



The aquadino *Spinosaurus* dives for prey in an artist's reconstruction.

PALEONTOLOGY

Giant dinosaur was a terror of Cretaceous waterways

Fossils offer first evidence that some dinosaurs could swim

By Michael Balter

Spinosaurus was a brute of a dinosaur. It weighed up to 20 metric tons and stretched 15 meters long, and its long jaws housed at least 2 dozen sharp, piercing teeth. It may have been the biggest carnivorous dinosaur ever; in the film *Jurassic Park III*, a *Spinosaurus* clamps its long jaw on the neck of a *Tyrannosaurus rex* and quickly snaps it.

In reality, however, this fearsome beast lived 30 million years before *T. rex*, and it may have been more of a danger to fish than to terrestrial rivals.

The most complete known skeleton of *Spinosaurus*, published online this week in *Science* (<http://scim.ag/NIbrahim>), shows clear adaptations to life both in the water and on land, according to a team led by paleontologists Nizar Ibrahim and Paul Sereno of the University of Chicago in Illinois. The bones, from 97-million-year-old

freshwater sediments in eastern Morocco, include parts of the skull, vertebral column, pelvis, and limb bones. They provide “compelling skeletal evidence for a lifestyle linked to water,” says paleontologist Lindsay Zanno of the North Carolina Museum of Natural Sciences in Raleigh, and make *Spinosaurus* the first dinosaur known to swim. (The dinosaurlike marine reptiles called plesiosaurs and mosasaurs actually belonged to different orders.)

Researchers knew that a number of dinos spent lots of time hanging around lakes and rivers. But clear fossil evidence that dinosaurs could swim has been lacking. *Spinosaurus* first surfaced in 1912 in Egypt and was described by the celebrated German paleontologist Ernst Stromer, who marveled at its size but didn’t recognize it as possibly aquatic. Then, in April 1944, British bombers blitzed Munich’s state paleontology museum and sent *Spinosaurus* and most of the rest of Stromer’s fossil collection into oblivion.

In the years since, evidence that some dinos might have swum has surfaced, including claimed “swim tracks”—scrape marks from the bellies of dinos—from lake and river bottoms in Utah and Spain. In 2010, a team led by Romain Amiot of the University of Lyon in France argued in *Geology* that oxygen isotopes suggest that dinosaurs closely related to *Spinosaurus* (known collectively as spinosaurs) were likely to have been aquatic.

In the new *Spinosaurus* skeleton, dug up over several years, Ibrahim and Sereno found signs of watery adaptation not seen in other dinosaurs: a small nostril located far back on the head, apparently to limit water intake; relatively long forelimbs; big flat feet suitable for paddling as well as walking on muddy ground; and very dense limb bones, which would have allowed *Spinosaurus* to submerge itself rather than float at the surface. The bone density in particular resembles that of early whales and today’s hippopotamus and makes a strong argument for semiaquatic life, says anatomist J. G. M. Thewissen of Northeast Ohio Medical University in Rootstown.

Sereno says that *Spinosaurus*’s crocodilelike snout, together with its long neck and body, would have made it look “like a duck with the tail of an alligator attached to it.” The spiny sail on its back was probably employed for sexual display rather than as an aid to swimming, the team surmises. Amiot adds that the new discoveries could help explain how a variety of different carnivorous dinosaurs could have coexisted in Africa, Europe, and Asia. The competition among them might have been diminished if the mighty *Spinosaurus* exploited freshwater lakes and rivers, eating fish, while other dinos hunted prey on land, he suggests.

All the same, Sereno and other team members think that amphibious life was not widespread among dinosaurs, but rather represented an “extreme evolutionary experiment” that did not leave descendants, as co-author Cristiano Dal Sasso of the Natural History Museum of Milan in Italy puts it. But James Kirkland, a paleontologist at the Utah Geological Survey in Salt Lake City and co-discoverer of some of the dino swim tracks found in the state, disagrees. “I would not consider *Spinosaurus* a fluke,” he says, pointing to evidence (such as the wear patterns on their teeth) that not only spinosaurs but also other carnivorous dinosaurs crunched into scaly fish.

If humans had been around to see it, Kirkland adds, *Spinosaurus* would have been a pretty sight as it swam along. “Those sails certainly would have looked brilliant in the tropical sunset.” ■