

Snappy evolution was behind the success of ancient crocodiles

23 March 2021



Modern crocodile. Credit: Rutpratheep Nilpechr

It turns out that some extinct crocodile groups, including dolphin-like thalattosuchians and small land-dwelling notosuchians, evolved very fast over many millions of years, and they underwent great changes to their skulls and jaws as they expanded into niches today occupied by other animal groups, particularly mammals.

The research also shows that crocodiles, alligators and gharials, the only living crocodylians, are more conservative than these extinct fossil groups, and evolved steadily for the last 80 million years, but there is no evidence for a slow-down in their [evolution](#) and they are not 'living fossils', as once thought.

New research led by the University of Bristol has revealed that crocodiles once flourished on land and in the oceans as a result of fast evolution.

Modern crocodiles are predators living in rivers, lakes and wetlands, grabbing fish, reptiles, birds and mammals with their conspicuous snouts and powerful jaws.

However, new research published today in the journal *Proceedings of the Royal Society B*, shows that ancient crocodiles were once much more varied because of [rapid evolution](#).

In the time of the dinosaurs, some crocodiles experimented with dolphin-like adaptations to living in the oceans, and others lived on land as fast-moving plant-eaters.

The researchers studied over 200 skulls and jaws, including fossils from the entire 230-million-year history of crocodiles and their extinct relatives. They explored shape variation to reveal differences between species and analyzed how fast crocodile groups changed through time.



Fossil land-dwelling crocodiles from the Cretaceous. Notosuchians had diverse diets, including insect-eating and plant-eating. Credit: Daniel Martins dos Santos

"However, the fossil record shows their amazing capabilities, including large numbers of species in the oceans and on land. Perhaps they only did well when world climates were warmer than today."

Lead author Dr. Tom Stubbs, a Senior Research Associate at the University of Bristol's School of Earth Sciences, said: "Crocodiles and their ancestors are an incredible group for understanding the rise and fall of biodiversity.

More information: Ecological opportunity and the rise and fall of crocodylomorph evolutionary innovation, *Proceedings of the Royal Society B* (2021). [rspb.royalsocietypublishing.org1098/rspb.2021.0069](https://royalsocietypublishing.org/doi/10.1098/rspb.2021.0069)

"There are only 26 crocodile species around today, most of which look very similar. However, there are hundreds of fossil species with spectacular variation, particularly in their feeding apparatus."

Provided by University of Bristol

Dr. Armin Elsler, a Research Associate in the Bristol School of Earth Sciences and co-author, added: "New state-of-the-art methods now mean we can test for differences in the speed of evolution through time and across groups."

It has long been suggested that dramatic shifts in habitat and diet can trigger rapid evolution, but these patterns are usually only reported in groups with great variety today, like birds, mammals and fish. This is the first time this trend has been shown in crocodiles, a group with a rich fossil history, but low modern diversity.

Dr. Stephanie Pierce, Associate Professor of Organismic and Evolution Biology at Harvard University, said: "Ancient crocodiles came in a dizzyingly array of forms. They were adapted to running on land, swimming in the water, snapping fish, and even chewing plants.

"Our study shows that these very different ways of living evolved incredibly fast, allowing extinct crocodiles to rapidly thrive and dominate novel ecological niches over many millions of years."

Professor Michael Benton from Bristol added: "It's not clear why modern [crocodiles](#) are so limited in their adaptations. If we only had the living species, we might argue they are limited in their modes of life by being cold-blooded or because of their anatomy.

APA citation: Snappy evolution was behind the success of ancient crocodiles (2021, March 23) retrieved 22 June 2021 from <https://phys.org/news/2021-03-snappy-evolution-success-ancient-crocodiles.html>

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