

dispersal (b-d) of the endemic East Asian clade of Cyprinidae under the development of the Yangtze River system in response to uplift of the Qinghai-Tibetan Plateau. Red dots indicate fossil sites. (C) Diversification dynamics and macroevolutionary patterns of endemic East Asian cyprinids. (a) A single rate shift configuration with the maximum a posteriori probability represented as a phylorate plot of the endemic East Asian cyprinids showing variation in speciation rates; (b) The rate-through-time plot of the endemic East Asian cyprinids implemented by BAMM; (c) net diversification rate through time for the endemic East Asian cyprinids inferred from the relationship between the net diversification rate and East Asian monsoon in RPANDA; (d) the haematite/goethite proxy of ODP Site 1148 in the South China Sea as a function of time (modified from Clift et al. 10). Credit: *The Innovation* (2023). DOI: 10.1016/j.xinn.2023.100417

The origins of the modern Yangtze River and evolution of drainage systems in South and East Asia were linked to Neogene uplift of the Qinghai-Tibet Plateau and onset of the modern Asian monsoon system. However, deriving an accurate understanding of the spatiotemporal evolution of the Yangtze River system has been challenging.

A growing scientific consensus suggests that the geomorphological process of river capture contributes substantially to evolutionary diversification in freshwater fishes. In turn, reconstruction of the phylogeographic dynamics of freshwater fishes can help constrain the spatiotemporal [evolution](#) of the river system. To date, the historical distribution and dispersal of endemic cyprinids across East Asia or the possible relationship between the spatiotemporal development of the Yangtze River and the evolution of egg types of endemic East Asian cyprinids has not been addressed.

In a study slated to be published in *The Innovation*, a research group led by Prof. Xie Ping from the Institute of Hydrobiology (IHB) of the

Chinese Academy of Sciences reconstructed the increased spatiotemporal resolution for the co-evolutionary histories of the Yangtze River and its biodiversity, and highlighted biological evidence concerning the geomorphological dynamics of the Yangtze River.

Through mitochondrial phylogenomics analysis of Cyprinidae calibrated by 15 fossils, the researchers inferred the diversification dynamics, ancestral distribution and egg types of the endemic East Asian cyprinids, and discussed the age at which the southwards-flowing palaeo-Jinshajiang first connected with the middle reaches via the First Bend and formed the Yangtze River ecosystems, including the potamo-lacustrine ecosystems in the middle and lower reaches.

The researchers found that prior to the formation of the Yangtze River, the ancestors of endemic East Asian cyprinids were confined to southern East Asia between the palaeo-Pearl and palaeo-Red Rivers during the Oligocene. At that time, the palaeo-Jinshajiang flowed southwards to the South China Sea roughly along the course of the modern Red River.

Additionally, the researchers discovered that by ~18 Ma, the endemic East Asian cyprinids dispersed into the Yangtze River basin and evolved into fishes laying semibuoyant eggs, indicating that a modern Yangtze riverine ecosystem had formed around the Oligocene-Miocene boundary (~18–23 Ma) in response to regional surface uplift and large strike-slip tectonics and climatic changes. By ~15 Ma, the endemic clade of East Asian cyprinids evolved into fishes spawning adhesive eggs again, coinciding with a rise to a peak in the net diversification rate of this endemic clade and a high intensity of the East Asian summer monsoon, indicating that the Yangtze River system probably had developed into a potamo-lacustrine ecosystem with [high productivity](#) by the middle Miocene.

Based on the fossil-calibrated phylogeny of the endemic clade of East

Asian cyprinids, this study constrains the ages of important events in the geological and ecological evolution of the Yangtze River, and provides a new paradigm for the reconstruction of the Yangtze's geological and life evolution.

More information: Feng Chen et al, The evolutions of the Yangtze River and its biodiversity, *The Innovation* (2023). [DOI: 10.1016/j.xinn.2023.100417](https://doi.org/10.1016/j.xinn.2023.100417)

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