

Lost giants: New study reveals decline in abundance of African megafauna

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Elephants (megaherbivores) in Tarangire National Park, Tanzania, Africa. The diversity and the abundance of such giants was much greater in the past than it is today. Credit: Juan Cantalapiedra

A new paper focuses on the size and abundance of living and non-living

large African mammals. With the use of fossil abundance data it sheds light on the ecological dynamics behind the decline of these iconic creatures. The findings challenge previous assumptions about the causes of megafaunal extinctions in Africa and provide new insights into the restructuring of ecosystems over millions of years. The research is published in the journal *Science*.

Faysal Bibi (Museum für Naturkunde, Berlin) and Juan L. Cantalapiedra (University of Alcalá, Madrid) used measurements of thousands of [fossil teeth](#) to reconstruct the size and abundance of large African mammals (>15 kg) over the last 10 million years. Despite many uncertainties affecting preservation in the [fossil record](#), the study revealed a highly similar relationship between an animal's size and its abundance between fossil and extant communities, indicating that fundamental ecological processes governing the structure of living communities are also preserved in the fossil record.

Above 45 kg, the researchers found evidence for decreasing abundance with increasing size, a pattern that aligns with the ecological "rule of metabolic scaling," whereby larger species have lower population densities compared to smaller ones. A deviation from the predicted ecological pattern was that mammals between ~15 and 45 kg were far less numerous than expected, both in living and fossil communities. They interpreted this as a signature of savanna habitats (where monkeys and small forest-living antelopes are rare).

The big surprise came when the researchers examined how size-abundance distributions changed over time. They discovered that earlier communities, those living more than ~4 million years ago, had a considerably higher number of large-sized individuals and a greater proportion of total biomass in larger size categories, than did younger communities. The high abundance of large individuals in these fossil African communities—with some individual elephants reaching sizes

over 10 tons—is unparalleled in ecosystems today. Since that time, there has been a gradual loss of large-sized individuals from the fossil record, reflecting the long-term decline of late Pliocene and Pleistocene large mammal diversity, and resulting in the impoverished and "miniaturized" communities we know today.

The study confirms recent work arguing for the deep-time antiquity of African megafaunal losses and challenging the idea that the decline of African megafauna was primarily driven by human activities. While the spread of humans across the globe during the late Pleistocene and Holocene (the last ~100,000 years) coincided with major extinction of many large animals, the research supports the idea that megafaunal losses in Africa began much earlier, around 4 million years ago, and long before humans learned to engage in efficient hunting. Instead, the study highlights [environmental factors](#), such as the long-term decrease in [global temperatures](#) and the expansion of tropical grasslands, as potential drivers of megafaunal extinctions.

The study also found that the loss of large individuals and the restructuring of biomass distributions in African large mammal communities could have been linked to decreases in primary productivity. Using an established relationship between the types of mammalian tooth shapes (morphological traits) and plant productivity (net primary productivity) today, the researchers calculated productivity for African communities in the past. They found an approximately two-thirds decrease in productivity since the late Miocene (> 5 million years ago), a pattern observed globally, and that could have significantly diminished the carrying capacity of large mammal communities, leading to reduced diversity and accelerated extinction of large species.

The research opens new avenues for understanding the dynamics of ecosystems and the complex interactions between individuals, species, and their environment. By analyzing fossil abundance data and

incorporating size-based approaches, scientists can gain valuable insights into the ecological dynamics underlying extinction.

The publication of this scientific paper marks a significant milestone in our understanding of African megafaunal extinctions and the restructuring of ecosystems over geological time scales. Bibi and Cantalapiedra's findings have the potential to inform [conservation efforts](#) and enhance our ability to predict and manage the consequences of biodiversity loss in the face of environmental change.

More information: Faysal Bibi, Plio-Pleistocene African megaherbivore losses associated with community biomass restructuring, *Science* (2023). [DOI: 10.1126/science.add8366](https://doi.org/10.1126/science.add8366).
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