

GENERAL BIOLOGY

New Data on the Time and Place of Extinction of the Woolly Rhinoceros *Coelodonta antiquitatis* Blumenbach, 1799

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The woolly rhinoceros (*Coelodonta antiquitatis* Blumenbach, 1799) is a typical representative of the Mammoth Faunal Complex of northern Eurasia [1]. Disruption of the Mammoth Complex and extinction of its members provide a good model for the study of general patterns of faunal changes and extinction of particular mammal species. Detailed reconstruction of this process has become possible due to the wide use of the radiocarbon (¹⁴C) dating of particular individuals, as this is the most reliable method for the study of the spatial and temporal dynamics of species and faunas [2–4].

The radiocarbon method was used to trace in detail the dynamics of extinction of the woolly mammoth *Mammuthus primigenius* and the giant deer *Megaloceros giganteus* Blumenbach in various areas of Eurasia and within the entire ranges of these species [3, 4]. In regard to other extinct species of the Mammoth Faunal Complex, including the woolly rhinoceros, only a few ¹⁴C dates have been published. Before the mid-2000s, a few radiocarbon dates were generated for the woolly rhinoceros from northern Asia [3, 5–8]. In the last years, we have obtained a series of ¹⁴C dates using bones of the woolly rhinoceros from localities of the Ural Mountains, Siberia, and Yakutia; a total of 81 finite ¹⁴C dates are presently available. This provides a better understanding of a general trend in extinction of this animal. In the present study, only noncalibrated radiocarbon dates are used.

Figure 1 shows the distribution of ¹⁴C dates, with the time increment of 1 ka. Let us consider the segment

from 30 to 10 ka, which includes the period of extinction of the woolly rhinoceros in northern Asia. The analysis of the distribution of available dates allows the recognition of four periods. Within the first period (30–23 ka), the distribution of dates is rather uniform. The second one (23–17 ka) includes two time intervals (23–21 ka and 19–17 ka) when ¹⁴C dates are absent. The third period lasted from 17 to 12 ka, showing a considerable increase in the number of dates from 17 to 15 ka and reaching a maximum within 15–14 ka; subsequently (14–12 ka), the number of dates decreases. The fourth period (from 12 to 10 ka) contains only one date (the latest) (Fig. 1; table).

As the periods recognized are compared with climatic–chronological divisions of the Late Neopleistocene [9] and the dynamics of climate, strong correlations are observed. The first period corresponds to the Karginian (Bryansk) interstadial (from 32 to 25 ka), with relatively favorable climatic conditions. The second period coincides with the Last Glacial Maximum in temperature (25–16.5 ka). The third period corresponds to the Late Glacial (16.5–11 ka). The last date coincides closely with the Younger Dryas (11–10.2 ka), when the climate suddenly became very cold; this resulted in a

Radiocarbon dates of bones of the woolly rhinoceros from Western Siberia and the Ural Mountains (less than 15 ka)

Locality	¹⁴ C date, years	Sample no.	Reference
Lugovskoe	10770 ± 250	SOAN-4757	[3]
Lobvinskaya	12275 ± 55	KIA-5670	[7]
Zlatoustovka	12330 ± 120	BashGI-107	[3]
Orda River	13165 ± 180	SOAN-6385	This work
Bobylek Cave	14200 ± 400	IERZh-164	[6]
Serpievskaya 1	14300 ± 110	SOAN-5307	This work
Kurgan City	14390 ± 150	SOAN-5880	This work
Bobylek Cave	14630 ± 80	OxA-11296	[6]
Orda River	14700 ± 210	SOAN-6386	This work

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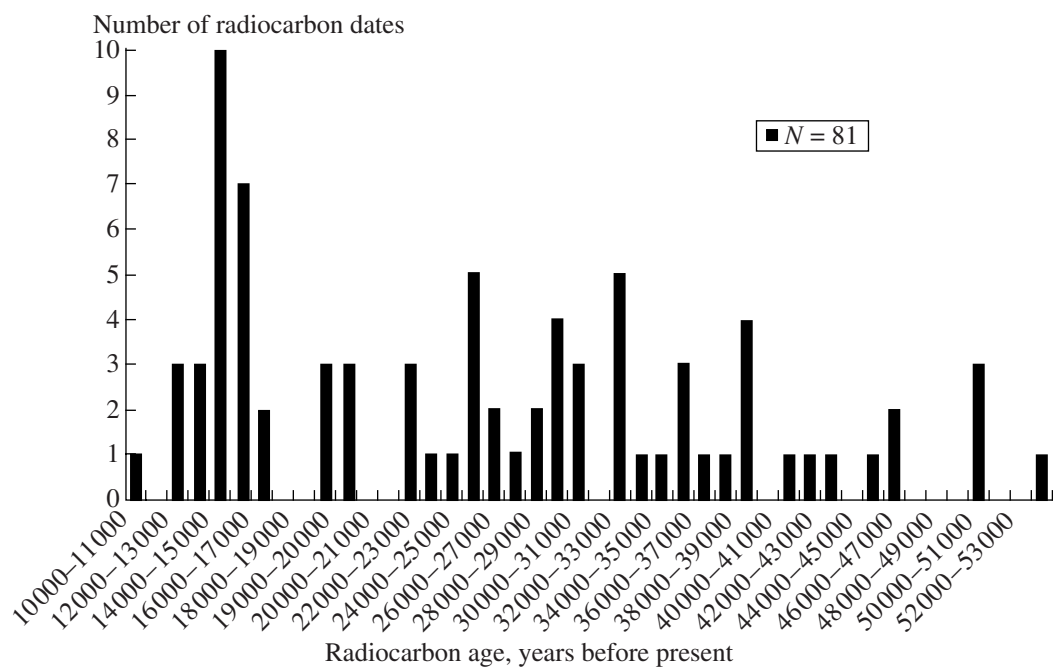


Fig. 1. Distribution of ^{14}C dates of the woolly rhinoceros from Siberia and the Ural Mountains.

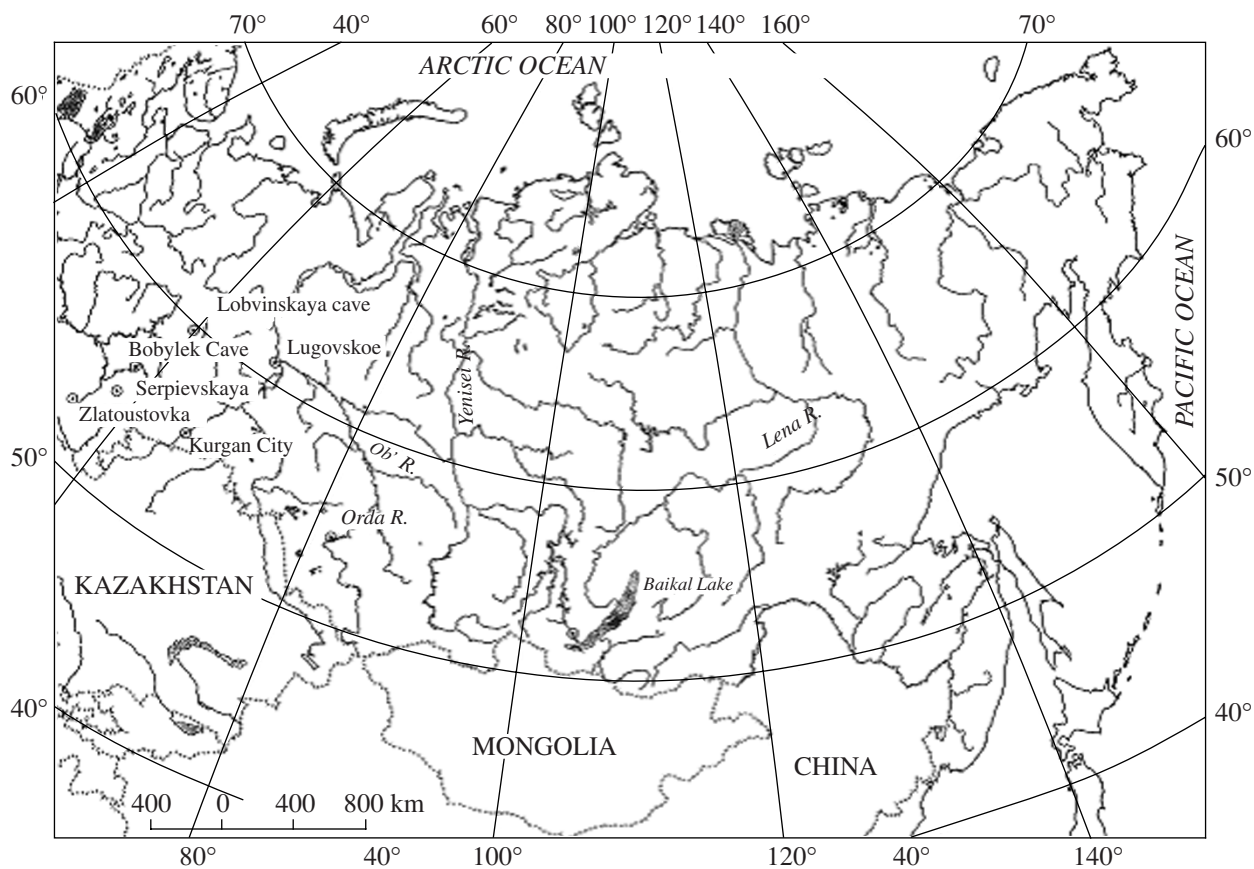


Fig. 2. Localities of the woolly rhinoceros in northern Asia dated to 15.0–10.7 ka.

decrease in the population size and extinction of the woolly rhinoceros in northern Asia.

At present, ^{14}C dates for woolly rhinoceroses from Western Siberia and the Ural Mountains are the latest in Eurasia. In northeastern Siberia, they are more than 14.3 ka; in Yakutia and Transbaikalia, 19.6 ka; and on the Russian Plain, 24 ka [1, 3, 5]. In Western Europe, the latest specimen is dated to about 13.7 ka [10]. New data are evidence that, in northern Asia, the woolly rhinoceros persisted to at least 10.7 ka (table). This date is not in error, since the same locality (Lugovskoe) has yielded mammoth bones with similar ^{14}C dates, 10.21 ± 0.135 ka (SOAN-4752), 10.82 ± 0.17 ka (SOAN-4943), and 11.31 ± 0.38 ka (SOAN-4755) [3].

Thus, the last populations of the woolly rhinoceros of northern Asia survived in the Trans-Ural region and Western Siberia (Fig. 2). This species became extinct in the Younger Dryas in the middle Ural Mountains and adjacent areas of Western Siberia.

This conclusion agrees with ^{14}C dates obtained using bones of other extinct species of the Mammoth Complex from this region, i.e., the woolly mammoth [3] and giant deer [4]; this corroborates the statement that the region under study was a refugium of the Mammoth Fauna at the end of the Pleistocene [3].

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