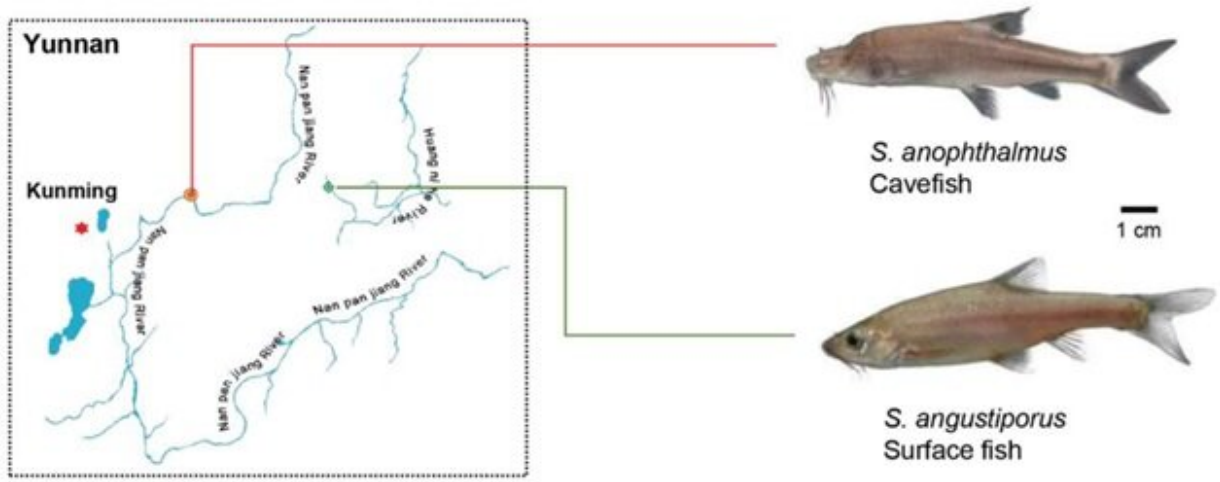
Cavefish modulate lipid metabolism to adapt to life in caves

March 21 2022, by Zhang Nannan



Schematic illustration on river drainages near the collection sites of cavefish (S.anopthalmus) 4 (orange mark) and surface fish (S.angustiporus) (green marks) near the city of Kunming, Yunnan 5 province. Credit: IGDB

The Sinocyclocheilus represents a rare freshwater teleost genus endemic to China. With widespread drying associated with the aridification of China during the late Miocene and Pliocene, Sinocyclocheilus began to seek refuge in deeper waters and colonized cave habitats, leading to the evolution of cave-dwelling forms. Cave dwellers evolve a series of troglodyte characteristics and behavioral adaptations to enhance survival in caves, an extreme environment of perpetual darkness with infrequent

food supply.

In a recent study published in *Molecular Biology and Evolution*, researchers led by Prof. Shui Guanghou from the Institute of Genetics and Developmental Biology and Dr. Meng Fanwei from the Institute of Zoology of the Chinese Academy of Sciences presented new findings pertaining to the differential regulation of lipid metabolism in the surface-dwelling and cave-dwelling forms of Sinocyclocheilus.

The researchers used a combination of quantitative lipidomics and spatial mass spectrometry imaging and systematically constructed a brain lipid atlas of the two forms of Sinocylocheilus. They observed a preferential accumulation of DHA-lipids in the brain of surface fish, while that of cavefish displayed a marked increase in ARA-lipids.

The preferential accumulation of specific polyunsaturated fatty acids extends to the liver and eye of the two fish forms, which the researchers attributed to the important role of DHA membrane lipids in mediating complex motor and visual functions critical to the survival of surface fish in an open environment.

They also found a selective demyelination of hindbrain raphe serotonergic neurons and the development of fatty livers in cavefish, which represent important metabolic adjustments that serve to eliminate complex social behavior and increase energy storage, respectively, allowing cavefish to thrive in their extreme habitats.

The surface-dwelling and cave-dwelling forms of Sinocylocheilus thus provided a natural paradigm in understanding how neurological and systemic adaptations in lipid metabolism form the basis of recessive evolution.

More information: Sin Man Lam et al, Quantitative lipidomics and

spatial MS-Imaging uncovered neurological and systemic lipid metabolic pathways underlying troglomorphic adaptations in cave-dwelling fish, *Molecular Biology and Evolution* (2022). DOI: 10.1093/molbev/msac050

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