 above the flood plain and represents the upper bone-bearing level. Part of a *Bison priscus* aff. *deminutus* Grom. skeleton was found at a depth of 3 m. The morphological characteristics of the skull prove that the bison is transitional from the short-horned form of bison to aurochs (Foronova, 1998; Shpansky, 1997). This fossil is dated to the period between the very end of the Late Neopleistocene and the Early Holocene.

The main source of the fossil material is in a lower concentration, at a depth of about 7 m, in the bed of fine- to medium-grained sands occurring horizontally and obliquely (bed 7) and enclosing abundant plant fossils. Sixteen species of mammals (some bones belong to birds and large fish) of the Mammoth Faunal Assemblage, including about 283 individuals were identified conclusively (Table 2). The majority of the beach material corresponds in age to this bone level, judging from its morphological features, the state of preservation, and color. Originally the Karginian Interglacial age was characterized by the absence of Arctic species (*Ovibos*, Arctic fox, lemming and others) and the presence of numerous elk, red deer and beavers in the complex. The age is also defined by radiocarbon dating

*Tel.: +7 3822 529748; fax: +7 3822 529895.
E-mail address: palcenter@ggf.tsu.ru.

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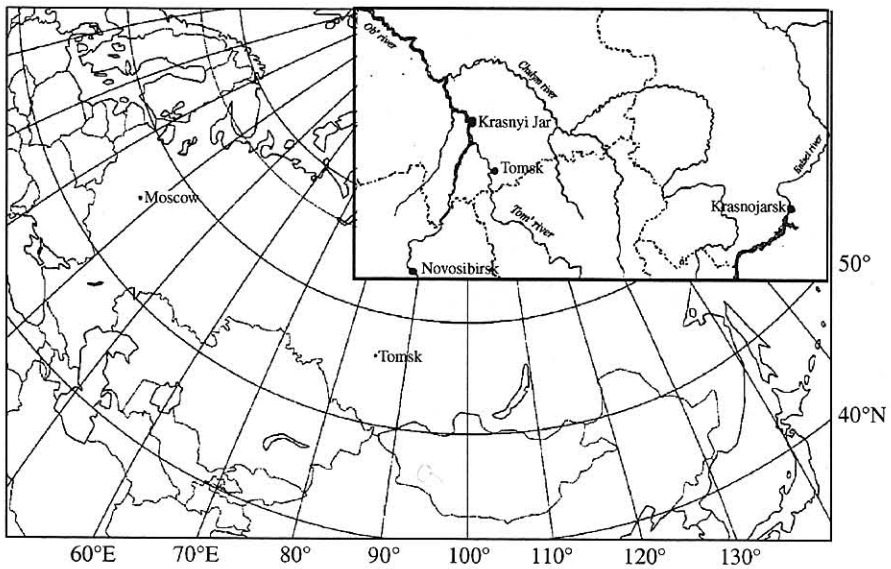

Fig. 1. Geographical position of the locality of Krasniy Yar (Tomsk region).

Table 1
Geological section, Ob River near Krasniy Yar

Stratigraphic units of Holocene and Pleistocene	Bed number and characteristics of deposits	Thickness, m	Depth, m
IV_{1-4}, Holocene	(1) cultural bed, podzolic soil disturbed in certain sites	0.2–0.5	0.2
	(2) grayish straw-colored, silty, macroporous, and structureless sandy loam; in the upper layers, patched with redeposited humus	0.6	0.8
	(3) horizontal thin-bedded yellowish-gray arenaceous quartz, varying in grain size, with ferruginous ortstein-like concretions; over bedding, sands range from gray and greenish-gray to brown and fulvous	1.2	2.0
III_{3-4} third and fourth grade of the Upper Neopleistocene	(4) medium-grained arenaceous quartz, heterogeneous in color: the upper and lower layers are yellowish-gray and the middle layers are greenish-fulvous; sands are lenticular obliquely bedded, gradually becoming clayed and micaceous; the upper layers enclose fragmentary skeleton of *Bison priscus* aff. *deminutus* Grom. (Shpansky, 1997).	0.8	2.8
	(5) bluish-gray micaceous medium-grained clayey arenaceous quartz, with fulvous ferruginous interbeds	2.2	5.0
	(6) bluish-gray layered viscous clays, with thin interbeds of compacted brownish-fulvous ferruginous clays	1.5–2.5	7.5
III_{kr}, Karginian Horizon, third grade of the Upper Neopleistocene	(7) horizontal obliquely bedded, gray, fine/medium-grained sands, with shingle lenses; the upper layers of the bed contained large mammals of the Mammoth Faunal Assemblage, abundant plant detritus and isolated vertical stubs	3.0	10.5
II_{sm}, Samara Horizon, second grade of the Middle Neopleistocene	(8 and 9) gray layered viscous clays, with thin interbeds of compacted brownish-fulvous clays; the upper position is occupied by lenticular peats attaining a thickness of 1 m	5.0	15.5
II_{tb}, Tobolsk Horizon, first grade of the Middle Neopleistocene	(10) Fine-medium-grained sands; the upper layers are reddish and enclosing *Mammuthus* ex gr. *trogontherii-chosaricus, Equus* ex gr. *mosbachensis-germanicus, Bison priscus,* and *Stephanorinus kirchbergensis*	1.5	17

(25650±420 yr (SB RAS–5201), 18505±215 yr (SB RAS–5555).

Within the base of the terrace, there are the Middle Neopleistocene beds nonconformable with the upper layers (layers 8–10). The remains of very large *Bison priscus* Boj. and *Equus* ex gr. *mosbachensis-germanicus* were collected from the sands assigned to the Tobolsk Age (bed 10). Teeth of *Stephanorhinus kirchbergensis* (Jaeger) were found on the beach. In 1999 the skull and several bones of *Mammuthus* ex gr. *trogontherii-chosaricus* having teeth of the transitional type were discovered in that layer.

Table 2
List of species of the Mammoth Fauna from the middle bone-bearing level of the Krasniy Yar locality, Tomsk region, collected to 2004

Species	Bones	%	Individuals	%
Rodentia *Castor fiber* L.	6	0.2	3	1.1
Lagomorpha *Lepus tanaiticus* Gureev	1	0.03	1	0.35
Artiodactyla *Bison priscus* Boj.	1442	45.1	109	38.5
Saiga ricea krasnojarika Shpanskii	9	0.3	3	1.1
Alces alces L.	185	5.8	19	6.7
Megaloceros giganteus Blum.	83	2.6	10	3.5
Cervus elaphus L.	49	1.5	6	2.1
Rangifer tarandus L.	15	0.5	2	0.7
Perissodactyla *Coelodonta antiquitatis* Blum.	239	7.5	29	10.2
Equus ex gr. *gallicus* Prat	597	18,7	72	25.4
Proboscidea *Mammuthus primigenius* Blum.	282	8.8	14	4.9
Carnivora *Panthera (Felis) spelaea* Goldf.	27	0.8	3	1.1
Ursus (Spelaearctos) rossicus Boris.	17	0.5	2	0.7
Canis lupus L.	13	0.4	7	2.5
Gulo gulo L.	3	0.1	1	0.35
Meles meles L.	1	0.03	1	0.35
Indeterminable	210	6.6		
Total: 16	3200	100	283	100

3. Taphonomic features of the locality

The Krasniy Yar locality is of alluvial origin. The accumulation of the remains was a result of frequent deaths during crossing of the ancient Ob river, or during drinking. Perishing during the passage across the river could be confirmed by the significant number of remains of young mammoths, wooly rhino, bison, and horse (Maschenko and Shpanskiy, 2002). Corpses of the animals and their fragments accumulated along a short interval of the river with a slow current (some bones are rolled or broken). Probably burial occurred relatively slowly, making the carcasses accessible for predators and rodents. Many bones preserve the traces of gnawing by large predators and middle-sized rodents (probably gophers). There are two ways for the predated remains to occur in the locality. The principal one is through accidental death during the spring high water of the river. As a result, the most numerous remains are those of gregarious ungulates, which perished most frequently at the site. The taphocoenosis formed in a few steps: in Tobolsk time (beginning of Middle Neopleistocene), in Karginian and Sartan time (second part of Late Neopleistocene) and in the Holocene (time of burial of the partial bison skeleton *Bison priscus* aff.. *deminutus* Grom. (Shpansky, 1997). Association of remains with a large time interval is characteristic of the second half of the Late Neopleistocene. This is shown by the radiocarbon date of 7000 yr.

These cycles of deposition and preservation are probably connected to the tectonic movements of the Western Siberian Plain, and the climatic cycle of the quaternary and meandering of the ancient river, i.e. changing direction and speed of current which may cause the preservation and burial of the remains.

4. Brief faunal analysis

The difference in the frequency of occurrence of skeletal elements directly depends on the transportation of a considerable part of bone material by streams (some of the fossils can be destroyed) (Shpansky, 1997). Distal parts of extremities were usually less damaged whereas radii were more affected. The dense parts of humeri, femurs, and tibiae were often found. The vertebral processes were usually damaged. Both the toothed mandibles and isolated teeth were collected. Ribs and shoulder blades were most often fragmentary. Complete skulls were rarely found, whereas their basal parts and horns were met more often. Numerous remains of fast-running ungulates were characteristic for the Mammoth Faunal Assemblage from the middle bone level. There were 1442 bones of *Bison priscus* (45.1%) belonging to at least 109 individuals (38.5%) and 597 bones of *Equus* ex gr. *gallicus* (18.7%), which belonged to 72 individuals (25.4%). The minimum number of individuals was estimated from similar bones of the distal part of extremities (Tables 3 and 4).

The above-mentioned animals inhabited open landscapes. Forest inhabitants were fewer (approximately 8%). It suggests that the steppe and forest-steppe landscapes prevailed. This is also confirmed by the relatively large quantity of woolly rhinoceros and mammoths [29 (10.2%) and 14 (4.9%), respectively]. The greater part of the mammoth remains belonged to mature and young individuals. There were even some

Table 3
The species of large mammal remains from the Middle Neopleistocene deposits of the Krasniy Yar locality

Species	Bones	%	Individuals	%
Carnivora *Pantera spelaea* Goldf.	1	1.0	1	4.8
Proboscidea *Mammuthus* ex gr. *trogontherii-chosaricus*	12	11.9	1	4.8
Artiodactyla *Bison priscus* Boj.	35	34.7	4	19.0
Cervalces cf. latifrons (Johnson)	2	2.0	1	4.8
Cervus elaphus L.	2	2.0	1	4.8
Perissodactyla *Equus ex gr. mosbachensis-germanicus*	34	33.7	10	47.6
Stephanorinus kirchbergensis (Jaeger)	7	6.9	2	9.5
Coelodonta antiquitatis (Blum.)	6	5.9	1	4.8
Indeterminable	2	2.0		
Total: 7	101	100	21	100

Table 4
The dimensional characteristics of bison skulls from different bone-bearing levels of the Krasniy Yar locality

Measurements	PM TSU 5/1744	PM TSU 5/1511	PM TSU 8/1
Forehead index, cm^2	883.6	824.0	632.2
Horn core length along the large curvature, mm	420	880?	650?
Girth of the horn basis, mm	394	294	230

bones of mammoth embryos. The absence of bones of small-sized animals (a few bones of hare and beaver) is due to their small size and the partial transportation of bone remains.

The number of predators (1.83%, 5 species, 14 individuals) does not reflect the real relationship between predators and victims. It may be explained by the taphonomic characteristics of the locality. The most numerous are *Panthera (Felis) spelaea* Goldf., *Ursus (Spelaearctos) rossicus* Boris. and *Canis lupus* L.

The significant prevalence of remains from fast-running mature herding animals (bison and horses) characterizes composition of species of the Mammoth Faunal Assemblage within the middle bone-bearing level (about 64%). At the same time, the percentage of remains of animals living in small groups (mammoths, rhinos, and some deer) makes up about 30%, thus reflecting their portion in the paleocoenosis.

The lower bone-bearing level is significantly impoverished in the quantity of bones and species. Four species of large herbivores have been identified to date (Table 3). The most abundant are the remains of the caballoid horse *Equus* ex gr. *mosbachensis-germanicus*, which is similar to the horse from Kemerovo region (locality: Novo-Sergeevski and Chernigovski quarries) in its size and morphological features (Shpansky, 1999). The skull of the adult elephant found together with the postcranial remains is referred by the author to the thick-enamel transitional (interglacial) form between the trogonterium and the chasaricum, as determined from the structure of the last upper molars. The species from the lower bone-bearing level resemble those of the Hazarian Faunal Assemblage of the Middle Neopleistocene. Subsequent work at this locality will allow us to distinguish more species of the faunal assemblage.

The morphological characteristics of the horse, bison and mammoth (the most rapidly changing phylogenetic lines among the mammals) demonstrate the considerable difference between their Middle and Late Neopleistocenian representatives. The common tendency of decrease in body size is observed in these animals. Hoof area declined in horses and bison, which proves their adaptation for more solid ground. The frequency of dental plates of mammoths tends to increase, thus adapting to coarse vegetation. The cranial remains of *Bison priscus* Boj. within these three bone-bearing levels show a gradual decrease in size and shortening of the horn core (Table 4, Fig. 2). For example, in a male bison skull [specimen no. 5/1744 of the Paleontological Museum of Tomsk State University (PM TSU)] from the lower bone-bearing level the incomplete length of the horn core along the large curvature is 420 mm. Horn cores are lower than the forehead surface. The short-horned form of bison is typical for the middle bone-bearing level. The spread of the horns of the largest skull (PM TSU 5/1511) is 880 mm. The Early Holocene skull of the female *Bison priscus* aff. *deminutus* Grom. from the upper bone-bearing level (PM TSU 8/1) has a 650 mm spreading of horns. The forehead index is significantly smaller than in more ancient skulls. The size difference is clearly traced within the levels of different ages, and there is no evident mixing of parameters. It allows using the bison cranial remains for the dating (with the accuracy of Neopleistocene units) of the deposits enclosing these remains.

5. Conclusion

The Krasniy Yar locality has three bone-bearing layers. The lower layer belongs to the Middle Neopleistocene,

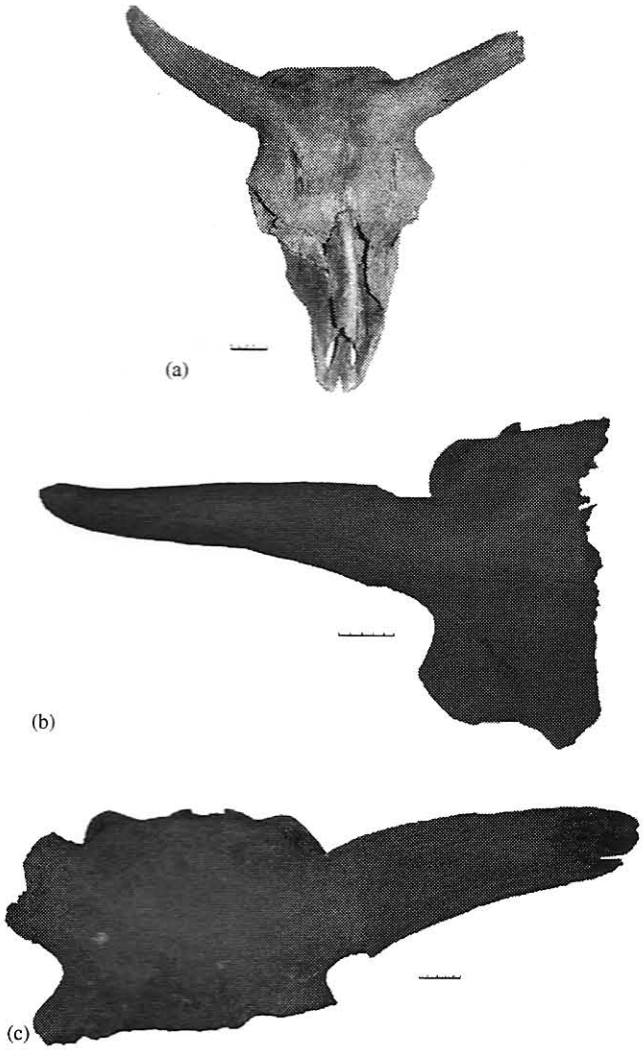

Fig. 2. *Bison priscus* Boj.skulls of different age from the Krasniy Yar locality: (a) PM TSU 8/1 upper bone-bearing level (tobol horizon); (b) PM TSU 5/1511 middle bone-bearing level (Karginian horizon); and (c) PM TSU 5/1744 lower bone-bearing level (end of Pleistocene—beginning of Holocene).

and the middle layer (preserving the most numerous and diverse remains) to the second half of the Late Neopleistocene. The upper layer is referred to the boundary of Pleistocene and Holocene. The accumulation of the remains took place in alluvial conditions in a few steps and during a long period of time. The specific content and the ratio of remains of different species is close to the other locality on the Ob region (Krasniy Yar, Novosibirsk region [Vasil'ev, 2002]).

The study of this locality is in progress, and collection takes place every year. Besides the species listed in tables the remains of birds, *Anser* sp. and *Aythyni gur* (identified by E.N. Kurochkin) are also found. In 2004 interesting specimens of large predatory fishes were found (not identified). I anticipate that an increasing number of species will be discovered in the lower bone-bearing layer, including a large number of older remains of mammoths, rhinoceros and bison of different ages (from embryos to almost adult animals (Maschenko and Shpanskiy, 2002; Shpansky and Billia, in press). Interesting bones having pathological alteration, probably related to the deaths of these individuals have also been collected. This data in addition to other evidence can help to reconstruct the taphonomic characteristics of the locality and clarify some aspects of the animals' evolution and paleoecology.

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