Unique fish fossils identified

April 30 2015

Kenyaichthys. Credit: M. Altner, LMU

A team of Ludwig-Maximilians-Universitaet (LMU) in Munich has identified the first fossil specimens of a major group of killifishes that is widely distributed in freshwater habitats today. The 6-million-year-old material sheds new light on the evolution of the bony fishes.

Killifish are true survivors. These colorful little fish are perfectly adapted to the demands of their ephemeral habitats. They spend their short lives in temporary freshwater pools that form during the rainy season, and owe their long-term survival to the fact that their eggs are resistant to desiccation. Although they are a species-rich group, and are widely distributed in the tropics and subtropics, their fossil record is sparse. But now LMU palaeontologists Professor Bettina Reichenbacher and Melanie Altner have identified the first fossil representatives of one of the two extant suborders of killifish. "The specimens are exceptionally well preserved, date from about 6 million years ago, and

were discovered in Kenya by French palaeoanthropologists," says Reichenbacher. "Our studies have now shown that they are members of a previously unknown genus that is now extinct, which we have named Kenyaichthys – the fish from Kenya."

A cache that includes 77 complete specimens

The fossils originate from a site located in the Tugen Hills, which lie in the Eastern arm of the East African Rift Valley. During the Late Miocene – about six million years ago – the site formed part of a lake, and the newly described specimens, each 2 to 4 cm long, were preserved in the sediment beds that accumulated on the lake bottom. "The sample comprises a total of 169 individuals, and 77 of these are complete," says Altner. The anatomical details discernible in the impressions left in the sediments enabled the two researchers to conclusively identify all of these individuals as killifishes. "Analysis of the structures of the tailfin, the pelvic fins and the bones in the skull, in particular, yielded crucial information that convinced us that this material constituted the first fossils attributable to the killifish Suborder Aplocheiloidei. This group also encompasses modern African killifishes, such as Pachypanchax from Madagascar, the striped panchaxes of Southeast Asia and the rivulids of South America," Altner explains.

In addition to the fossil aplocheiloids, only a few other freshwater forms were found at the site. Reichenbacher and Altner assume that the prevailing environmental conditions were too extreme for less specialized species. During the Late Miocene, the climate got drier and extensive areas of savannah developed. "We believe that, like modern killifish species, Kenyaichthys was well equipped to survive long periods of drought, and could cope better with such conditions than other species of fish," says Reichenbacher.

A unique combination of traits

Since many killifish species are short-lived they are used to study aging processes. But the group is also of interest to evolutionary biologists because they offer useful models for the study of speciation – and in this context some of the characters displayed by Kenyaichthys are especially intriguing: "Our fossils exhibit morphological traits that are found in extant African species of killifish. But they also possess one specific trait that is typical for contemporary rivulids from South America. This combination is very unusual, and may indicate that Kenyaichthys is closely related to forms that are now restricted to South America. Alternatively, this particular character may have been lost in the lineage that gave rise to modern African aprocheiloids," Altner explains.

Furthermore, many features of the new fossils – including elements of the tailfin and the dorsal fins, and the relative sizes of the different body parts – vary markedly from one individual to the next. As the closest surviving relatives of Kenyaichthys do not display such a wide range of variability, the fossil material from the Tugen Hills appears to document a particularly fascinating evolutionary process – the diversification of a so-called species flock. The term 'species flock' refers to a group of closely related species that have evolved from a single progenitor species in an isolated population and developed distinct specializations that enable them to coexist. Darwin's finches, which occupy different ecological niches on the Galapagos, are perhaps the best known example of a species flock. "So, this is an exciting find in many respects, which provides wholly new insights into the evolutionary history of the killifishes and their relatives," says Reichenbacher.

More information: "†Kenyaichthyidae fam. nov. and †Kenyaichthys gen. nov. – First Record of a Fossil Aplocheiloid Killifish (Teleostei, Cyprinodontiformes)." *PLoS ONE* 10(4): e0123056. DOI: 10.1371/journal.pone.0123056

Provided by Ludwig Maximilian University of Munich