

# Dinosaur predecessors gain ground in wake of world's biggest biodiversity crisis

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The pig-size *Dicynodon* was part of a large, dominant group of plant eaters found across the southern hemisphere until the mass extinction event weakened their numbers so that newly emerging herbivores could compete. Credit: Marlene Donnelly/Field Museum of Natural History

Many scientists have thought that dinosaur predecessors missed the race to fill habitats emptied when nine out of 10 species disappeared during the Earth's largest mass extinction, approximately 252 million years ago.

The thinking was based on fossil records from sites in South Africa and southwest Russia. It turns out that scientists may have been looking for the starting line in the wrong places.

Newly discovered fossils from 10 million years after the [mass extinction](#) reveal a lineage of animals thought to have led to dinosaurs taking hold in Tanzania and Zambia in the mid-[Triassic period](#), many millions of years before dinosaur relatives were seen in the [fossil record](#) elsewhere on Earth.

"The fossil record from the Karoo of South Africa remains a good representation of four-legged [land animals](#) across southern Pangea before the [extinction event](#). But after the event animals weren't as uniformly and widely distributed as before. We had to go looking in some fairly unorthodox places," said Christian Sidor, University of Washington professor of biology. He's lead author of a paper appearing the week of April 29 in the early edition of the *Proceedings of the National Academy of Sciences*.

The new insights come from seven fossil-hunting expeditions since 2003 in Tanzania, Zambia and Antarctica, funded by the National Geographic Society and National Science Foundation, along with work combing through existing fossil collections. The researchers created two "snapshots" of four legged-animals about 5 million years before and again about 10 million years after the extinction event at the end of the [Permian period](#).



Ten million years after the mass extinction, members of the archosaur reptiles -- such as the 10-foot (3 meter) long *Asilisaurus* pictured -- had more restricted geographic ranges compared to the communities of four-legged animals that existed before the extinction. Credit: Marlene Donnelly/Field Museum of Natural History

Prior to the extinction event, for example, the pig-sized *Dicynodon* -- said to resemble a fat lizard with a short tail and turtle's head -- was a dominant plant-eating species across southern Pangea. Pangea is the name given to the [landmass](#) when all the world's continents were joined together. Southern Pangea was made up of what is today Africa, South America, Antarctica, Australia and India. After the mass extinction at the end of the Permian, *Dicynodon* disappeared and other related species

were so greatly decreased that newly emerging herbivores could suddenly compete with them.

"Groups that did well before the extinction didn't necessarily do well afterward," Sidor said. "What we call evolutionary incumbency was fundamentally reset."



Newly discovered fossils, and those from existing collections, were considered from five basins in the south of what was once a single large land mass known as Pangea, and today are part of (from left to right) South Africa, Zambia, Malawi, Tanzania and Antarctica. Credit: U of Texas at Austin/U of Washington

The snapshot 10 million years after the extinction event reveals, among other things, that archosaurs were in Tanzanian and Zambian basins, but not distributed across all of southern Pangea as had been the pattern for four-legged animals prior to the extinction. Archosaurs are the group of reptiles that includes crocodiles, dinosaurs, birds and a variety of extinct forms. They are of interest because it is thought they led to animals like *Asilisaurus*, a dinosaur-like animal, and *Nyasasaurus parringtoni*, a dog-sized creature with a five-foot tail that scientists in December 2012 announced could be the earliest dinosaur, or else the closest relative found so far.

"Early archosaurs being found mainly in Tanzania is an example of how fragmented communities became after the extinction event," Sidor said. And the co-authors write: "These findings suggest that . . . archosaur diversification was more intimately related to recovery from the end-Permian mass extinction than previously suspected."



Fossilized remains are sorted of a new specimen of *Asilisaurus* collected from the Manda beds in Tanzania. Credit required: Roger M.H. Smith

A new framework for analyzing biogeographic patterns from species distributions, developed by co-author Daril Vilhena, a UW biology graduate student, provided a way to discern the complex recovery, Sidor said.

It revealed that before the extinction event 35 percent of four-legged species were found in two or more of the five areas studied, with some species having ranges that stretched 1,600 miles (2,600 kilometers), encompassing the Tanzanian and South African basins. Ten million years after the extinction event, the authors say there was clear geographic clustering and just 7 percent of species were found in two or more

regions.

The techniques – new ways to statistically consider how connected or isolated [species](#) are from each other – could be useful for other paleontologists and modern day biogeographers, Sidor said.

In the early 2000s Sidor and some of his co-authors started putting together expeditions to collect fossils from sites in Tanzania that hadn't been visited since the 1960s and in Zambia where there'd been little work since the '80s. Two expeditions to Antarctica provided additional materials, as did long-term efforts to examine museum-held fossils that had not been fully documented or named.

**More information:** Provincialization of terrestrial faunas following the end-Permian mass extinction, *PNAS*,  
[www.pnas.org/cgi/doi/10.1073/pnas.1302323110](http://www.pnas.org/cgi/doi/10.1073/pnas.1302323110)

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