

Tiny fossil teeth offer new hints about the evolution of deep-sea fish

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Cyclothone microdon front close upper teeth wet. Credit: *Proceedings of the Royal Society B: Biological Sciences* (2026). DOI: 10.1098/rspb.2025.3032, Yale Peabody Museum Ichthyology

The deep ocean remains largely unexplored, despite containing a large portion of the living organisms and animals on Earth. Among the many

creatures populating the deep-sea are so-called Cyclothone, also known as bristlemouth fish. Cyclothone are a genus (i.e., group of species) of tiny fish that reside in the dimly lit layer of water that is between 200 and 1,000 meters below the sea surface.

Previous studies suggested that Cyclothone appeared during the Miocene epoch (i.e., between 11 and 16 million years ago). Researchers at Yale University, University of Washington and Woods Hole Oceanographic Institution recently set out to further explore the evolution of these fish by examining microscopic and fossilized teeth preserved in ocean floor sediments. Their paper, [published](#) in *Proceedings of the Royal Society B: Biological Sciences*, suggests that these fishes might have evolved at least 40 million years earlier than originally predicted.

"My primary work focuses on isolated microfossil fish teeth preserved in deep sea sediments to explore how fish—and the marine ecosystems that they live within—have responded to past intervals of extreme global change," Elizabeth C. Sibert, Ph.D., Assistant Scientist at Woods Hole Oceanographic Institution and senior author of the paper, told *Science X*.

"The biggest challenge with these microfossils is that they are not attached to the rest of the fish, so it is a real challenge to identify them to species. This paper came about because of a conversation with my co-author, Karly Cohen, where we discovered some of my fossils looked just like an SEM of a Cyclothone specimen Karly had taken, and like a digital microscope photo of a different species of Cyclothone that I had taken. We thought that this might be a clue to unlocking the taxonomic identity of some of these microfossil teeth."



Cyclothone microdon front upper teeth dry. Credit: *Proceedings of the Royal Society B: Biological Sciences* (2026). DOI: 10.1098/rspb.2025.3032, Yale Peabody Museum Ichthyology

Analyzing microscopic fossil teeth

The main objective of this recent study was to determine whether a spiraling tooth form that the team had observed in microfossils could be conclusively matched to the Cyclothone fish lineage. Matching this tooth form to Cyclothone would alter the known timeline of fish evolution, as currently these specific fossils were linked to other deep-sea fish.

"Our first goal was to confirm that the spiraling form was, indeed, matched to Cyclothone but not any other fish," explained lead author and Yale undergraduate Karinne Tennenbaum. Tennenbaum imaged all Cyclothone species in the collections available, plus another 35 of their closest fish relatives within the taxonomic Order, Stomiiformes, to build a high-resolution catalog of tooth morphology for the group.

After imaging all the extant Cyclothone and Stomiiformes specimens available to them, Sibert and her colleagues compared the characteristics of these fish to those of more than 200 other unrelated fish species. Notably, they found that all adult fish belonging to the Cyclothone genus had spiraling teeth, which none of the other fish species they examined had.

"Our observations confirmed that the spiraling form was diagnostic of Cyclothone," said Sibert. "Subsequently, Immanuel 'Chas' Bissell, another Yale undergraduate and myself sifted through dozens of deep-sea sediment samples and looked at thousands of microfossil teeth to find ones with the unique spiraling form. It just so happened that the oldest samples we found fossil Cyclothone teeth were nearly 56 million years old—compared to the oldest previously known fossils from the group, which were only ~14 million years old."



Cyclothone microdon lower back teeth dry. Credit: *Proceedings of the Royal Society B: Biological Sciences* (2026). DOI: 10.1098/rspb.2025.3032, Yale Peabody Museum Ichthyology

New clues about the evolution of deep-sea fish

Collectively, the analyses performed by the researchers suggest that bristlemouth fish existed much earlier than earlier studies predicted. In fact, they were able to recognize spiraling teeth distinctive to these fish in microfossils that were dated back to the Earliest Eocene period, more than 55 million years ago.

"We are particularly excited about the utility of [tooth surface texture](#) as a potential diagnostic taxonomic feature that can be used to classify some microfossil teeth—the puzzle of which fish made the literally trillions of tiny teeth that are preserved in the sedimentary record is a huge endeavor and we're just beginning to capture that," said Sibert.

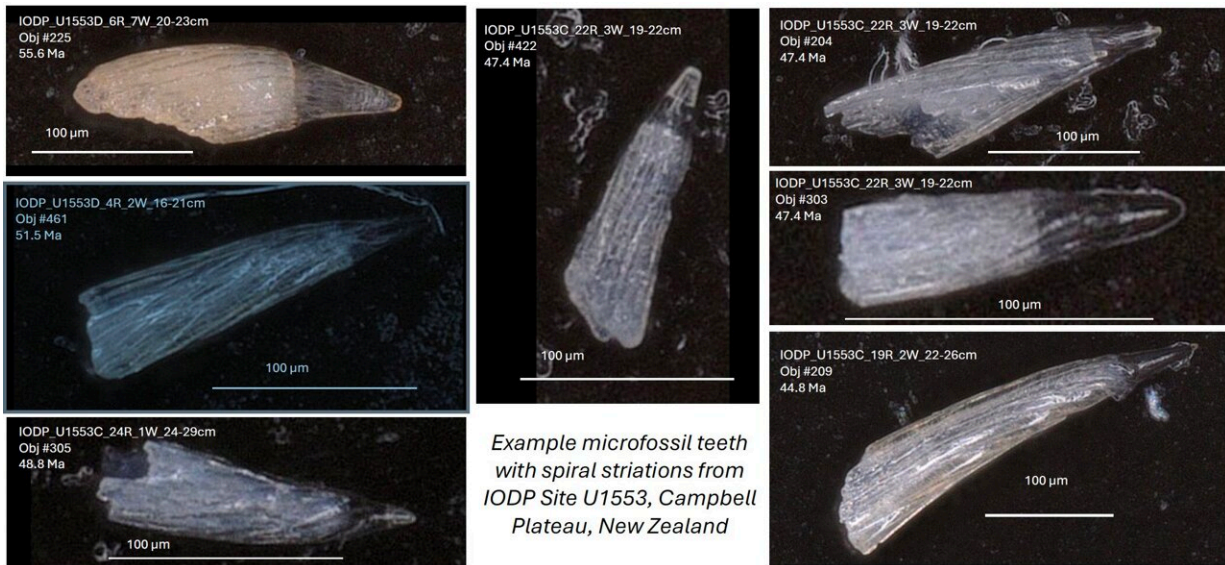
"The other super exciting finding here is—of course—that Cyclothone, the most numerically abundant fish genus on the planet, evolved and thrived in the early Paleogene greenhouse, during some of the hottest climatic conditions the Earth has experienced, suggests that this group has an evolutionary history of resilience to changing environmental conditions, and that leaves me hopeful that the deep sea ecosystem may have more resilience in it than previously thought."



Clyclothone microdon back teeth dry. Credit: *Proceedings of the Royal Society B: Biological Sciences* (2026). DOI: 10.1098/rspb.2025.3032, Yale Peabody Museum Ichthyology



Cyclothone signata. Credit: *Proceedings of the Royal Society B: Biological Sciences* (2026). DOI: 10.1098/rspb.2025.3032, Yale Peabody Museum Ichthyology



Examples of microfossil teeth from the Campbell Plateau in New Zealand.
Credit: E. Sibert

The findings gathered by Sibert and her colleagues could soon inspire further research focusing on the evolution of *Cyclothone*, as well as other deep-sea fish. These works could eventually offer new insight into how living organisms in the sea and marine ecosystems respond to dramatic environmental changes, including shifts that could result from climate change.

"This work is just the very beginning—we are really excited about the potential for novel tooth morphologies to shed light on deep sea fish evolution, and are currently conducting dozens of similar taxonomic 'deep dives' into fish tooth morphology and ecology, providing valuable biological context to these isolated microfossils, and we are excited to see what things come out next," added Sibert. "We're also really curious about the functional morphology of these spiraling teeth and would like to understand more about why these fish might have teeth like this."

More information: Karinne Tennenbaum et al, Microfossil spiral teeth reveal mesopelagic Cyclothone (bristlemouths) fish evolved during the early Palaeogene greenhouse, *Proceedings of the Royal Society B: Biological Sciences* (2026). [DOI: 10.1098/rspb.2025.3032](https://doi.org/10.1098/rspb.2025.3032)

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