Ancient DNA is preserved in fish fossils from tropical lake sediments

Moritz Muschick[1], Eliane Jemmi[1], Nicholas Lengacher[1], Stephanie Hänsch[2], Nathan Wales[3], Mary Kishe[4], Salome Mwaiko[5], Jorunn Dieleman[6], Mark Lever[7], Walter Salzburger[8], Dirk Verschuren[6], and Ole Seehausen[9]

[1]University of Bern
[2]University of Oslo
[3]University of York
[4]Tanzania Fisheries Research Institute
[5]Eawag Swiss Federal Institute of Aquatic Science and Technology
[6]Ghent University
[7]ETH Zurich
[8]University of Basel
[9]Eawag Das Wasserforschungsinstitut des ETH-Bereichs

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Abstract

Tropical freshwater lakes are well-known for their high biodiversity, and the East African Great Lakes in particular are renowned for their endemic cichlid fish adaptive radiations. While comparative phylogenetic analyses of extant species flocks have revealed patterns and processes of their diversification, evolutionary trajectories within lineages, impacts of environmental drivers, or the scope and nature of now-extinct diversity remain largely unknown. Time-structured paleodata from geologically young fossil records, such as fossil counts and particularly ancient DNA data, would help fill this large knowledge gap. High ambient temperatures can be detrimental to the preservation of DNA, but refined methodology now allows data generation even from very poorly preserved samples. Here, we show for the first time that fish fossils from tropical lake sediments yield endogenous ancient DNA (aDNA). Despite generally low endogenous content and high sample drop-out, high-throughput sequencing and in some cases sequence capture allowed for taxonomic assignment to family or tribe level and phylogenetic placement of individuals. Even skeletal remains weighing less than 1 mg and up to 2700 years of age could be phylogenetically placed. We find that the relationship of degradation of aDNA with the thermal age of samples is similar to that described for terrestrial samples from cold environments adjusted for elevated temperatures. Success rates and aDNA preservation differed between the investigated lakes Chala, Kivu and Victoria, possibly caused by differences in water oxygenation at deposition. Our study demonstrates that sediments of tropical lakes preserve genetic information on rapidly diversifying taxa over time scales of millennia.

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