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大槌域における河川水と淡水型イトヨのストロンチウム同位体比：現在の生息域と過去の移動の推定法として
87Sr/86Sr of threespine sticklebacks and water in Otsuchi: Implications for the current habitat range and past movement

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All living organisms have various interactions with surrounding organisms and their physical environment. For conservation and management purposes, it is important to understand the environmental condition not only in the present but also in the past. Strontium isotope ratio ($^{87}Sr/^{86}Sr$), often measured in otoliths of a fish, has been used as an indicator to estimate current habitat range and past movement of the fish. The method is based on two assumptions. 1, $^{87}Sr/^{86}Sr$ of a fish is almost the same as that of the ambient water. 2, $^{87}Sr/^{86}Sr$ of river water is characterized by the underlying bedrock geology. If there are significant differences among $^{87}Sr/^{86}Sr$ of the habitats in the study area, it is possible to estimate the past movement of a fish. However, the method cannot be used when there are no significant differences within the area. Wide study area potentially provides high probability that there are significant differences of $^{87}Sr/^{86}Sr$ among the habitats, so that most studies using this method subjected fishes that move widely. In this study, we propose to develop the $^{87}Sr/^{86}Sr$ method to reconstruct the movements of a small fish, threespine stickleback (Gasterosteus aculeatus). Japanese marine threespine sticklebacks can be classified into two genetically divergent groups, the Pacific Ocean anadromous form and the Japan Sea anadromous form. In Otsuchi area, Iwate Prefecture, both the Pacific resident freshwater form and the Japan Sea anadromous form of threespine sticklebacks occur, and there are many freshwater habitats including new coastal habitats that were made by a natural disaster of tsunami in 2011. For conservation and ecological understanding of threespine sticklebacks, it is important to know the past movement of the individual fish.

In this study, we analyzed $^{87}Sr/^{86}Sr$ of back bones of the freshwater form threespine sticklebacks and compared with that of ambient water in order to estimate the current habitat range and the past movement. Results and discussions are shown as follows.

1. $^{87}Sr/^{86}Sr$ of ambient water can be grouped into three regions (more than 0.709156, 0.708165~0.709156, and less than 0.708165). The result suggests that there are significant differences among the habitat of threespine sticklebacks in Otsuchi area.
2. There was a significant correlation between 87Sr/86Sr of threespine sticklebacks and that of environmental water in each sampling point. The result indicates that Sr of threespine sticklebacks mainly derived from the environmental water.
3. $^{87}Sr/^{86}Sr$ of threespine sticklebacks can be grouped into three regions as well as the ambient water. The result suggests that threespine sticklebacks moved only within each region.
4. There were significant differences between $^{87}Sr/^{86}Sr$ of threespine sticklebacks and that of the ambient water in each sampling point. The result implies that threespine sticklebacks moved among sampling points within each region. However, the detected differences were small, and the temporal changes of water $^{87}Sr/^{86}Sr$ need to be studied.
5. In the coastal area, $^{87}Sr/^{86}Sr$ of threespine sticklebacks was higher than that of the ambient water, probably because the water was affected by the sea water ($^{87}Sr/^{86}Sr$ = 0.70918) at high tide. However, there was a significant positive correlation between them. The result suggests that although these sampling points were expected to have connected with each other at the flood, threespine sticklebacks did not move among the points frequently.