Spinosaurus: The Largest Carnivorous Dinosaur

by Joseph Castro, Live Science Contributor   |   October 30, 2014 11:51pm ET

*Spinosaurus* was the biggest of all the carnivorous dinosaurs, larger than *Tyrannosaurus* and*Giganotosaurus*. It lived during part of the Cretaceous period, about 112 million to 97 million years ago, roaming the swamps of North Africa.

Two *Spinosaurus* species have been named based on the regions where they were discovered: *Spinosaurus aegyptiacus* Egyptian spine lizard) and *Spinosaurus maroccanus*(Moroccan spine lizard).

*Spinosaurus* means "spine lizard," an appropriate descriptor, as the dinosaur had very long spines growing on its back to form what is referred to as a "sail." The distinctive spines, which grew out of the animal's back vertebrae, were up to 7 feet (2.1 meters) long and were likely connected to one another by skin.

Recent fossil evidence shows *Spinosaurus* was the [first dinosaur that was able to swim](http://www.livescience.com/47797-swimming-dinosaur-found-spinosaurus-was-adapted-for-aquatic-life.html), and likely spent most of its life in the water, according to a study published September 2014 in the journal Science. "*Spinosaurus* had short hind limbs (like early whales and other animals that spent more and more time in the water), dense and compact bones (penguins show a similar bone profile in cross section), wide and flat claws and feet (possibly used in paddling), and a long and slender snout with conical teeth (perfect for catching fish)," said Nizar Ibrahim, a University of Chicago vertebrate paleontologist and lead author of the study.

**Function of the sail**

There has been much scientific debate regarding the evolution and purpose of *Spinosaurus*' sail.  [Because of its size](http://www.livescience.com/18314-dinosaurs-grew-huge.html), this dinosaur did not have many predators, but the sail could have been used to ward off enemies, as the dinosaur would have appeared to be twice its size with the sail fully extended. The dinosaur's upper spine was fairly flexible, and its vertebrae had ball-and-socket joints, meaning it was likely able to arch its back to a point. It may have been able to spread the sail when threatened or looking to attract a mate.

In a 1997 study published in the Journal of Paleontology, paleontologist Jack Bowman Bailey proposed that *Spinosaurus* and the similar *Ouranosaurus* didn't have sails after all, and instead had [large, bisonlike backs](http://www.jstor.org/discover/10.2307/1306608?uid=3739632&uid=2129&uid=2&uid=70&uid=4&uid=3739256&sid=21104423018011). (*Ouranosaurus* was another spiny dinosaur, which lived in the same general area as *Spinosaurus* a few million years earlier.) These humps, Bailey argued, would have acted as dissipative "heat shields" that, unlike sails, would have helped the dinosaurs survive in the hot and dry environment they were thought to have lived in (it's now known that their environment was actually a lush swamp).

Other paleontologists have hypothesized that *Spinosaurus* used its sail to regulate its body temperature by absorbing heat or storing fat. However, Ibrahim and his colleagues found that the spines were composed of dense bones with few blood vessels and were likely wrapped snugly in skin, which doesn't support the thermoregulation idea.

"The sail was likely used as a display structure," Ibrahim told Live Science. "It would have been visible from far away and even when the animal was swimming. This way, the animal could convey information about its age, size and … gender to other animals, in particular other *Spinosaurus*."

Additionally, some paleontologists, Ibrahim included, have hypothesized that the sails were brightly colored (much like the fins of some modern-day reptiles), making them even better display structures. But, Ibrahim notes, "the sail likely had more than one function."

**More gigantic than Giganotosaurus**

*Spinosaurus*was larger than both *T. rex* and *Giganotosaurus*, which was previously the largest carnivorous dinosaur known. But it's unclear just how big *Spinosaurus* was, due to incomplete fossils.

In a 2005 study in the Journal of Vertebrate Paleontology, [researchers estimated](http://www.bioone.org/doi/abs/10.1671/0272-4634%25282005%2529025%255B0888%253ANIOTSO%255D2.0.CO%253B2?journalCode=vrpa) *Spinosaurus* was 52 to 59 feet (16 to 18 m) long and weighed 7.7 to 9.9 tons (7 to 9 metric tons), based on extrapolations from skull measurements. However, other scientists [took issue with the study's methods](http://www.bioone.org/doi/abs/10.1671/0272-4634%282007%2927%255B108%3AMTIBTY%255D2.0.CO%253B2), and instead claimed the behemoth was 41 to 47 feet (12.6 to 14.3 m) long and 13.2 to 23 tons (12 to 20.9 metric tons), according to a 2007 study in the same journal.

The partial *[Spinosaurus](http://www.sciencemag.org/content/345/6204/1613.abstract)*[skeleton](http://www.sciencemag.org/content/345/6204/1613.abstract) Ibrahim his colleagues analyzed suggests the specimen was 50 feet (15.2 meters) long and still growing. The fossils also suggest *Spinosaurus*' long neck and trunk shifted the dinosaur's center of mass forward. This allowed the animal to move easily in water, but made movement on land nearly impossible unless the dinosaur used all four legs.

*Spinosaurus*had a long and narrow snout at the end of its skull, and a small crest above its eyes. It had six or seven needlelike teeth on each side of the very front of the upper jaw and another 12 teeth behind those. There were also a few large, slanted teeth that interlocked at the end of the snout. While its jaw was powerful, none of the teeth were serrated, making it unlikely that it could have used them to tear into tough prey. This gives credence to the theory that it mostly survived on fish and carcasses.

**What did Spinosaurus eat?**

*Spinosaurus*is thought to have survived primarily on fish, including giant coelacanths, sawfish, large lungfish and sharks, which lived in the dinosaur's river system, according to Ibrahim. "The skull of *Spinosaurus* has 'fish eating' written all over it, so those are the kinds of animals *Spinosaurus* would have preyed on," he said.

In addition to anatomical evidence[, chemical analyses also suggest *Spinosaurus* preferred to dine on fish](http://intl-geology.geoscienceworld.org/content/38/2/139.abstract), a 2010 study in the journal Geology shows.

In 2004, researchers found a tooth belonging to *Irritator challengeri*— a spinosaur, or dinosaur in *Spinosaurus*' taxonomic family, Spinosauridae — [embedded in the remains of a Cretaceous pterosaur](http://www.nature.com/nature/journal/v430/n6995/full/430033a.html) (flying reptile). The find, detailed in the journal Nature, suggests the fish-loving spinosaurs also hunted (or scavenged) nonaquatic animals.

*Spinosaurus*lived in Egypt and Morocco. There is speculation that the [Sahara](http://www.livescience.com/23140-sahara-desert.html) is rich with *Spinosaurus*fossils, but the harsh environment makes them difficult to unearth. [[Images: Digging Up a Swimming Dinosaur Called Spinosaurus](http://www.livescience.com/47795-swimming-spinosaurus-dinosaur-images.html)]

**Fossil discoveries**

Very few *Spinosaurus*fossils have been discovered, and no complete remains have been found. The first *Spinosaurus*partial skeleton was unearthed in 1912 by Richard Markgraf in the Bahariya Formation of western Egypt.

These original remains, which were [described and named by Ernst Stromer in 1915](http://www.dinochecker.com/papers/Stromers-Egypt-expedition_Spinosaurus_Stromer_1915.pdf), were destroyed in Allied bombing raids on Munich, Germany, during World War II. It is only due to Stromer's meticulous notes, including detailed descriptions and sketches, that much of the scant knowledge surrounding this dinosaur has been retained.

In 2011, a neck vertebra from a dinosaur, believed to be a spinosaur, with a snout resembling that of a crocodile was [found in Australia](http://rsbl.royalsocietypublishing.org/content/early/2011/06/16/rsbl.2011.0466.abstract), showing that the dinosaur family had a much wider range than scientists had previously thought possible, according to the study published in the journal Biology Letters.

*Kim Ann Zimmermann contributed to this article.*

**Additional resources**

* See a *Spinosaurus* up close and personal at the [National Geographic Museum](http://events.nationalgeographic.com/exhibits/2014/09/12/spinosaurus-lost-giant-cretaceous/) in Washington, D.C.
* Read the paper by Nizar Ibrahim, et al., "[Semiaquatic adaptations in a giant predatory dinosaur](http://www.sciencemag.org/content/345/6204/1613.short)," in the journal Science.