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Woolly Rhinoceros (*Coelodonta antiquitatis*) from Wrangel Island

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Zusammenfassung

Auf der Wrangel-Insel (Nordost-Sibirien) wurden ein vorderes Nasenhorn, ein Sacrum, ein Humerus, ein Femur, ein Radius und ein Metatarsale III des Wollhaarigen Nashorns (*Coelodonta antiquitatis*) in gutem Erhaltungszustand gefunden. Ihre Maße werden mit anderen Funden sibirischer *Coelodonta* verglichen. Mit hoher Wahrscheinlichkeit stammen alle Überreste vom selben Individuum, das mit ^{14}C auf ein geologisches Alter von etwa 36.000 Jahren datiert wurde (Karginsk-Interstadial). Pollenanalysen aus dem mutmaßlichen Einbettungshorizont zeigen ein reicheres Artenspektrum als die heutige Vegetation der Wrangel-Insel (welche immer noch artenreicher ist als vergleichbare arktische Floren). Da es sich um den Alaska nächstgelegenen Fundort von *Coelodonta* handelt und der Meeresspiegel im Karginsk-Interstadial gegenüber heute abgesenkt war, steigt die Wahrscheinlichkeit, die Art eines Tages auch auf dem amerikanischem Kontinent zu finden.

Abstract

On Wrangel Island (northeastern Siberia) an anterior nasal horn, a sacrum, a humerus, a femur, a radius and a metatarsal III of woolly rhinoceros (*Coelodonta antiquitatis*) were found. Their measurements are compared to other Siberian *Coelodonta*. There is high probability that all remains belonged to one individual, which was ^{14}C dated at about 36,000 years BP (Karginsk interstadial). Pollen analyses from the putative sediment of origin show a richer species diversity than today's vegetation of Wrangel Island (which is still richer than comparable arctic floras). As Wrangel island represents the locality of *Coelodonta* nearest to Alaska, and sea level in the Karginsk interstadial was lower than today, the probability of finding woolly rhino in the American continent has risen.

Introduction

Remains of woolly rhinoceros are present in most Late Pleistocene localities in Northern Asia. However, they are usually rare in comparison with other representatives of the mammoth fauna. In assemblages from Paleolithic sites in southern Siberia and the Transbaikal, rhinoceros remains are encountered more frequently (3–10% of bones of hunted animals) (Ermolova 1978) than in central and northern Siberia (0.5–2%). In Far East localities this animal is especially rare (0.05–0.2%). The distribution of woolly rhinoceros during the Late Pleistocene in Siberia reflects the invariable presence of this species in both the south and the north. In central Siberia, it was probably absent by the beginning of the last glaciation. So, for example, there are no remains of rhino in the fauna of archaeological sites assigned to the Dyuktai culture (35,000–17,000 years BP) (Mochanov 1977), and other late Pleistocene localities in central Yakutia. At the same time, this species is occasionally found in northern Yakutia – at the Berelekh "cemetery" (14,000–10,000 years BP), and more often in Transbaikalia – at the site of Kodakhta (22,000–10,000 of years BP) (Kasparov 1986).

In northeast Siberia, woolly rhinoceros inhabited the Kolyma Basin, where its remains have been found on Anyui and Omolon Rivers (Vangengeim 1977; Alexeeva 1990). The age of these finds ranges from 49,000 to 14,000 years BP (Sulerzhitskyi & Romanenko 1997). The presence of rhinoceros in the basin of the Anadyr' River and other parts of central and eastern Chukotka was demonstrated by the identification of two rhino horns from Amguema River in the museum at Egvekinot (Garutt 1998).

Vereschagin & Baryshnikov (1980) also noted that this animal inhabited the Anadyr' River valley. Woolly rhinoceros is unknown in Alaska, and in the opinion of many specialists, did not penetrate into North America. Now this conclusion is called into question by the discovery of rhino remains on Wrangel Island. The presence of rhinoceros on the island was recognized for the first time in 1994, when the members of a Russian-Swedish expedition found the fragment of ulna in the southern part of the island, in the valley of the Mamontovaya River, which yielded a radiocarbon estimate of 29,800 ± 340 years BP (GIN-8259a) (Sulerzhitskyi & Romanenko 1997).

In 1996 the authors conducted field work in the Neizvestnaya River (northern part of the island) at roughly 180 degrees East (JOGER 1996). Over the course of two days, three bones (left humerus, left radius, and left third metatarsus) and the first horn of woolly rhinoceros were recovered at the same locality. On the basis of their comparable degree of preservation and size, they appear to have been derived from one adult individual. Previously – in approximately the same location – V. BARANYUK found a rhino sacrum, exhibiting features similar to those of the bones mentioned above. Near the river, roughly 1 km from this locality, a femur of a subadult rhino was found. Thus, during the 1996 season on the Neizvestnaya River, a total of five bones and one horn of woolly rhinoceros were collected. Wrangel Island was connected to the Siberian mainland throughout the Late Pleistocene and at times part of the Beringian mainland. The presence of rhino so close to Alaska raises the possibility of its penetration into North America.

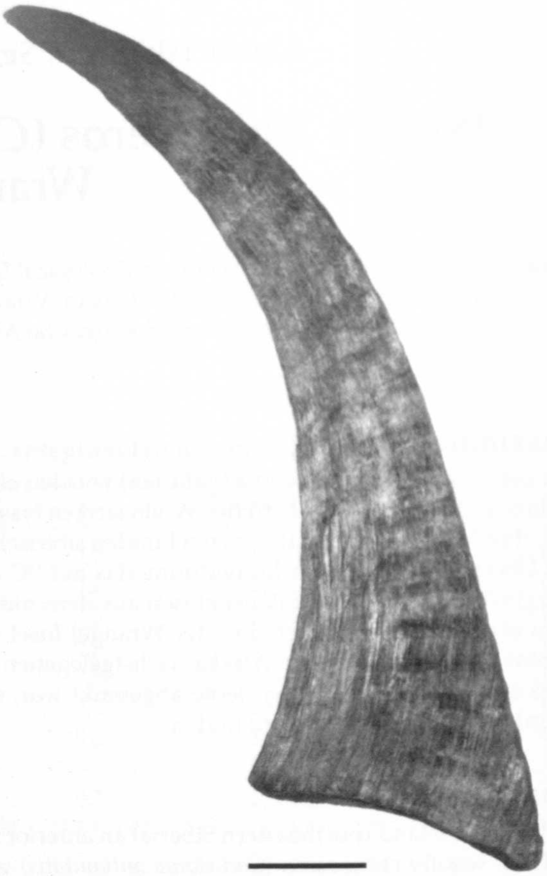

Fig. 1: Anterior horn of the rhinoceros from Wrangel Island. Scale: 10 cm.

The morphological characteristics of horn and bones

Rhinoceros of the Late Pleistocene of Siberia are usually assigned to the nominal subspecies *Coelodonta antiquitatis antiquitatis* BLUM. However, another subspecies has been described from Yakutia – *C. a. humilus* RUSSANOV 1968.

In our view, this is a smaller subspecies. In contrast to the Transbaikalian *C. tologojensis*, the Late Pleistocene woolly rhinoceros possessed shorter limbs and massive bones (ALEXEEVA 1980). Although the small sample size precludes systematic conclusions, standard morphological descriptions of the horn and bones are presented.

Measurements on the bones are based on VON DEN DRIESCH (1976), and on the horn, on FORTELIUS (1983).

Horn

The first horns of woolly rhinoceros vary little with respect to shape and size. The horn from Wrangel is complete and well preserved (Fig. 1). At the time of discovery, the color was light grey, and has subsequently darkened slightly. The length of horn, along its outer curvature (on the forward edge) is 106 cm, the length of the base is 25.5 cm, the width of the base is 7.2 cm, and the chord (least distance from the back edge of basis up to tip of horn) equals 81 cm. On the surface of horn, approximately 25 darker bands are visible, indicating that the age of the individual at death was roughly 20–25 years. About one half of the known first horns of woolly rhino do not exceed 100 cm in length along the outer curvature (GARUTT 1998). However, a very large first horn (1249 mm along the outer curvature) probably belongs to a senescent female, the skeleton of which was found in Churapcha (Yakutia) (LAZAREV 1998). The horn from Wrangel falls into the size range for males, which were more massive than females (CHERNOVA et al. 1998).

This conclusion is based on analogy with the modern rhinoceros, and also on measurements of fossil samples from museum collections.

The comparative analysis of the sizes of rhino bones from Wrangel reveal that they are comparable to the largest specimens from Siberia.

Sacrum

The sacrum of the rhinoceros comprises five vertebrae. Only one complete sacrum was studied from collections; it belongs to a subadult individual that was found on the Yana River (Zoological Institute, St. Petersburg, No. 10776). The Wrangel Island sacrum possesses only four vertebrae; the last vertebra is absent (Fig. 2). A comparison with a sacrum from European Russia indicates that the Wrangel specimen is slightly larger with respect to the majority of dimensions.

Humerus

Left, almost complete, with fully fused epiphyses, derived from a large adult animal. In terms of length and massiveness, the Wrangel humerus is comparable to the largest specimens from Europe and the Urals (Tab. 1); however, it is somewhat shorter than the largest Siberian specimens, thus exceeding them in terms of massiveness (Fig. 3).

Radius

Left complete, belonging to a large adult animal (Fig. 4). The proximal epiphysis is slightly damaged. With respect to length, the bone from Wrangel is larger than other radii from Siberian collections. Also, data from various sources (Alexeeva 1990; Kuzmina & Kuzmina 1995; Lazarev 1998; Borsuk & Bialynicka 1973) indicate that woolly rhinoceri from Europe had longer limbs than the Siberian sample. However, Alexeeva (1980) described some radii from the southern part of Western Siberia that significantly exceeded all other known specimens (GL = 396–420 mm). In terms of massiveness, the woolly rhinoceros radius from Wrangel corresponds to the mean parameters for this bone in Europe, but exceeds the maximum value for Siberia (Tab. 2).

Meatatarsale

The metatarsale III (Fig. 5) is poorly known and difficult to identify. Only with reference to an assembled hind leg of a Black African rhinoceros was it possible to establish that the Wrangel Island bone was a rhinoceros metatarsale III. The dimensions of this bone were estimated from data on the woolly rhinoceros of the Urals region (Kuzmina & Kuzmina 1995).

Femur

Right, with slightly damaged epiphyses; may be attributed to a subadult animal, because the boundary between the proximal epiphysis and diaphysis is clearly visible. The entire bone was sacrificed for a radiocarbon date.

Palaeogeographical description of the locality and the age of finds

The horn, humerus, radius and metatarsal bones of a rhinoceros were recovered from a channel of the Neizvestnaya River, northern plain of Wrangel Island, beneath an erosional cut on the right bank (Locality No. 96). The femur was found below the same exposure further downstream. The excellent preservation of the remains suggests that they had been buried in frozen sediment until shortly before their discovery, and they were most probably buried in the exposed alluvium at Locality No. 96.

Locality No. 96 represents a exposure on the right bank of the Neizvestnaya River, 12 km downstream from where the river issues from mountains onto the northern coastal plain. The locality is roughly 2 km long and up to 6–7 meters above the level of the water, although the cleaned-off section is only about 5 meters above the water.

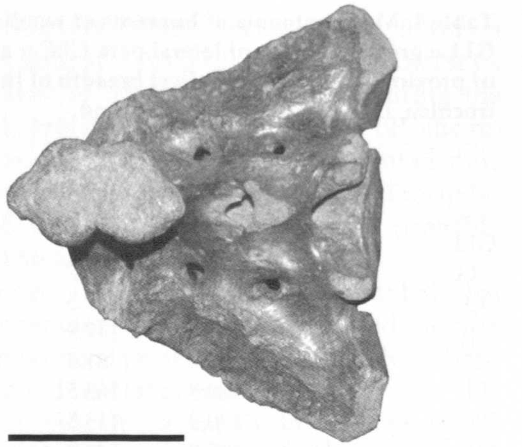

Fig. 2: Sacrum of the rhinoceros from Wrangel Island. Scale: 10 cm.

Fig. 3: Humerus of the rhinoceros from Wrangel Island. Scale: 10 cm.

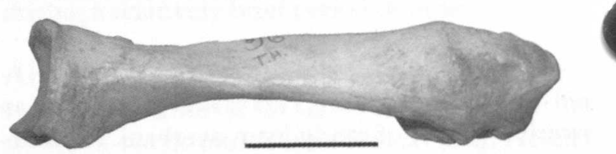

Fig. 4: Radius of the rhinoceros from Wrangel Island. Scale: 10 cm.

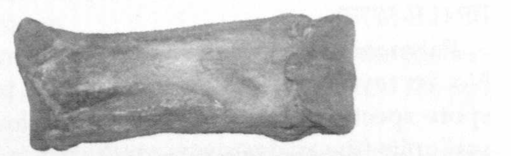

Fig. 5: Metatarsale III of the rhinoceros from Wrangel Island. Scale: 10 cm.

The exposed sediment reflects two cycles of riverine deposition of the river Neizvestnaya during Late Quaternary time.

The ancient alluvium is overlain by polygenetic deposits of Holocene age that are no more than 0.5 m in thickness and are widespread on the plains of Wrangel Island. Both alluvial units exhibit a similar, binomial structure: a layer of chan-

Table 1: Measurements of humerus of woolly rhinoceros. Measurements were taken from von den Driesch (1976). GLI = greatest length of lateral part, CLC = greatest length from caput, Bp = breadth of proximal end, Dp = depth of proximal end, SD = smallest breadth of the distal end, Bd = breadth of the distal end, Bt = breadth of the trochlea, Dd = depth of the distal end.

	European Russia			Siberia			Wrangel Island
	lim	x	n	lim	x	n	n = 1
GLI	391.6 – 468.0	419.9	11	438.9 – 445.8	–	2	440.0
CLC	346.8 – 419.7	368.7	9	376.0 – 421.4	400.7	5	373.0
Bp	187.2 – 255.0	209.5	10	198.0 – 224.6	211.0	4	214.0
Dp	111.3 – 168.0	147.9	7	175.9	–	1	160.2
SD	72.6 – 96.0	81.5	11	77.0 – 93.0	81.8	5	88.4
Bd	144.3 – 189.8	163.5	10	153.9 – 190.0	166.3	3	185.6
Bt	107.0 – 130.0	113.5	9	112.0 – 124.5	116.3	5	122.9
Dd	113.9 – 135.0	122.9	8	126.9 – 130.6	128.7	3	131.6

Table 2: Measurements of radius of woolly rhinoceros. GL = greatest length, PL = physiological length (longitudinal axis of the bone from the proximal articular surface to the distal articular surface), LI = length of the lateral part, Bp = breadth of proximal end, Bfp = breadth of humeral proximal articular surface, SD = smallest breadth of the distal end, Bd = breadth of the distal end, Bfd = breadth of distal articular surface, IM = Index of massivity in % (GL [length of the bone] to SD [breadth of diaphysis]).

	European Russia			Siberia			Wrangel Island
	lim	x	n	lim	x	n	n = 1
GL	340.7 – 394.6	369.2	7	347.5 – 391.4	380.6	12	392.0
PL	302.6 – 358.5	329.3	6	308.8 – 351.3	335.3	8	333.0
LI	295.7 – 344.1	320.0	6	305.1 – 345.3	324.6	8	321.0
Bp	105.6 – 121.0	114.4	7	105.2 – 130.0	114.7	12	125.1
Bfp	105.6 – 119.9	113.8	6	101.2 – 121.7	109.7	8	122.9
SD	57.4 – 74.0	64.1	7	54.2 – 78.0	62.4	12	65.0
Bd	103.9 – 130.0	118.0	7	109.5 – 134.0	116.5	12	123.6
Bfd	86.1 – 108.8	99.4	6	90.1 – 120.0	102.0	12	113.0
IM	16.1 – 19.7	17.3	7	14.6 – 16.2	15.5	12	16.6

nel deposits comprising rubble and gravel, and an overlying layer of sandy loam overbank flood deposits. The overbank facies of the lower alluvial unit contains inclusions of redeposited, decomposed sandy peat. A sample of this peat (recovered from a depth of 2.2 meters from the surface) yielded a radiocarbon date of 43,300 ± 3,000 years BP (LE-5277).

Palynological analysis of samples from Locality No. 96 reveals a significant difference in pollen-spore spectra between the upper and lower alluvial units (the analysis was conducted in the laboratory at the Institute of Geography, St. Petersburg University by D.P. Ponomareva). A characteristic feature of the spectrum from the overbank flood facies in the lower alluvial unit is the presence of pollen of woody vegetation and shrubs (10–17% of the total number of microfossils). The foreign pollen of genus *Pinus* and *Picea* (up to 11%), and local taxa *Alnaster* cf. *fruticosus* (5–7%), *Betula nanae* (10–38%) and *Salix* spp. (30–72%), are also represented. Among grassy plants and shrubs (60–85% of the total), Cyperaceae (35–60%) and cereals (Poaceae, 20–53%) are predominant, while *Artemisia* (1–3%) and Ericaceae (2–7%) are rare, and other genera and families are represented by only isolated grains. Among spore plants, the moss *Sphagnum* (up to 68%) and Bryales (17%) predominate, while lycopodiums range from 10 to 37%, including *Selaginella sibirica* (no more than 4%).

The results of the pollen-spore analysis indicate that during the deposition of the lower alluvial unit, conditions for plant growth were more favorable than today (birch and alder are now completely absent from the flora of Wrangel Island). Similar pollen-spore spectra are characteristic of interstadial deposits preceding to the Last Glacial Maximum (Karginsk Interstadial of Siberia, which correlates with OIS 3). A Karginsk age for the lower alluvial unit is also supported by radiocarbon dating of the peat. However, in our view, the age of deposits is slightly younger than the date, which was obtained on redeposited material.

The remains of rhino from the river Neizvestnaya, yielded the following radiocarbon dates: 36,600 ± 1,600 (LE-5275) on the radius, and 35,200 ± 1,200 (LE-5276) on the femur. The dates were obtained in the Laboratory of Geochronology at the Institute of the History of Material Culture in St. Petersburg by S. Vartanyan and V.

SEMENTSOV. The radiocarbon age of the finds is consistent with the date of the peat, and supports the conclusion that the bones of rhino are derived from the lower alluvial unit; thus, the pollen-spore analysis allow us to assess environmental conditions for woolly rhino on Wrangel Island.

Sea level during the Karginsk interval was significantly lower than modern sea level, and large areas of the coastal shelf were exposed. The modern territory of Wrangel Island was probably joined to the Siberian mainland.

The predominant vegetation types in lowland areas were cereal-carex and carex-cereal cenoses, with well developed wide spectra of grasses. Along river floodplains, bushes (*Salix, Betula, Alnaster*) were present, the pollen of which is necessarily local, as these taxa lack the means for long-distance pollen dispersal. The presence of foreign pollen of woody vegetation indicates the existence of wood refugia on Chukotka peninsula during Karginsk time.

Discussion

The presence of woolly rhinoceros in the extreme northeast of Siberia is an important paleozoogeographical discovery that permits a reassessment of the distributional pattern of this species during the Late Pleistocene. On the basis of the morphological data, we conclude that the horn, sacrum, humerus, radius, and metatarsus III belonged to one individual. Taking into account the well expressed sexual dimorphism of rhinoceros, it appears likely that this individual was a large adult male. Because the sample of rhinoceros remains on Wrangel Island is small, we cannot draw any conclusions about its morphological features.

The timing of rhinoceros habitation of the island, which is assigned to the end of the Karginsk Interstadial when conditions were milder than the Last Glacial Maximum may be significant. At this time Wrangel Island was situated near the delta of the Pre-Kolyma River, which is clearly observable on bathymetric maps of this part of the Arctic Ocean. On the basis of these maps, we assume that woolly rhinoceros could have reached the northern coast of Alaska during this interval.

Today, Wrangel Island has a higher diversity of plant species than other arctic coastal areas (YURTSEV 1994). In comparison to the Chukotkan and Alaskan coasts, Wrangel Island also has a more continental climate, which would have been more pronounced under conditions of lowered sea level. Under these circumstances, meadow-like vegetation probably existed during the Karginsk period. This is supported by pollen-spore analysis described above.

From the cuticular analysis of plant fragments from woolly rhinoceros teeth, as well as the shape of its upper lip (analogous to the African white rhino), GUTHRIE (1990) concluded that it was a grazing animal. According to UKRAINTSEVA (1993), most of Siberia was forested during the Karginsk Interstadial. For 37,000 years BP, she reconstructed a light larch forest with mountain pine and alder for the lower Kolyma basin. Precipitation and summer temperatures were probably higher than today.

However, UKRAINTSEVA also concluded that azonal communities like meadows and steppes should have been present. These would have been the preferred habitat of woolly rhino.

The survival of mammoth on Wrangel Island until mid-Holocene times (VARTANYAN et al. 1995) indicates little change in ecological conditions on Wrangel since the Pleistocene. However, woolly rhinoceros is not known to survive on the island during the terminal Pleistocene or Holocene. It was probably more dependent on steppe/meadow-like vegetation than the more euryoecous mammoth. *Coelodonta* likely moved north not during severe glaciations, but during interglacial periods, along with the majority of large herbivores, following the valleys of the large rivers.

Among the reasons for the extrem scarcity of this species in northeast Siberia are its low population density, and the comparatively brief span of the interstadial when environmental conditions for its existence were most favorable. It is possible that woolly rhino also penetrated into North America, but probably in very small numbers and during a relatively brief period of time.

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