Fossils of a saber-toothed top predator reveal a scramble for dominance leading up to 'the Great Dying'

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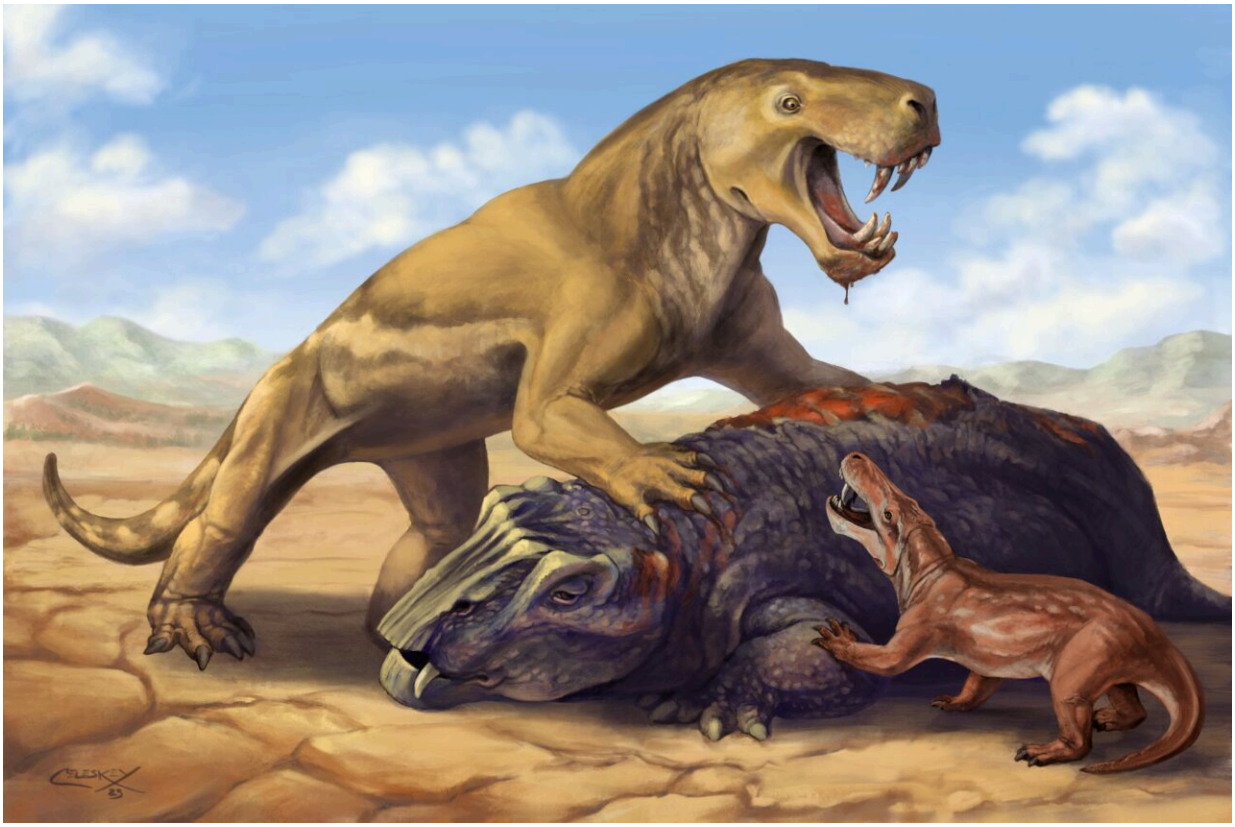

Giant gorgonopsian Inostrancevia with its dicynodont prey, scaring off the much smaller African species Cyonosaurus. Credit: Art by Matt Celeskey.

Two hundred and fifty-two million years ago, Earth experienced a mass

extinction so devastating that it's become known as "the Great Dying." Massive volcanic eruptions triggered catastrophic climate change, killing off nine out of every ten species and eventually setting the stage for the dinosaurs. But the Great Dying was a long goodbye— the extinction event took place over the course of up to a million years at the end of the Permian period. During that time, the fossil record shows drama and upheaval as species fought to get a foothold in their changing environments. One animal that exemplifies this instability was a tiger-sized, saber-toothed creature called Inostrancevia: a new fossil discovery suggests that Inostrancevia migrated 7,000 miles across the supercontinent Pangaea, filling a gap in a faraway ecosystem that had lost its top predators, before going extinct itself.

"All the big top predators in the late Permian in South Africa went extinct well before the end-Permian mass extinction. We learned that this vacancy in the niche was occupied, for a brief period, by Inostrancevia," says Pia Viglietti, a research scientist at the Field Museum in Chicago and a co-author of the new study in *Current Biology*.

The prehistoric creature looked the part of "top predator." "Inostrancevia was a gorgonopsian, a group of proto-mammals that included the first saber-toothed predators on the planet," says Viglietti. It was about the size of a tiger and likely had skin like an elephant or a rhino; while vaguely reptilian in appearance, it was part of the group of animals that includes modern mammals.

Prior to this new paper, Inostrancevia had only ever been found in Russia. But while examining the fossil record of South Africa's Karoo Basin, Viglietti's colleague Christian Kammerer identified the fossils of two large predatory animals that were different from those normally found in the region. "The fossils themselves were quite unexpected," says Viglietti. It's not clear how they made it from what's now Russia, or how long it took them to cross Pangaea and arrive in what's now South

Africa. But being far from home was just one element of what made the fossils special.

Inostrancevia fossils in the field. Credit: Jennifer Botha.

"When we reviewed the ranges and ages of the other top predators normally found in the area, the rubidgeine gorgonopsians, with these Inostrancevia fossils, we found something quite exciting," she says. "The local carnivores actually went extinct quite a bit before even the main extinction that we see in the Karoo— by the time the extinction begins in

other animals, they're gone."

The arrival of Inostrancevia from 7,000 miles away and its subsequent extinction indicates that these top predators were "canaries in the coal mine" for the larger extinction event to come.

"This shows that the South African Karoo Basin continues to produce critical data for understanding the most catastrophic mass extinction in Earth's history," says co-author Jennifer Botha, director of GENUS Centre of Excellence in Palaeosciences and professor at the Evolutionary Studies Institute, University of the Witwatersrand, Johannesburg.

Paul October, a now retired field technician from Iziko South African Museum, with Inostrancevia fossils in the field. Credit: Jennifer Botha.

"We have shown that the shift in which groups of animals occupied apex predator roles occurred four times over less than two million years around the Permian-Triassic mass extinction, which is unprecedented in the history of life on land. This underlines how extreme this crisis was, with even fundamental roles in ecosystems in extreme flux," said Christian Kammerer, the study's first author and a research curator of paleontology at the North Carolina Museum of Natural Sciences and research associate at the Field Museum.

The vulnerability of these top predators matches what we see today. "Apex predators in modern environments tend to show high extinction risk, and tend to be among the first species that are locally extirpated due to human-mediated activities such as hunting or habitat destruction," says Kammerer. "Think about wolves in Europe or tigers in Asia, species which tend to be slow to reproduce and grow and require large geographic areas to roam and hunt prey, and which are now absent from most of their historic ranges. We should expect that ancient apex predators would have had similar vulnerabilities, and would be among the species that first go extinct during mass extinction events."

In addition to shedding new light on the extinction event that helped lead to the rise of the dinosaurs, Viglietti says that the study is important for what it can teach us about the ecological disasters the planet is currently experiencing.

The field location where the Inostrancevia were found (a farm called Nooitgedacht in the Free State Province of South Africa's Karoo Basin). Credit: Pia Viglietti.

"It's always good to get a better understanding of how mass extinction events affect ecosystems, especially because the Permian is basically a parallel on what we're going through now," said Viglietti. "We don't really have any modern analogs of what to expect with the mass extinction happening today, and the Permo-Triassic mass extinction event represents one of the best examples of what we could experience with our climate crisis and extinctions. I guess the only difference is, we know what to do and how to stop it from happening."

More information: Christian F. Kammerer, Rapid turnover of top predators in African terrestrial faunas around the Permian-Triassic mass extinction, *Current Biology* (2023). DOI: 10.1016/j.cub.2023.04.007. www.cell.com/current-biology/f … 0960-9822(23)00455-4

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