Paleontologists discover fossil birds with teeth had seeds in their stomachs, indicating that they ate fruit

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An illustration of Longipteryx, a fossil bird with unusually strong teeth right at the tip of its beak. Credit: Ville Sinkkonen.

For paleontologists who study animals that lived long ago, fossilized

remains tell only part of the story of an animal's life. While a well-preserved skeleton can provide hints at what an ancient animal ate or how it moved, irrefutable proof of these behaviors is hard to come by. But sometimes, scientists luck out with extraordinary fossils that preserve something beyond the animal's body.

Case in point: in a study published in the journal *Current Biology*, researchers found fossilized seeds in the stomachs of one of the earliest birds. This discovery shows that these birds were eating fruits, despite a long-standing hypothesis that this species of bird feasted on fish (and more recent hypotheses it ate insects) with its incredibly strong teeth.

Longipteryx chaoyangensis lived 120 million years ago in what's now northeastern China. It's among the earliest known birds, and one of the strangest.

"Longipteryx is one of my favorite fossil birds, because it's just so weird— it has this long skull, and teeth only at the tip of its beak," says Jingmai O'Connor, associate curator of fossil reptiles in the Field Museum's Neguanee Integrative Research Center and the study's lead author.

"Tooth enamel is the hardest substance in the body, and Longipteryx's tooth enamel is 50 microns thick. That's the same thickness of the enamel on enormous predatory dinosaurs like Allosaurus that weighed 4,000 pounds, but Longipteryx is the size of a bluejay," says Alex Clark, a Ph.D. student at the Field Museum and the University of Chicago and a co-author of the paper.

Longipteryx was discovered in 2000, and at the time, scientists suggested that its kingfisher-like elongated skull meant that it too hunted fish. However, this hypothesis has been challenged by a number of scientists, including O'Connor.

"There are other fossil birds, like Yanornis, that ate fish, and we know because specimens have been found with preserved stomach contents, and fish tend to preserve well. Plus, these fish-eating birds had lots of teeth, all the way along their beaks, unlike how Longipteryx only has teeth at the very tip of its beak," says O'Connor. "It just didn't add up."

Skull of Longipteryx, showing its teeth. Credit: Xiaoli Wang.

However, no specimens of Longipteryx had been found with fossilized food still in their stomachs for scientists to confirm what it ate— until now.

O'Connor visited the Shandong Tianyu Museum of Nature in China, where she noticed two Longipteryx specimens that appeared to have something in their stomachs.

She consulted with her colleague, paleobotanist and Field Museum associate curator of fossil plants Fabiany Herrera, who was able to determine that the tiny, round structures in the birds' stomachs were seeds from the fruits of an ancient tree. (Or technically, flesh-covered seeds—"true fruits" are only found in flowering plants, which were just starting to flourish 120 million years ago when Longipteryx lived. The trees that Longipteryx was feeding from were gymnosperms, relatives of today's conifers and gingkos.)

Since Longipteryx lived in a temperate climate, it probably wasn't eating fruits year-round; O'Connor and her colleagues suspect that it had a mixed diet which included things like insects when fruits weren't available.

A photograph of the stomach contents of a fossil Longipteryx; the three round structures are seeds. Credit: Xiaoli Wang

Longipteryx is part of a larger group of prehistoric birds called the enantiornithines, and this discovery marks the first time that scientists have found any stomach contents from an enantiornithine in China's Jehol Biota despite thousands of uncovered fossils.

"It's always been weird that we didn't know what they were eating, but this study also hints at a bigger picture problem in paleontology, that physical characteristics of a fossil don't always tell the whole story about what the animal ate or how it lived," says O'Connor.

Since Longipteryx apparently wasn't hunting for fish, that leaves a

question: what was it using its long, pointy beak and crazy-strong teeth for? "The thick enamel is overpowered, it seems to be weaponized," says Clark, who looked to modern birds to try to understand what Longipteryx was doing with its beak.

"One of the most common parts of the skeleton that birds use for aggressive displays is the rostrum, the beak. Having a weaponized beak makes sense, because it moves the weapon further away from the rest of the body, to prevent injury."

"There are no modern birds with teeth, but there are these really cool little hummingbirds that have keratinous projections near the tip of the rostrum that resemble what you see in Longipteryx, and they use them as weapons to fight each other," says O'Connor.

A modern hummingbird, Androdon aequatorialis, which has tooth-like structures at the tip of its beak that it uses to fight. Credit: Kate Golembiewski

Weaponized beaks in hummingbirds have evolved at least seven times, allowing them to compete for limited resources. Clark suggested the hypothesis that perhaps Longipteryx's teeth and beak also served as a weapon, perhaps evolving under social or sexual selection.

The researchers say that beyond figuring out more about the life of one weird prehistoric bird, they hope their research helps illuminate broader questions in paleontology about how much scientists can (or can't) trust skeletal traits to tell the story of animal behavior.

"We're trying to open up a new area of research for these early birds and get paleontologists to look at these structures, like the beak, and think about the complexity of the behaviors that these animals might have engaged in beyond just what they were eating," says O'Connor. "There are many factors that could be shaping the structures that we see."

More information: Direct evidence of frugivory in the Mesozoic bird Longipteryx contradicts morphological proxies for diet, *Current Biology* (2024). DOI: 10.1016/j.cub.2024.08.012. www.cell.com/current-biology/f … 0960-9822(24)01124-2

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