Fossil teeth suggest that seeds saved bird ancestors from extinction

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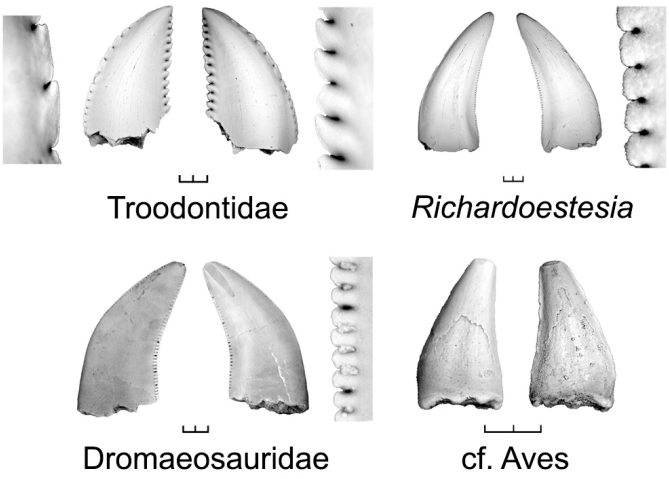
A number of bird-like dinosaurs reconstructed in their environment in the Hell Creek Formation at the end of the Cretaceous. Middle ground and background: two different dromaeosaurid species hunting vertebrate prey (a lizard and a toothed bird). Foreground: hypothetical toothless bird closely related to the earliest modern birds. Credit: Danielle Dufault

When the dinosaurs became extinct, plenty of small bird-like dinosaurs disappeared along with giants like Tyrannosaurus and Triceratops. Why only some of them survived to become modern-day birds remains a mystery. Now, researchers reporting April 21 in *Current Biology* suggest that abrupt ecological changes following a meteor impact may have been more detrimental to carnivorous bird-like dinosaurs, and early modern birds with toothless beaks were able to survive on seeds when other food sources declined.

"The small bird-like dinosaurs in the Cretaceous, the maniraptoran dinosaurs, are not a well-understood group," says first author Derek Larson, a paleontologist at the Philip J. Currie Dinosaur Museum in Alberta and PhD candidate at the University of Toronto. "They're some of the closest relatives to modern birds, and at the end of the Cretaceous, many went extinct, including the toothed birds—but modern crown-group birds managed to survive the extinction. The question is, why did that difference occur when these groups were so similar?"

The team of researchers, which also included David Evans of the Royal Ontario Museum and the University of Toronto and Caleb Brown of the Royal Tyrrell Museum of Paleontology, began by investigating whether the extinction at the end of the Cretaceous was an abrupt event or a progressive decline simply capped off by the meteor impact. The fossil record holds evidence to support both scenarios, depending on which dinosaurs are being examined.

Delving into the bird-like dinosaurs, Larson collected data describing 3,104 fossilized teeth from four different maniraptoran families. Some were already published, but much of the information came from Larson's own work at the microscope, cataloging the shape and size of each tooth.



Representative teeth from the four groups of bird-like dinosaurs (including toothed birds) analyzed in this study, with enlarged images of tooth serrations. Scale = 1 mm. Credit: Don Brinkman. Modified from Larson et al. 2010. *Can. J. Earth Sci.* 47: 1159-1181.

Larson and his colleagues were looking for patterns of diversity in the teeth, which spanned 18 million years (up until the end of the Cretaceous). If the variation between teeth decreased over time, the team reasoned, this loss of diversity would indicate that the ecosystem was declining and may have paralleled a long-term species loss. If the teeth maintained their differences over time, however, that would indicate a rich and stable ecosystem over millions of years and suggest that these bird-like dinosaurs were abruptly killed off by an event at the end of the Cretaceous.

In the end, the tooth data favored the latter interpretation. "The maniraptoran dinosaurs maintained a very steady level of variation through the last 18 million years of the Cretaceous," says Larson. "They abruptly became extinct just at the boundary."

The team suspected that diet might have played a part in the survival of the lineage that produced today's birds, and they used dietary information and previously published group relationships from modern-day birds to infer what their ancestors might have eaten. Working backwards, Larson and his colleagues hypothesized that the last common ancestor of today's birds was a toothless seed eater with a beak.

Coupled with the tooth data indicating an abrupt Cretaceous extinction, the researchers suggest that a number of the lineages giving rise to today's birds were those able to survive on seeds after the meteor impact. The strike would have affected sun-dependent leaf and fruit production in plants, but hardy seeds could have been a food source until other options became available again.

"There were bird-like dinosaurs with teeth up until the end of the Cretaceous, where they all died off very abruptly," says Larson. "Some groups of beaked birds may have been able to survive the extinction event because they were able to eat seeds."

More information: *Current Biology*, Larson et al.: "Dental disparity and ecological stability in bird-like dinosaurs prior to the end-Cretaceous mass extinction" DOI: 10.1016/j.cub.2016.03.039

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