

Ancient amphibians evolved a bite before migrating to dry land

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Ancient aquatic amphibians developed the ability to feed on land before completing the transition to terrestrial life, researchers from Harvard University report this week in the *Proceedings of the National Academy of Sciences*.

Their work is based on analysis of the skulls of the first amphibians, which arose 375 million years ago, and their fish ancestors. The shapes of the junctions between adjacent skull bones -- termed "sutures" -- in the tops of these fish and amphibian skulls reveal how these extinct animals captured prey, say authors Molly J. Markey and Charles R. Marshall.

"Based on experimental data obtained from living fish, we found that the shapes of sutures in the skull roof indicate whether a fish captures its prey by sucking it into the mouth -- like a goldfish -- or by biting on it directly, like a crocodile," says Markey, a postdoctoral researcher and lecturer in Harvard's Department of Earth and Planetary Sciences. "A biting or chewing motion would result in a faint pushing together of the frontal bones in the skull, while a sucking motion would pull those bones ever so slightly apart. By comparing the skull roofs of living fish to those of early amphibians and their fishy ancestors, we were able to determine whether the fossil species fed by suction or by biting."

Using this approach, Markey and Marshall found that in one key transitional species, the aquatic amphibian *Acanthostega*, the shapes of the junctions between adjacent skull bones are consistent with biting

prey. This finding, the scientists say, suggests that the water-dwelling *Acanthostega* may have bitten on prey at or near the water's edge.

"Going from the aquatic realm to land involved a series of adaptations to facilitate changes in locomotion, respiration, reproduction, sensation, and feeding," Markey says. "In water, suction is an efficient method of feeding, but it does not work in the much less dense air environment. Early terrestrial inhabitants would thus have had to develop the means for chomping prey."

Markey and Marshall first measured the skull roof sutures, those areas where the bones of the skull roof meet, in the living fish *Polypterus* as it fed. They then analyzed the same cranial junctions in several fossils -- the early amphibian *Acanthostega*, its fishy ancestor *Eusthenopteron*, and the extinct terrestrial amphibian *Phonerpeton* -- to determine how these bones may have moved relative to each other during feeding. By analyzing the tiny forces that the sutures experienced during feeding, such as tension or compression, the researchers could determine how the skull roof likely deformed as the animals ate.

Living fish exhibit an incredible array of tooth and jaw shapes, suggesting that, ironically, direct analysis of fossil jaws would be a less precise means of determining the feeding methods of extinct species, Markey says.

"Analysis of the sutures of the early amphibian species *Acanthostega* revealed that, while it had many adaptations to an aquatic lifestyle, it was more likely a biter than a sucker," Markey says. "The analysis suggests that amphibians evolved a bite before emerging onto land as fully terrestrial animals."

Source: Harvard University

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