

## **Unraveling the chronological, geographical, and taphonomic complexities of the occurrence of the woolly rhinoceros in the Pleistocene contexts of Poland (WOOLRHINOPOLI) and Europe.**

The woolly rhinoceros (*Coelodonta antiquitatis* Blumenbach 1799) is an extinct species of rhino that lived in the Pleistocene in Europe and Asia. Until ca 40 ka (thousand years) it was geographically widely distributed across Eurasia, including in Poland, preferring areas of cold steppe tundra. The woolly rhinoceros, along with a second megaherbivore—the woolly mammoth (*Mammuthus primigenius*)—is a crucial element of megafauna, that is a more or less cold-adapted Pleistocene large mammals.

From the perspective of research results on these taxa, knowledge of the history of these two species differs significantly, with a surprising underestimation in the woolly rhinoceros, given its abundance in the fossil record. Specifically, in contrast to the mammoth, little is known about the chronological data of the woolly rhinoceros in Central and Western Europe, including Poland. There are no available DNA results for the woolly rhinoceros from Poland, and there are very few from Europe. The rhinoceros' presence in Europe is discontinuous, or else its continuity is unrecognized due to the lack of sufficiently high resolution radiocarbon dating results, as indicated by the presence of significant gaps in the radiocarbon dating results (e.g., at ca 40–34 ka BP (before present)). The date of its extinction in Eurasia is placed around 14 ka BP, but the timing of extinction across various locations in continental area is poorly recognized. Hence it is not clear whether extinction was simultaneous or gradual in different parts of Europe. The timing leading up to the final extinction of the woolly rhinoceros in Eurasia is also important from the point of view of the size, condition and stability of its population, and touches on whether it was as genetically diverse as the population in Eastern Europe.

In proposed project, entitled 'Unraveling the chronological, geographical, and taphonomic complexities of the occurrence of the woolly rhinoceros in the Pleistocene contexts of Poland (WOOLRHINOPOLI) and Europe' we will strive to unravel these questions by examining the remains of the woolly rhinoceros from Poland, the North Sea, and selected European countries (Germany, the Czech Republic, the Netherlands, the United Kingdom, France, Spain, Italy, Romania, Moldova, Russia). For this purpose, we plan to collect archive data and to scan the entire territory of Poland in search of sites with remains. Studies have been designed for taxonomic determination of remains, age and sex determination, measurements of bones and skulls (figure), determination of pathological changes in relation to past diseases or injuries, determination of absolute age of remains by radiocarbon dating, and DNA analysis.

In addition, the analysis of all marks that have been recorded on the surface of woolly rhinoceros remains will allow us to determine the factors behind the accumulation of rhinoceros remains at the Polish sites, the extent to which they were natural, and the extent to which they were affected by anthropogenic factors. A reliable evaluation of human impact on the remains should lead to a determination of the relationship between humans and the woolly rhinoceros, which is previously unexamined in Polish studies. The integrated results will constitute the first synthetic history of the woolly rhinoceros in Poland, and will come sixty years after the last published description of the state of knowledge of this topic. The end result of the Polish research will be the creation of a database on Polish Pleistocene Woolly Rhinoceros (WOOLRHINOPOLI).

We expect that the compilation of existing data on the woolly rhinoceros from other European countries, along with our planned radiocarbon and DNA studies and their integration with Polish results, will contribute to the chronological and demographic history of the species in Central and Western Europe, to the evaluation of the relationship between the range of distribution of the species and the size of the population and its genetic diversity, and to the determination of the nature of the process of extinction in the late Pleistocene.

