Lake-bed trails tell ancient fish story

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This graphic shows how the movements of the fish along the lake bed left the trails. Credit: Anthony Martin

The wavy lines and squiggles etched into a slab of limestone found near Fossil Butte National Monument are prehistoric fish trails, made by *Notogoneus osculus* as it fed along a lake bottom, says Emory University paleontologist Anthony Martin.

"This is a fish story, about the one that got away 50 million years ago," Martin says. "And I can tell you that the fish was 18-inches long, based on good evidence."

He led a detailed analysis, published May 5 in *PLoS One*, that gives new insights into the behavior of the extinct *N. osculus*, and into the ancient ecology of Wyoming's former Fossil Lake.

"We've got a snapshot of *N. osculus* interacting with the bottom of a lake that disappeared millions of years ago," Martin says. "It's a fleeting glimpse, but it's an important one."

Fossil Lake, part of a subtropical landscape in the early Eocene Epoch, is now a sagebrush desert in southwestern Wyoming, located in Fossil Butte National Monument and environs. The region is famous for an abundance of exquisitely preserved fossils, especially those of freshwater fish.

Trails left by these fish, however, are relatively rare. The National Park Service had identified about a dozen of them and asked Martin to investigate. Martin specializes in trace fossils, including tracks, trails, burrows and nests made by animals millions of years ago.

One of the fish trace fossils especially intrigued Martin. In addition to apparent fin impressions of two wavy lines, it had squiggles suggesting oval shapes. "The oval impressions stayed roughly in the center of the wavy lines and slightly overlapped one another. I realized that these marks were probably made by the mouth, as the fish fed along the bottom," Martin says.

He then deduced that the trace was likely made by *N. osculus* - the only species found in the same rock layer whose fossils show a mouth pointing downward.

Martin brought his detailed notes, photos and sketches of the trace fossil back to Atlanta, where he enlisted the aid of disease ecologist Gonzalo Vazquez-Prokopec and geographer Michael Page, two of his colleagues in Emory's Department of Environmental Studies.

Vazquez-Prokopec, who does digital spatial analyses of geographic patterns of diseases and pathogens, applied similar techniques to the trace fossil data. The results showed a mathematical correlation between the trace impressions and the mouth, tail, pelvic and anal fins of an 18-inch *N. osculus*.

"This provides the first direct evidence of *N. osculus* bottom feeding," Martin says. "Not only that, the fish was bottom feeding in the deepest part of the lake. Previous research had suggested that the bottom of the lake had such low levels of oxygen that it was hostile to life. Our analysis indicates that, at least seasonally, some fish were living on the lake bottom."

The scientists were also able to calculate how the fish was moving, and the pitch and yaw of its swimming motion. "The trace fossil lines look simple, but they're not so simple," Martin says, explaining that even the gaps in the lines carry information.

Page, an expert in cartography and geographic information systems, created a map of the discovery site, and a Web site that allows viewers to zoom in on different aspects of the fish trace: edc.library.emory.edu/datalib/ … entBin/fistrace.html .

"All three of us believe in making scientific data as open and assessable as possible," Martin says, adding that he thinks it may be the first collaboration between a paleontologist, a disease ecologist and a geographer. "This opens up a new technique for studying trace fossils that we hope other people will try and test."

Provided by Emory University