

2024_65_NHM_AG: Reconstructing vertebrate faunal dynamics in Central Asia through the last mass extinction

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The Cretaceous/Paleogene (K/Pg) mass extinction produced a massive shift in global biodiversity 66 million years ago, ending the dominance of non-avian dinosaurs and paving the way for the “Age of Mammals”. One of the major hindrances in understanding this event and reconstructing its drivers and impact is a fossil record that is highly biased towards a few regions, with approximately 75% of vertebrate fossils from this interval coming from North America, Europe, and East Asia. The distances between the best-studied regions also means that we have little understanding of faunal ranges or dispersal through this interval, though we know this to be critical factors for survivorship. The result is that there are major gaps in our understanding of the origins of major vertebrate clades.

One persistent mystery involves our own clade, eutherian mammals. Though many fossil eutherians are known from the Cretaceous, only a single small clade is known from South Asia, and none at all from other Gondwanan regions. In contrast, they achieve a global distribution within an extremely short period in the aftermath of the mass extinction. Thus, a major need exists to study localities intermediate between well-studied regions. Moreover, we still have no understanding of where or when the crown group of placental mammals originated, with estimates ranging over 30 million years and no reasonable constraint on place of origin.

Decades ago, a series of excellent Cretaceous fossil-bearing localities were identified in Kazakhstan, at the intersection of Asia and Europe. These localities exposed numerous vertebrate fossils, including several species of mammals, though few have been fully studied. Nonetheless, the diversity of eutherian mammals in those sites exceeds that known anywhere else in the world during the Late Cretaceous. Thus this area has long been thought of as a promising area for the common ancestor of placentals. New opportunities for fieldwork in this region, as well as much improved models for palaeobiogeographic reconstruction, macroevolution, divergence estimation, and phylogenetic analysis, provide an ideal opportunity to expand and integrate new knowledge of Central Asian vertebrate evolution through the last mass extinction.

In this project, we will conduct field explorations of three key regions of Central Asia. We will collect, describe, and identify vertebrate macrofossils and sieve for microfossils. We will conduct phylogenetic analyses of the mammalian fossils to constrain their position relative to other eutherians, including crown placentals, and place these taxa into biogeographic models to understand their movements through this interval and estimate the placental time and place of origin. Finally we will estimate ecological traits through quantitative analysis and assess extinction selectivity and response to the immense environmental change that accompanied the end-Cretaceous mass extinction.

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