

Early carnivorous dinosaurs crossed continents

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This is a fleshed-out reconstruction of the head of the new Triassic carnivorous dinosaur *Tawa hallae*. Credit: Jorge Gonzalez.

Did the first dinosaurs wander across continents or stay put where they first evolved? The first dinosaurs evolved 230 million years ago when the continents were assembled into one landmass called Pangea. The question of early dinosaur movements remained unclear until the discovery of some exciting new fossils.

In the Dec. 11, 2009, issue of *Science*, a team of paleontologists presents the 213-million-year-old fossils of previously unknown carnivorous dinosaur *Tawa hallae*, including several of the best preserved dinosaur skeletons from the [Triassic Period](#).

Fossil bones of *Tawa*, named after the Hopi word for the Puebloan sun god, were recovered from a dig site in northern New Mexico known as Hayden Quarry. The quarry is located on Ghost Ranch, where late painter Georgia O'Keeffe once lived. [Fossil bones](#) of several individuals were recovered, but the type specimen is a nearly complete skeleton of a juvenile that stood about 28 inches (70 centimeters) tall at the hips and was approximately 6 feet (about 2 meters) long, from snout to tail. Its body was about the size of a large dog, but with a much longer tail.

Based on an analysis of the relationships among *Tawa* and other early dinosaurs, the researchers hypothesize that dinosaurs originated in a part of Pangea that is now South America, diverging into theropods (like [Tyrannosaurus rex](#)), sauropodomorphs (like *Apatosaurus*) and ornithischians (like *Triceratops*); and then dispersed more than 220 million years ago across parts of Pangea that later became separate continents.

"This new dinosaur *Tawa hallae* changes our understanding of the relationships of early dinosaurs, and provides fantastic insight into the evolution of the skeleton of the first carnivorous dinosaurs" said Randall Irmis of the Utah Museum of Natural History and University of Utah, a co-author of the study.

In addition to Irmis, authors of the study included lead author Sterling Nesbit of the University of Texas at Austin; Nathan Smith of the University of Chicago and the Field Museum of Natural History; Alan Turner of Stony Brook University; Alex Downs of the Ruth Hall Museum of Paleontology in Abiquiu, N.M.; and Mark Norell of the American Museum of Natural History.

"If you have continents splitting apart, you get isolation," said Nesbitt. "So when barriers develop, you would expect that multiple carnivorous dinosaurs in a region should represent a closely related endemic radiation. But that is what we don't see in early dinosaur evolution."

Instead, the research team found three distinct [carnivorous dinosaurs](#) - including the newly discovered *Tawa* - in the fossil-rich, Late Triassic beds they investigated at Ghost Ranch. "When we analyzed the evolutionary relationships of these dinosaurs, we discovered that they were only distantly related, and that each species had close relatives in South America," said Irmis. "This implies that each carnivorous dinosaur species descended from a separate lineage before arriving

in [the part of Pangea that is now] North America, instead of all evolving from a local ancestor."



Randall Irmis (left), of the Utah Museum of Natural History at the University of Utah, and Sterling Nesbitt (right) excavate at the Hayden Quarry, Ghost Ranch, New Mexico. Credit: Alan Turner.

At Ghost Ranch, the researchers found fossils from a carnivorous dinosaur related to *Coelophysis*, common to that region, and fossils from a carnivore closely related to *Herrerasaurus*, which lived in South America. The 6.6- to 13-foot-long (2- to 4-meter-long) skeletons of *Tawa* display characteristics that exist in both species and features found in neither, implying a separate lineage.

"The discovery of multiple dinosaur species in one place that emigrated from elsewhere got us wondering whether other Late Triassic reptiles show similar patterns" said Irmis. "It turns out a variety of other reptile groups made multiple trips from the northern and southern continents [then parts of Pangea] and back again during the Late Triassic, including other dinosaurs."

Because so many different groups with different life modes were able to move freely across Pangea, the research team concluded that during the Late Triassic, there were no major physical barriers, such as large mountain ranges, to the movement of reptiles between parts of Pangea that later separated into distinct continents.

But this presented a paradox to the team: "We

wondered: if reptiles, including dinosaurs, were able to freely move around Pangea during the Late Triassic, then why aren't there any sauropodomorph and ornithischian dinosaurs in North America during the Triassic?" said Irmis. "Our conclusion is that climate, possibly related to latitude, controlled the distributions of some reptile species."

"We think that all the major dinosaur groups had the ability to get to North America [part of Pangea] during the Late Triassic, and may have even passed through, but for some reason, only the carnivorous [dinosaurs](#) found the North American climate to be hospitable during this time," concluded Irmis.

The first *Tawa* fossils were discovered in 2004 by volunteers taking a paleontology seminar at the Ruth Hall Museum of Paleontology in New Mexico. Museum scientists invited the team of paleontologists to come and take a look.

"The specimens are unusual because they are so well preserved," said Irmis. "Because dinosaur bones are hollow, they are usually broken and crushed, but those of *Tawa* are nearly pristine."

Irmis and the rest of the team began a full-scale excavation in 2006 and have continued to unearth new material every summer since then. The fossil bone bed extends for tens of yards along a hillside, promising many years of potential significant finds.



This is a fleshed-out reconstruction of the new Triassic carnivorous dinosaur *Tawa hallae*. Credit: Jorge Gonzalez.

Source: University of Utah ([news](#) : [web](#))

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