Arctic fossils reveal world's oldest salmon and carp relatives

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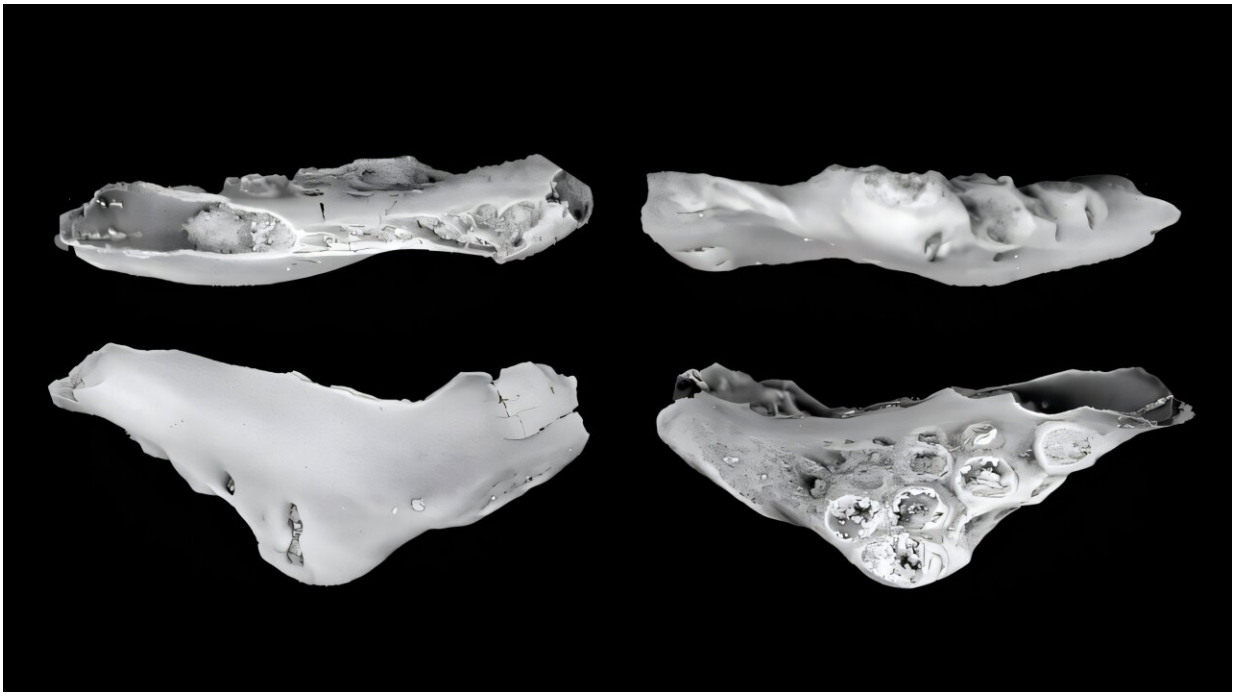

Photographs of cypriniform fossil specimens dusted with ammonium chloride (top) and digital reconstructions from computed tomography scans (below). Cypriniforms are part of the same group as today's minnows and carp. Credit: Lisa Van Loon

Most people picture the time of dinosaurs as a steamy, tropical world. But during the Late Cretaceous period, northern Alaska was a different kind of wild. Located far above the Arctic Circle, it endured months of

winter darkness and freezing temperatures—even as much of the planet remained warm. Think sub-Arctic Canada today: cold, wet and seasonal.

A diverse international team of scientists has now made a remarkable discovery: The world's oldest known relatives of salmon and carp lived in this extreme environment.

Using the latest in 3D imaging technology, Lisa Van Loon and Neil Banerjee from Western and their collaborators analyzed fossilized fish bones found in the rocks of the Prince Creek Formation in Alaska to reveal a previously undiscovered polar ecosystem. The findings were published May 7 in the journal *Papers in Paleontology*.

"These discoveries suggest this remote region may have been an evolutionary launchpad for fish that now dominate northern rivers and lakes worldwide," said Van Loon, adjunct research professor in the departments of Earth sciences and anthropology at Western.

Some of the fossils discovered in Alaska were barely larger than a pinhead and were deeply embedded in rock. Traditional fossil preparation, which involves carefully removing surrounding sediment by hand, wasn't an option; the specimens were simply too fragile.

Using synchrotron micro-computed tomography (micro-CT) scanning technology at the Advanced Proton Source, with support from the Canadian Light Source, researchers scanned the fossil-bearing rocks without physically disturbing them. The ultra-bright, high-resolution X-ray beams allowed them to digitally reconstruct the anatomy of these ancient fish in 3D, revealing intricate structures such as jaws, teeth and fin rays in remarkable detail.

"Many of these fossils were so delicate and deeply encased in rock that traditional preparation would have destroyed them," said Banerjee, an

Earth sciences professor at Western. "Using synchrotron micro-CT scanning, we were able to peer inside the rock in extraordinary detail—resolving tiny jaw bones and teeth without laying a chisel on them. This technology has completely transformed how we study ancient life."

The scans made it possible to identify entirely new species, some of which represent the earliest-known members of fish groups that today dominate northern rivers and lakes, such as salmon, carp and pike.

Sivulliusalmo alaskensis, meaning "first salmon of Alaska" in Iñupiaq, is now the earliest known member of the salmon family, eclipsing previous records by nearly 10 million years. The earliest known cypriniform, part of the same group as today's minnows and carp, was also found, marking its first appearance in North America (as they were previously only found in Asia and Europe).

Newly found species of pike-like fish also lived at Prince Creek Formation, some 73 million years ago, including Archaeosiilik gilmulli and Nunikuluk gracilis, as they successfully adapted to the Arctic's long winters. Sharks like Squatina (a relative of angel sharks), sturgeon and paddlefish, were also revealed within the fossil samples.

"The synchrotron allowed us to virtually reconstruct these fish in 3D, bone by bone," said Van Loon.

Built for the cold

These ancient fish were survivors. In the Late Cretaceous period, the Arctic saw four months of total darkness each year, with mean annual temperatures around 6°C and icy winters. Fossils show adaptations—such as depressible teeth, complex jaw structures and cold-climate tolerances—that hint at how early these fish had evolved to

handle life in the cold.

"This discovery changes our understanding of fish evolution. It suggests that high-latitude ecosystems like Alaska weren't just receiving species from the south—they were creating them," said Banerjee. "Traits we see in today's salmon and northern fish likely evolved in polar environments like this one, millions of years ago."

In fact, this study supports the idea of a distinct Arctic ecosystem, known as the Paanaqtat Province, where unique animals—dinosaurs, mammals, and now fish—evolved in isolation.

These discoveries, using cutting-edge imaging technology, were made possible by painstaking fieldwork in Arctic Alaska, where researchers collected fossil-rich sediments using screen-washing techniques. Collaboration across institutions, including the University of Alaska, University of Florida, University of Colorado Boulder, Royal Tyrrell Museum and Western, was essential to managing the challenges of such an ambitious project.

"As a result of this discovery, we now have a clearer view of a long-lost polar world, and a new understanding of how some of today's most iconic freshwater fish first began their evolutionary journey," said Van Loon.

More information: Donald B. Brinkman et al, Fishes from the Upper Cretaceous Prince Creek Formation, North Slope of Alaska, and their palaeobiogeographical significance, *Papers in Paleontology* (2025). DOI: 10.1002/spp2.70014. onlinelibrary.wiley.com/doi/fu … l/10.1002/spp2.70014