

Migration history of pelagic crucian carp "*Carassius auratus grandoculis*" endemic to Lake Biwa: Reconstructed from otolith strontium stable isotope.

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Migration is a biological phenomenon in which animals routinely move their habitats depending on their developmental stages and environmental changes in their life history, and is found in many taxonomic group including to fish species. Some migratory fish have homing behavior to their nursery to spawn. This behavior supplies nutrient such as phosphorus that flow out from coastal land (Kaeriyama, 2005). Lake Biwa is the biggest lake in Japan. In this lake, many endemic species evolved from their fluvial ancestors to adapt to pelagic environment. All of them migrate from pelagic to coastal area for reproduction. Some of these fish are threatened with extinction due to decline in their spawning habitat such as paddy field and lagoon, and the disconnection of the lake from network their nursery. Crucian carp "*Carassius auratus grandoculis*" is one of the endemic pelagic fish in Lake Biwa, and uses paddy field and lagoon for spawning. However, little known about migration history according to their developmental stage, although these knowledges are indispensable to restore their population. In recent study, analysis of otolith micro-chemical composition and stable isotope are often using to reconstruct fish migration history. Strontium stable isotopic ratio ($^{87}\text{Sr}/^{86}\text{Sr}$) of otolith is known to powerful tracer of fresh water habitats of fish (Kennedy et al. 2002, Jen C. Hegg et al. 2015), and it changes to reflect in ambient water condition or physiological conditions of fish. Elements deposited to otolith are not metabolized. Therefore, otolith have the function as time recode. On the other hand, chemical composition and $^{87}\text{Sr}/^{86}\text{Sr}$ for inland water reflects the geological characteristics of watershed, and shows significant spatial variation. Therefore, it is possible to distinguish individual rivers flowing into Lake Biwa (Nakano et al. 2008).

In this study, we analyzed trace elements and $^{87}\text{Sr}/^{86}\text{Sr}$ of otolith micro samples for ALC marked fish which returned to the natal rice paddy for spawning and wild population. Micro core samples collected time-series along growth curve from otolith core to edge by using micro-milling device. Here, we examined to be able to reconstructed migration history for crucian carps and their natal place by otolith (lapillus).

As a result, $^{87}\text{Sr}/^{86}\text{Sr}$ signature of otolith core for marked fish showed similar to those of irrigated waters in the rice paddy where the fish were stocked, demonstrating that our isotope approach is powerful tool to identify the natal sites. The otolith core $^{87}\text{Sr}/^{86}\text{Sr}$ signature for wild adult fish where came to paddy and lagoons, some of them shows similar to those of paddies and lagoons value. On the other hand, $^{87}\text{Sr}/^{86}\text{Sr}$ of otolith edge signature for wild fish shows pelagic of the Lake Biwa or their ambient water where they caught. It is suggested that wild adult fish returned to their natal area after migration from the pelagic habitat, or some of them have inhabited same place in where they were born. It revealed individual variation in the migration pattern and the homing ability.

Keywords: strontium stable isotope , otolith (Lapillus), fish migration, Lake Biwa watershed