Geophysical Research Abstracts
Vol. 18, EGU2016-18523, 2016
EGU General Assembly 2016

Fish as a proxy for African paleogeography: results from both extant and fossil taxa and prospects to constrain faunal exchange pathway through time

Olga Otero (1), Josephine Joordens (2), Agnès Dettai (3), Leemans Christ (2), and Aurélie Pinton (1)

(1) iPHEP - UMR CNRS 7262 (Université Poitiers), France (olga.otero@univ-poitiers.fr), (2) Faculty of Archaeology, Leiden University, The Netherlands, (3) YSIEB - UMR CNRS 7205 (CNRS, MNHN), France

We assume that basin boundaries constitute barriers to dispersal for freshwater fish and as a consequence that basin geomorphology and connectivity, and its changes through time, can be reconstructed thanks to fish evolutionary history.
Firstly, this primary intuitive hypothesis is supported by patterns of fish distribution in the different basins and sub-basins of modern Africa, at both a specific and a generic level, and in certain cases at a family level. This is illustrated by the fact that hydrographical basin boundaries are reflected in the ichthyological provinces as defined and used by ichthyologists for a long time. Moreover, we show that at a continental scale, the hierarchical fish distribution patterns fit with main geological and climatic events according to their depth in time and amplitude [1].
Secondly, we further tested this hypothesis in several ways: (1) through the phylogeographical study of the catfish genus Synodontis [2], chosen because of its modern distribution and its rich fossil record, and (2) through the examination of the fossil record and systematics of the African lungfish Protopterus [3], of the catfish Calarius and of an extinct acanthomorph fish called Semlikiichthys [4,5]. We were then able to correlate these fish histories with quaternary climate change and with geological events throughout the Tertiary in Africa.
Our conclusions are also corroborated by existing fish phylogenies that overlap with our region of interest, and elsewhere. While in the last years an increasing number of molecular phylogenetical studies support correlation between fish evolution and basin history at shallow time scales, our studies (and a few other studies) also demonstrate the relevance of fish evolution to work at deeper time and larger geological scales, depending on the taxon distribution and age. Moreover, we plead for the inclusion of fossils when available. Indeed, for extant taxa they are useful to calibrate molecular clocks but also to reveal ancient distributions. The further we are going back in time the more they will constitute most of or the whole relevant sample. Our results also suggest that information on the (paleo)ecology of the fish provides useful data notably to qualify the aquatic systems that have prevailed at the time of connection between basins.

So, changes in basin geomorphology constrain fish evolution, and thus we are able to reconstruct and date these changes thanks to fish evolution studies. Since it is widely agreed that the identification of corridors and barriers is critical to understand faunal exchange, we are convinced that for each case study, we can identify the fish (either fossil or extant) that will provide a relevant “geomorphological model”. To validate this approach, our current project aims to identify the exchange corridor that may have intermittently existed between the Chad and Turkana basins during the last 3 million years [6]. These corridors may have constituted possible pathways for interbasinal exchange of large mammals at a key time period of Australopithecine evolution. We will end our presentation with preliminary results concerning phylogeography of the extant catfish Synodontis schall, one of our three model species.

[1] Pinton A., Otero O. in progress – How much do fish distribution depend on drainage system history? the case study of continental Africa.
[2] Pinton A., Agnèse J.F., Paugy D., Otero O. 2013 – A large-scale phylogeny of Synodontis (Mochokidae, Siluriformes) reveals the influence of geological events on continental diversity during the Cenozoic. Molecular Phylogenetics and Evolution, 66 (2013): 1027–1040.
[3] Otero O. 2011 – Current knowledge and new assumptions on the evolutionary history of the African lungfish, Protopterus, based on a review of its fossil record. Fish & Fisheries, 2011(12): 235–255.
[4] Otero O., Pinton A., Mackaye H.T., Likius A., Vignaud P., Brunet M. 2009 – Fishes and palaeogeography of the African drainage basins: relationships between Chad and neighbouring basins throughout the Mio-Pliocene.

Palaeobiogeography, Palaeoclimatology, Palaeoecology, 274 (2009): 134–139.
[5] Argyriou T., Otero O., Pavlakis P., Boaz N.T. 2012 – Description and paleobiogeographical implications of new Semlikiichthys (Teleostei, Perciformes) fish material from the Late Miocene deposits of Sahabi, Libya. Geobios, 45(2012): 429–436.
[6] Joordens J (Pi) – Coastal origins? A biogeographical model for mominin evolution and dispersal in Africa between 5 and 2.5 million years ago.