両側回遊性ハゼ類における洞窟性種の進化

全文要約

Cavefishes have long attracted attention as a model system for evolutionary biology, but knowledge of their natural history background (taxonomy, phylogeny, and ecology) is lacking, except for a few model taxa. Most cavefishes are endemic to a specific cave or region, reflecting population isolation; however, some are known to be geographically widely distributed, and how these taxa evolved has been an enigma. In this study, using the Gobiiformes as a model system, I examined how cavernicolous species with a wide geographic range evolved. The Gobiiformes include both a geographically widespread cave species (an uncertain species of the genus *Eleotris*) and a species with a regionally limited range (*Bostrychus microphthalmus* Hoese and Kottelat, 2005).

The results of a phylogenetic analysis suggested that both widespread and endemic species evolved from amphidromous ancestors. Otolith microchemistry and population genomic analysis revealed that the widespread *Eleotris* sp. is currently maintaining an amphidromous lifecycle and is dispersed across a wide area in the Indo-Pacific region. I propose that a habitat preference shift in the larval recruitment to inland water might have initiated speciation. In contrast, the endemic stygobiotic species *B. microphthalmus* from Sulawesi has lost its dispersal ecology and shows deep divergence from other congeners, suggesting an ancient speciation event. Considering the geographic and faunal background of the region, the species might have become confined to the cave and ceased to migrate as a result of past geographical events.

Regardless of the current dispersal ecology, both widespread species and those with limited ranges exhibited common trends for adaptive morphological characters directly related to the cave environment, suggesting irreversible evolution of these characters. After systematic reassessment of the cavefishes and related species and/or genera, both cavefishes and related taxa were found to share specialized neuromast arrangements, suggesting that this is a pre-adaptive trait. Furthermore, *Eleotris eigenmanni* Popta, 1921, which has been redescribed as the uncertain cavernicolous *Eleotris* sp., exhibits phenotypic plasticity in eye diameter. This finding suggests that genetic assimilation of cave-adaptive traits has taken place.

Overall, my results suggest that the evolution of cavernicolous species, which originated from amphidromous ancestors, did not solely follow the classic scenario of simple isolation but also involved persistence of their amphidromous ecology. Considering this scenario, the endemic species could have evolved either after rapid landlocking into caves or by a transition from an amphidromous cave species via loss of dispersibility. There may be multiple pathways for the evolution of cave species.