Journal of Applied Sciences

ISSN 1812-5654

science alert

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Size of Mammals Exploded After Dinosaur Extinction, Researchers Confirm

Researchers have demonstrated that the extinction of dinosaurs 65 million years ago paved the way for mammals to get bigger -- about a thousand times bigger than they had been. The study titled, "The Evolution of Maximum Body Size of Terrestrial Mammals," released in the journal Science, is the first to quantitatively explore the patterns of body size of mammals after the demise of the dinosaurs.

The research, funded by a National Science Foundation Research Coordination Network grant and led by University of New Mexico Biology Associate Professor Felisa Smith, brought together an international team of paleontologists, evolutionary biologists and macroecologists from universities around the world.

The goal of the research was to revisit key questions about size, specifically in mammals. "Size impacts all aspects of biology, from reproduction to extinction," said Smith. "Understanding the constraints operating on size is crucial to understanding how ecosystems work." In order to document what happened to mammals after the extinction of dinosaurs, researchers collected data on the maximum size for major groups of land mammals on each continent, including Perissodactyla, odd-toed ungulates such as horses and rhinos; Proboscidea, which includes elephants, mammoth and mastodon; Xenarthra, the anteaters, tree sloths, and armadillos; as well as a number of other extinct groups. The researchers spent three years assembling the data.

"The database is unique," said Smith "because it's comprehensive, including mammals from all continents since the extinction of the dinosaurs. We estimated body size from fossil teeth, which are the most commonly preserved parts of mammals."

Mammals grew from a maximum of about 10 kilograms when they were sharing the earth with dinosaurs to a maximum of 17 tons afterwards. The researchers found that the pattern was surprisingly consistent, not only globally but also across time and across trophic groups and lineages -- that is, animals with differing diets and descended from different ancestors -- as well. The maximum size of mammals began to increase sharply about 65 million years ago, peaking in the Oligocene Epoch (about 34 million years ago) in Eurasia, and again in the Miocene Epoch (about 10 million years ago) in Eurasia and Africa. The largest mammal that ever walked the earth -- Indricotherium transouralicum, a hornless rhinoceros-like herbivore that weighed approximately 17 tons and stood about 18 feet high at the shoulder -- lived in Eurasia almost 34 million years ago.

"The remarkable similarity in the evolution of maximum size on the different continents suggests that there were similar ecological roles to be filled by giant mammals across the globe," said Smith. "This strongly implies that mammals were responding to the same ecological constraints."

The results give clues as to what sets the limits on maximum body size on land; the amount of space available to each animal and the climate they live in. The colder the climate, the bigger the mammals seem to get, as bigger animals conserve heat better. It also shows that no one group of mammals dominates the largest size class -- the absolute largest mammal belongs to different groups over time and space. "The results were striking. Global temperature and terrestrial land area set constraints on the upper limit of mammal body size," said Smith, "with larger mammals evolving when the earth was cooler and the terrestrial land area greater. Our analysis reflected processes operating consistently across trophic and taxonomic groups, and independent of the physiographic history of each continent."

The interest in the size of mammals for Smith began years ago when she was a graduate student at the University of California. "I worked on a number of islands off the coast of Baja, California where rodents had evolved into gigantic body sizes. I've been interested in size ever since."

Smith's colleagues in the project include from UNM Distinguished Professor of Biology Jim Brown, Marcus Hamilton and Jordan Okie. Other coauthors are: Alison Boyer, Daniel Costa, Tamar Dayan, Morgan Ernest, Alistair Evans, Mikael Fortelius, John Gittleman, Larisa Harding, Kari Lintulaakso, Kathleen Lyons, Christy McCain, Juha J. Saarinen, Richard Sibly, Patrick Stephens, Jessica Theodor and Mark Uhen.